

Medico-legal Issues

Homicidal Somnambulism: A Case Report

*R. Broughton, †R. Billings, ‡R. Cartwright, §D. Doucette, †J. Edmeads,
§M. Edwardh, #F. Ervin, †B. Orchard, †R. Hill and **G. Turrell

*University of Ottawa, Ontario, Canada;

†University of Toronto, Ontario, Canada;

‡Rush-Presbyterian Medical Center, Chicago, Illinois, U.S.A.;

§Ruby and Edwardh Barristers, Toronto, Ontario, Canada;

#McGill University, Montreal, Quebec, Canada; and

**Toronto, Canada

Summary: A case of a homicide and an attempted homicide during presumed sleepwalking is reported in which somnambulism was the legal defense and led to an acquittal. Other possible explanations including complex partial seizures, dissociative state, rapid eye movement sleep behavior disorder and volitional waking behavior are discussed. The evidence supporting the probability that this act occurred during an episode of somnambulism and sleep-related confusional arousal is reviewed and weighed. This evidence includes personal and family history of somnambulism and related disorders; neurological, psychiatric and psychological assessments; presence of possible precipitating factors; and polysomnographic data. **Key Words:** Somnambulism—Homicide—Aggression.

In their review of violence in sleep, Howard and D'Orban (1) described the main situations in which nocturnal aggression most often occurs: abrupt confusional arousals from sleep, somnambulism and rapid eye movement (REM) sleep behavior disorder. On occasion, homicide has been the result of such aggression. Perhaps the first documented case was in medieval times and concerned the confusional arousal of the Silesian woodcutter Bernard Schedmaizig [cf. Gastaut and Broughton (2)]. He woke abruptly after only a few hours of sleep, thought he saw an intruder at the foot of his bed and, picking up his axe, killed his wife asleep beside him. There are a number of episodes of homicidal violence documented in association with presumed sleepwalking. Homicide related to REM sleep behavior disorder has not yet been reported.

Early legal cases involving homicide during presumed sleepwalking were reviewed by Walker (3). They included a colonel who shot a guardsman on patrol and his own horse, a servant girl who stabbed one of her master's children to death and a London housewife

who threw her infant out a window. Other case reports were subsequently published. A father picked up his infant son from a crib during apparent sleepwalking and hit his head against the floor until the skull was split and the brain lacerated (4). A fireman awoke to find himself battering his wife's head with a shovel and immediately fainted. On regaining consciousness he realized she was dead and attempted suicide (1). Hartmann (5) reported a 50-year-old man with a history of sleepwalking and sleep terrors aggravated by stress and alcohol who became tired while driving. He pulled off onto the highway shoulder to sleep. About an hour later, during an episode for which he had no recall, he started the car and drove onto the highway and along the wrong side of the road. Drivers going the other direction noted a "fixed, blank expression" and honked to alert him, but to no avail. One oncoming car could not avoid a head-on collision and three occupants were killed.

Drug intake has been involved in several cases. A mother killed her only daughter with an axe during presumed sleepwalking related to hypnotic intake (6). Another mother receiving a combination of thioridazine and trichlorethanol for psychotic behavior arose and stabbed her daughter to death. In this case follow-up studies showed that thioridazine induced sleep-

Accepted for publication December 1993.

Address correspondence and reprint requests to Roger J. Broughton, M.D., Division of Neurology, Ottawa General Hospital, 501 Smyth Rd., Ottawa, Canada K1H 8L6.

walking on three of four polysomnographically monitored nights (7). Similarly, alcohol was involved in a case of apparent sleep-related lethal strangling (8,9).

There are also numerous cases of presumed sleepwalking in which very serious but nonhomicidal aggression has occurred. They include, for example, a "perfect husband" who strangled his wife and hit her head with an axe (1). She lived and later testified to his virtues. Howard and D'Orban (1) also reported on another male who during presumed sleepwalking stabbed and seriously wounded a friend who was sleeping overnight in his home and had earlier made unexpected and unwanted homosexual advances. The drug thioridazine was again involved in the case of an ambulance driver whose wife awoke with him strangling her (10). Oswald and Evans (11) reported three cases involving nonlethal strangling, stabbing and serious self-injury from jumping out a window. Schenck et al. (12) recently reviewed a series of 100 patients with sleep-related injury, a number of whom had aggression during sleepwalking.

The homicidal cases of presumed sleepwalking are of particular medical and legal interest. Murder only exists when there is provable intent to kill. The issue of voluntary control of one's actions during somnambulism also enters the legal argument. It is generally accepted that sleepwalking is a state of automatism in which an individual is unaware of, and has no control of, his or her behavior.

We report here the case of a young man who stabbed his mother-in-law and assaulted his father-in-law in the early hours of the morning. He was charged with first degree murder of his mother-in-law and with attempted murder of his father-in-law. The most probable mechanism was considered to be unpremeditated homicide during a sleepwalking episode. This was the legal argument at his defense, and the patient was acquitted of both charges.

