

# DREAM RECALL AND EYE MOVEMENTS DURING SLEEP IN SCHIZOPHRENICS AND NORMALS

WILLIAM DEMENT, M.D.

Aserinsky and Kleitman (2) have recently reported the occurrence of rapid, jerky, conjugate eye movements during sleep and an association of these movements with dreaming. They studied 26 subjects and observed discrete periods of eye motility in all but four. Ten subjects were awakened 27 times while the eye movements were present, and in 20 instances were able to recall with great clarity the content of their dreams. In 23 awakenings during ocular quiescence, there were only two instances of dream recall.

The following study of schizophrenics and normals was undertaken, under the stimulus of these observations, with three aims: 1) to gather confirmatory data relating dream recall to eye movements; 2) to see if schizophrenics exhibited rapid eye movements during sleep; and 3) if so, to utilize the possible association with dreaming to gather data on psychotic dream content.

## METHOD OF STUDY

The subjects were 17 chronic schizophrenics, nine males and eight females, ranging in age from 21 to 53, and a normal group of 13 medical students, all males, aged 22 to 32. All were presumably in good physical health. The schizophrenics were picked randomly from a larger group being studied at the Manteno State Hospital (1), stipulating only that they be manageable and at least to a slight degree communicative. Two schizophrenic females had undergone bilateral prefrontal lobotomies approximately 2 months prior to being used as subjects, and two schizophrenic males were studied both before and after a course of convulsive therapy (10).

Continual recordings of eye movements and brain waves were made on two subjects at a time during an average night's sleep without sedation. Supra-orbital, infra-orbital, parietal, and ear electrodes were affixed to each subject and the potentials led into a Grass eight-channel electroencephalograph in an adjoining room. Four pens were allotted to each subject.

One pen recorded parietal brain waves, one, eye movements bipolarly from the supra-orbital lead referred to the infra-orbital, and the other two, eye movements monopolarly from the two orbital leads referred to the ears. Changes in the corneo-retinal potential field, as the eyeball rotated, were probably responsible for the electrical impulses generated (5). Eye movement potentials were out of phase on the two monopolar pens, while large brain waves were in phase. Furthermore, eye movement potentials were larger on the bipolar pen, and the spread from high voltage brain waves showed up larger on the two monopolar pens. Thus, there was a double differentiation between eye movement potentials and EEG artifacts. Vertical movements gave the largest potentials in this method of recording, with movements in other directions varying approximately as the cosine of the angle of displacement from the vertical. Horizontal movements showed little or no potential. However, preliminary studies indicated that periods of ocular motility contained movements in all directions, and since the aim was to establish only the presence or absence of movements, not to analyze or quantify them, this method was felt to be satisfactory.

The subjects were instructed to go to sleep in their usual fashion, the lights were turned off, and from this point on at least 1 minute of record was taken every 5 minutes throughout the night. A fair amount of waking record was obtained before the onset of sleep in most cases. All the subjects had good waking eye movement potentials and, with one exception, were alpha dominant or mixed alpha brain wave types (insofar as this rhythm appeared in the parietal leads). The electrical recordings of the eye movements were occasionally confirmed by direct observation.

The onset of sleep was arbitrarily defined as the time of appearance of the first sleep spindles in the brain wave record. In most cases, this occurred very shortly after the disappearance

of alpha rhythm, with only a short interval of the so-called "drifting" or "drowsy" EEG. Criteria of spontaneous awakening during the night were a reappearance of alpha rhythm, excessive body movement, opening the eyes, and calling out to the experimenter. The schizophrenics averaged about 7 hours of sleep per night and the medical students about 6.

On certain nights, mixed irregularly among the others, subjects were awakened during eye movement periods and asked whether they were dreaming and, if so, to relate the content of the dream. A control series of awakenings was done during periods when there were no eye movements, and the EEG was roughly similar to that seen during eye movement periods. In all cases, the questions and awakening procedures were identical. The subjects, of course, were not told whether their eyes had been moving.

Before the experiments began, the subjects were questioned about their dream activity. None admitted dreaming more frequently than once or twice a month, and four of the schizophrenics stated that they never dreamt. The schizophrenic subjects were questioned daily about the previous night's dream activity for 6 days prior to being observed during sleep. This was to accustom them to being interrogated and to see if the process of questioning produced any change in their ability to recall dream material.

With few exceptions the subjects had little difficulty in falling asleep. The schizophrenics accepted the experimental situation quite calmly. In only one or two instances did they show evidence of fright, and these were on first nights in the new situation.

The chronic schizophrenics accounted for a total of 55 nights, with a range of 1 to 7 nights per subject, while the medical students slept 30 nights, 1 to 9 nights per subject.

## RESULTS

*Eye motility.* One normal subject who was observed only a single night failed to show rapid eye movements during sleep. Three schizophrenics and one medical student did not exhibit eye movements on the first night but showed them on subsequent nights. Rapid eye movements were seen in all others every night they slept.

The eye movements occurred in discrete periods, but the eyes were not constantly in motion during such a period. Rather, the activity occurred in irregular bursts of one or two movements—up to 20 or 30. The bursts were usually separated by a few seconds of quiescence although occasionally 4 or 5 minutes passed without a movement. A period of eye motility was thus delimited by periods of quiescence on either side, lasting more than 5 minutes, and almost always these quiescent periods were of the order of 40 to 60 minutes. A single movement generally took place in 0.2 seconds and was followed by a fixational pause of varying duration. There was no pattern to the direction of the movements. Occasionally, on direct observation, several small jerks in one direction were seen, or there were bursts of movements through large arcs in all directions. As many as six movements were counted in a period of 2 seconds although the number was usually less. The amount of activity varied widely from period to period and from night to night. No relationship of the amount of movement to the time of the period or to a particular subject could be demonstrated, nor was there any apparent relation to age or sex. The movements were easily seen on direct observation with a very dim light, in spite of the closed eyelids. This was documented by Aserinsky and Kleitman who were able to take motion pictures of the eye movements in two subjects. The subjective impression was that the eye movements resembled those of an individual scanning his environment or watching some event associated with a great deal of movement and activity.

In general, a night's record for any single individual showed a periodic occurrence of eye movements, alternating with ocular quiescence. The periods averaged approximately 20 minutes in length and tended to be longer the later in the night they appeared. Those occurring about an hour after the onset of sleep were usually around 5 minutes in length, while those near the end of the night often lasted for more than 30 minutes. The chronic schizophrenics averaged one rapid eye movement period every 1.60 hours, while for the normals the ratio was 1.55. Waking the subjects seemed to have almost no effect on the

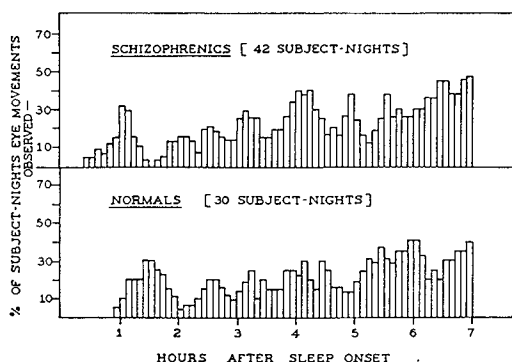


FIG. 1. Incidence of eye movements in successive six-minute periods after the onset of sleep.

over-all pattern except in rare instances when the subjects remained awake. In 118 awakenings during eye movement periods, there were 25 instances of recurrence immediately on falling asleep again. Whether the remaining 93 were artificially shortened or were about to end by themselves cannot be said. Eye movements never occurred immediately on returning to sleep from the control awakenings. In addition, there were only two instances of eye movements immediately after the initial onset of sleep, both occurring in the same subject after about 3 hours of tossing and turning. There was a considerable variation in the pattern of occurrence of periods of eye motility from subject to subject and from night to night, but an over-all regularity was maintained.

The graphs in figure 1 show a summation of the eye movement periods for the two groups of subjects. The vertical bars indicate the percentage of subjects showing eye movements at any time during successive 6-minute periods after the onset of sleep. Infrequent large periods of wakefulness have been deleted, and the sleep considered continuous. As can be seen, the records of the two groups, schizophrenics and normals, are roughly similar. Periodicity is not easily compared. In the graphs, both groups have an early peak of eye movement activity at about 1 hour after the onset of sleep, followed by subsequent peaks. However, as time progresses, individual differences tend to have a cancelling effect and flatten the histograms. The initial peak in the schizophrenics seemed to occur somewhat earlier than in the medical students. However,

the difference of the means of the time of onset of the eye movement periods making up the initial peaks in the two groups was not significant. It must be remembered that figure 1 does not give an absolutely exact picture of the quantity of eye movement as many periods were terminated by interrogations.

The data obtained on the two females with bilateral prefrontal lobotomies and the two males after convulsive therapy were at least qualitatively similar to those obtained from the other subjects. In addition, no change in eye motility was noted in the two male psychotics, with reference to data obtained before convulsive therapy, although the EEG showed marked slowing.

*Association of dream recall and eye movements.* There was no apparent change in the schizophrenics' ability to recall dreams during the 6-day period of questioning prior to being studied during sleep. Among all 17, only three recalled a single dream.

Twelve schizophrenic subjects in 24 nights were awakened 95 times, 67 during eye movement periods and 28 during periods of ocular quiescence. Ten normals were awakened 70 times in 18 nights, 51 during eye movement periods and 19 during control periods. The replies to interrogation fell into four categories: the subjects (a) remembered dreaming and were able to recall the content quite vividly; (b) remembered dreaming but were unable to recall any of the content, or at best, quite

TABLE 1.—RESULTS OF INTERROGATION DURING PERIODS OF EYE MOVEMENT AND PERIODS OF OCULAR QUIESCENCE

	Eye Movement				Quiescence			
	Positive		Negative		Positive		Negative	
	Subject recalls dream vividly	Subject remembers dreaming but cannot recall content	Subject uncertain whether or not was dreaming	Subject certain was not dreaming	Subject recalls dream vividly	Subject remembers dreaming but cannot recall content	Subject uncertain whether or not was dreaming	Subject certain was not dreaming
Schizophrenics...	40	12	5	10	0	3	2	23
Normals.....	45	2	3	1	0	0	4	15

vaguely; (c) were unsure whether or not they had been dreaming; (d) felt sure that they had not been dreaming. The first two categories were considered positive and the last two negative. From table 1 it can be seen that the schizophrenics gave 79 per cent positive replies and 60 per cent dream recall when awakened

during eye movements, while the normals gave 92 per cent positive replies and 88 per cent dream recall. The over-all total for both groups was 72 per cent dream recall after eye movement interrogation, as opposed to 0 after control awakenings. Every subject in the two groups gave at least one positive reply to the eye movement interrogations.

TABLE 2.—EXAMPLES OF SCHIZOPHRENIC DREAMS

- 
1. Q.—Were you dreaming?  
A.—Yes.  
Q.—What about?  
A.—A hat.  
Q.—Is that all?  
A.—Yes.  
Q.—Just a hat?  
A.—Yes.  
Q.—Were you wearing it?  
A.—No.
  2. Q.—Were you dreaming?  
A.—Yes.  
Q.—What about?  
A.—There was ah- ah- a trunk and curtain rods.  
Q.—A trunk and curtain rods?  
A.—Yes.  
Q.—What else?  
A.—Nothing.  
Q.—You mean there was nothing but just a trunk and curtain rods? No people?  
A.—Yes.  
Q.—Were you in it?  
A.—I don't think so. I saw them.
  3. Q.—Were you dreaming?  
A.—Yes.  
Q.—What about?  
A.—A coat that was ripped.  
Q.—A coat that was ripped, is that all?  
A.—Yes. There's nothing in my dreams.
  4. Q.—Were you dreaming?  
A.—Yes.  
Q.—What about?  
A.—A shelf.  
Q.—Is that all?  
A.—Yes.  
Q.—Just a shelf hanging in space?  
A.—Yes.
  5. Q.—Were you dreaming?  
A.—Yes sure.  
Q.—What about?  
A.—A suitcase.  
Q.—Were you in the dream yourself?  
A.—No.  
Q.—Just a suitcase?  
A.—Yes.  
Q.—Was it doing anything?  
A.—No sir. It was just sitting there.
- 

*Dream content.* It was assumed that the dream reports given immediately after awakening during a dream, if that is what actually occurred, would be much more reliable than those obtained by questioning subjects the next morning. It was hoped that this method might lead to the discovery of consistent and easily recognizable differences between schizophrenic and normal dream content. However, the only obvious difference was that about half of the chronic schizophrenics frequently reported dreams of isolated, inanimate objects, apparently hanging in space, with no overt action whatsoever. The control group of medical students did not report a single dream of this type. That these peculiar dream reports were probably not just the result of a deteriorated ability to communicate was brought out by the fact that the same patients described other dreams which seemed quite normal and were also able to communicate fairly adequately in the waking state. Several examples of these dream reports are given in table 2.

*Electroencephalography.* The purpose of recording the EEG was merely to obtain a check on whether subjects were asleep. It was felt that a single lead could serve this purpose well enough, and thus the EEG data are not very extensive. No abnormalities, either awake or asleep, were seen in the two groups except for the two lobotomized schizophrenics and the two post-convulsive schizophrenics, in whom slow waves were evident from the parietal region while awake. Figure 2 is a sample recording. Subject F. S. shows eye movement potentials. The out-of-phase relationship of the two monopolarly eye pens can be seen as well as the increased amplitude on the bipolarly pen. The other subject is in a period of ocular quiescence. The EEG during ocular quiescence was generally characterized by high voltage, low frequency waves early in the night with some spindling, and later by frequent well-defined spindles against a low voltage

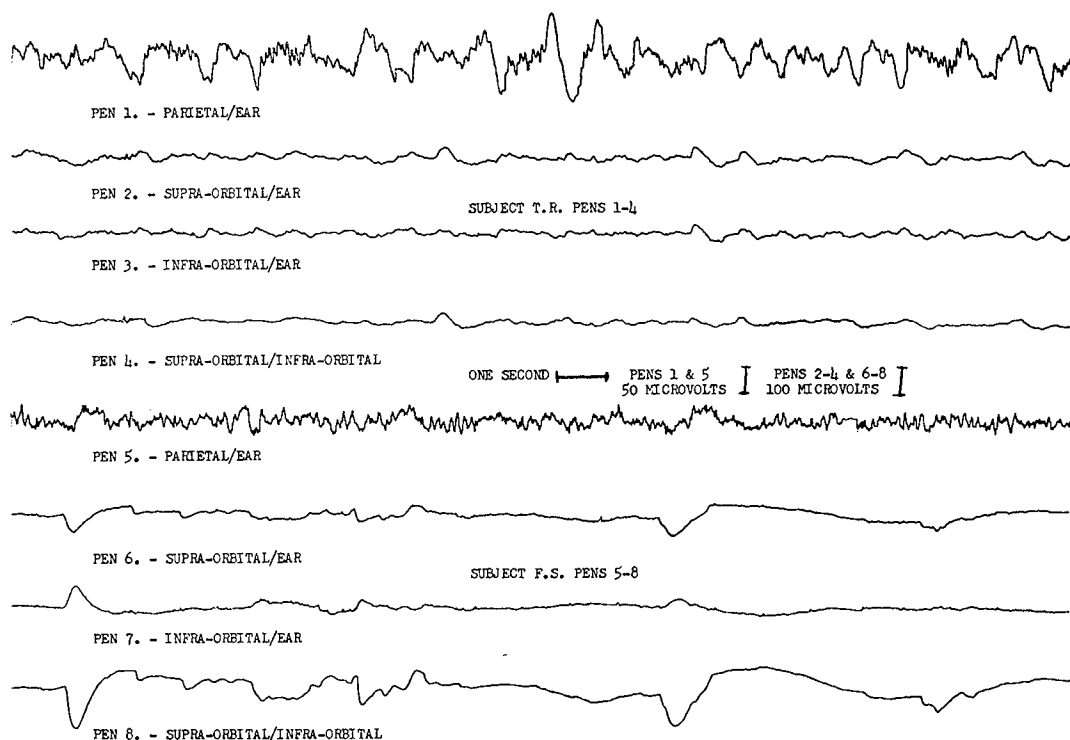


FIG. 2. Sample recording of eye motility and brain waves in two subjects.

background. During eye movement periods, spindles were not seen. Most waves fell into frequency ranges of 4-7 per sec. and 15-25 per sec. and were 50 microvolts or less.

#### DISCUSSION

It seems likely that chronic schizophrenics and normals have no marked inter-group differences with regard to the frequency and periodicity of rapid eye movements during sleep, nor in the quality of these movements.

In their original paper on rapid eye movements during sleep in normal subjects, Aserinsky and Kleitman indicated that the first eye movement periods occurred from 1 hour and 40 minutes to 4 hours and 50 minutes (3 hours and 14 minutes, mean) after the onset of sleep. In this study, it was found that in many instances the first periods occurred much earlier than this, from 40 to 90 minutes after the onset of sleep. Later work (4) with continuous recording, rather than sampling, has confirmed this. In the great majority of nights, an eye movement period occurred around 1 hour after the onset of sleep, and even when

eye movements were not seen, there was at least a "lightening" of the brain waves.

The nights on which rapid eye movements were not seen were always first nights with any one subject. Thus, there appeared to be a tendency for eye movements to be suppressed on the first night that a subject slept in new surroundings. This is contrary to what one might expect if eye movements are in some way related to disturbed or restless sleep. On the other hand, if eye movements are part of a definite and contingent sleep pattern or rhythm, a restless or disturbed sleep should tend to disrupt their occurrence.

Aserinsky and Kleitman found 74% dream recall when awakened during eye movement periods which corresponds nicely to the overall figure of 72% for both groups in this study. The difference between the figure of 60% for the schizophrenics and 88% for the medical students seems best explained on the basis of the mental illness. Certain of the schizophrenics consistently replied negatively to interrogation regardless of whether awakened during eye motility or quiescence. The replies of these

subjects were characterized by a monotonous stereotypy which made it doubtful that they represented a true verbalization of inner experiences.

If it is assumed that the dream visualizations the subjects recalled when awakened during eye movement periods actually took place during these periods, it appears that dreaming occurs much more frequently than was heretofore realized. In most previous studies of frequency of dreaming (9), even when subjects were awakened during the night rather than questioned the next day, it was the rare person who remembered dreaming more than once a night, and many did not recall dreaming at all. Subjects in the present study who stated that they dreamt only once or twice a year often recalled four or five lengthy dreams a night when awakened during eye movement periods. It is unlikely that there was simply more frequent dreaming in the experimental situation, as on nights when they showed four or five eye movement periods but were not awakened, the subjects usually did not recall dreaming. The objection that this dream recall was in response to the awakening stimulus is, of course, answered by the fact that no dream recall was elicited after the control awakenings.

On the basis of interview techniques, Boss (3), Kant (7) and Noble (8) have concluded that many schizophrenics dream as much as normals, but that some do not. Since no clear-cut instance of lack of rapid eye movements during sleep was found in any of the schizophrenics in this study, and the frequency of eye movement episodes in the schizophrenics and normals was virtually equal, it seems reasonable to conclude that schizophrenics dream as much as normals, including even those who persistently deny dreaming.

The dreams reported here were always approximately the same length whether the subject was awakened after 5 or after 50 minutes of eye movements. This probably means that only the dream material occurring just before awakening was remembered and that the remainder, presumably a large amount, was not recalled. It seems possible that each burst of eye motility, occurring in a single period, represented a dream episode.

The appearance of the eye movements themselves suggested that they were a direct result of visual experience, rather than merely a result of heightened nervous activity.

The results of this study indicate that a great deal more information about the content of dreams can be obtained if subjects are awakened during eye movement periods, than by questioning them at other times, or even during such heightened states of recall as psychoanalytic therapy (6). But whether such information would have enough practical value to offset the trouble of getting it is a question for psychiatrists to answer. It would be premature, on the basis of the relatively small amount of dream material, to say that dreams of isolated, inanimate objects are characteristic of schizophrenic subjects. These dreams were elicited during eye movement periods. If eye movements are directly related to the visual content, little or no movement would be expected in a dream of this sort. Although this could mean that eye movements are not directly representative of the visual activity, it is more likely that the verbalizations represent a distorted schizophrenic concept of a more active visual experience. The fact that Boss, Kant, and Noble found no such dreams in the material of their schizophrenics from daytime questioning suggests the importance of nocturnal awakenings.

It is interesting to note that there were 25 instances of recurrence of rapid eye movements immediately on returning to sleep from eye movement awakenings. Seemingly, the period of heightened CNS activity had not run its course, and although the subjects were able to fall asleep, they continued to dream. On the other hand, when an awakening occurred during ocular quiescence, the return to sleep was never associated with an eye movement period. Nor was the time of onset of the next period markedly changed from what would have been expected in the absence of an awakening. Thus, the periods were neither initiated nor always ended by the disturbances. It seems likely, therefore, that the rapid eye movement periods and probably associated dream activities do not occur in response to random environmental stimuli, but are part of an intrinsic physiological sleep pattern.

# SUMMARY

Periods of rapid eye movements were seen to occur during sleep in both schizophrenic and normal subjects. The quality of the movements, their pattern of occurrence, and the duration of the periods were virtually the same in the two groups. The initial period after the onset of sleep was observed to occur earlier in both groups than was previously reported in normals.

There was a high degree of association of dream recall and rapid eye movements in both groups confirming the report of Aserinsky and Kleitman. The suggestion was made that the discrete bursts of motility seen in a single period might represent single dream episodes and that the eye movements themselves might be a direct manifestation of the visual imagery.

A great deal of information about the content of their dreams was obtained from the subjects during the course of the study, and the schizophrenics differed from the non-schizophrenics in reporting many dreams of isolated, inanimate objects apparently hanging in space with no movement.

Thanks are extended to Dr. Nathaniel Apter for helpful criticism and for the use of patients under his

supervision, to Dr. Paul Alfred Bay for the use of facilities and EEG equipment at the Manteno State Hospital and to Prof. Nathaniel Kleitman, for counsel during the experiments.

# BIBLIOGRAPHY

1. Apter, N.: Research approaches to chronic schizophrenic reactions: Methodological problems. *Bull. Menninger Clin.*, 18: 154, 1954.
2. Aserinsky, E., and Kleitman, N.: Regularly occurring periods of eye motility, and concomitant phenomena, during sleep. *Science*, 118: 273, 1953.
3. Boss, M.: Psychopathologie des Traumes. *Ztschr. f. d. ges. Neurol. u. Psychiat.*, 162: 459, 1938.
4. Dement, W., and Kleitman, N.: Incidence of eye motility during sleep in relation to varying EEG pattern. *Federation Proc.*, 14: 216, 1955.
5. Fenn, W., and Hursh, J.: Movements of the eyes when the lids are closed. *Am. J. Physiol.*, 118: 8, 1937.
6. Fisher, C.: Studies on the nature of suggestion. I. Experimental induction of dreams by direct suggestion. *J. Am. Psychoanal. Assoc.*, 1: 222, 1953.
7. Kant, O.: Differential diagnosis of schizophrenia in the light of the concept of personality stratification. *Am. J. Psychiat.*, 97: 335, 1940.
8. Noble, D.: A study of dreams in schizophrenia and allied states. *Am. J. Psychiat.*, 107: 612, 1951.
9. Ramsey, G.: Studies of dreaming. *Psychol. Bull.*, 50: 432, 1953.
10. Reilly, R. et al.: Convulsant effects of isoniazid. *J. A. M. A.*, 152: 1317, 1953.

DEPARTMENT OF PHYSIOLOGY  
UNIVERSITY OF CHICAGO  
CHICAGO 37, ILLINOIS