CASE REPORT

Events prior to the night of homicide

The patient, Kenneth Parks, was a 23-year-old male, educated through the 11th grade, who at the time of the homicide worked in the electronics trade in the Toronto, Ontario, area. His father had abandoned the family when he was 4 years old. There was a distant and somewhat difficult relationship with both his stepfather and his natural father, whom he rarely saw. When he was a teenager, his mother and stepfather decided to move with his two brothers and half-sister to a different town. Ken wished to remain in the same high school and consequently stayed with his grandparents while he was 15–20 years of age. He married at 21

years of age, and at the time of the tragedy had a 5-month-old daughter. Ken had developed warm and good relationships with his parents-in-law; indeed, he became closer to them than to his own parents. In particular, he had what he considered a close mother-son relationship with his mother-in-law. She called him "her gentle giant".

The summer before the events in question, the patient began to bet at the horseraces and got progressively further into financial difficulties. He had previously avoided any serious betting. However, one summer day he accepted an invitation of friends to go to the races, placed a bet and won. Within a 5-week period he went from betting a few dollars on thoroughbreds to several hundreds of dollars on trotters and occasionally played for even higher odds. To cover heavy losses, he initially took funds from the family savings, then began to embezzle at work. Hiding these problems from his wife placed severe stress on the marriage. There were also major strains at work in covering up the thefts.

Ken began to have problems getting to sleep at night and developed a delayed sleep-phase pattern with sleep onset regularly occurring in the early hours of the morning around 1:00–2:30 a.m. followed by 4–6 hours of solid sleep. In December 1986, their daughter was born and his night sleep became quite fragmented. He would have occasional totally sleepless nights thinking of his problems and began to experience daytime headaches. These were both sharp, painful headaches attributed to chemicals used at work in the making of blueprints and "pressure headaches" for which he took Tylenol #3. In March 1987, the embezzlement was discovered. He was fired and, on March 29, charged with theft. The electronics company did not intend to prosecute for a criminal offense.

The house was initially put up for sale to cover the debt. Explaining the persistent betting to his wife was difficult. Ken became withdrawn and noncommunicative because of the problems on his mind; after the discovery he hardly ever saw his in-laws, due to embarrassment and guilt. Ken gave up gambling for several weeks, then began again. On two occasions he forged his wife's signature for funds. On May 15 he was seen at the emergency room of a community hospital for left chest pain unrelated to activity, shortness of breath, dry nonproductive cough and episodes of vomiting. EEG, chest x-ray, biochemistry, hematology and enzyme studies were all normal and Ken was sent home. Reconfrontation concerning his gambling caused him to come to greater grips with his problems; and on May 20, he went to his first "Gamblers Anonymous" meeting. It was decided to discuss his problems with both families. Plans were made to tell his grandmother the following Saturday (May 23) and to explain

his gambling problems and family financial difficulties to his parents-in-law on Sunday (May 24).

Friday night, May 22, he could get no sleep whatsoever. On Saturday morning he announced to his wife that he would delay telling his grandmother until the next day and had instead decided to play rugby with his buddies. This apparent avoidance of responsibility made his wife angry. The rugby game lasted some 2 hours. During the game he suffered a mild blow to his right temple without being dazed or losing consciousness; afterwards he was exhausted. Returning home around 2:30 p.m., Ken had an intense argument with his wife, who at 4:30 p.m. went to work. He had supper, put the baby to bed around 8:30 p.m. and then watched TV until 9:30–10:30 p.m., when his wife returned from work. She joined him watching TV until around midnight and then went to bed. Ken fell asleep on the couch around 1:30 a.m. watching "Saturday Night Live"¹ with the next-day visits to his parents-in-law, his grandmother and, in the evening, a return to Gamblers Anonymous on his mind. No alcohol or drugs had been consumed.

The homicide

The next thing Ken reports being able to recall after falling asleep was looking down at his mother-in-law's face. Her mouth and eyes were open and she had a "frightened 'help-me' look". He did not recall seeing marks or blood on her face. His next remembrance was hearing the younger children of the in-laws yelling upstairs. Following this, there is a period of patchy recall for isolated events with amnesia for others in between. For instance, Ken recalled subsequently being at the top of the stairs attempting to reassure the children by yelling "kids, kids" (they were hiding behind a door and later reported only "animal noises"), being back downstairs, starting his car and it lurching forwards, realizing in the car that he had a knife in his hands, shaking the knife onto the floor and subsequently saying at the police station upon questioning "I think I have killed some people . . . my hands". It was only at this time that Ken felt any hand pain related to severe and multiple severed flexor tendons. He recalled having gone to the police station for help.

¹ Retrospective enquiry found that this Saturday Night Live show was hosted by Dennis Hopper and showed several violent scenes. Motorcyclists were shot at from a farmer's truck and their motorcycles then exploded in a field (a scene from Easy Rider). A story was told by Hopper in which he was "stoned on cocaine" and ran out into the street screaming "If you are going to kill me, kill me like this, kill me like this, kill me naked". And a scene from the movie "Blue Velvet" showed a person pumped full of carbon monoxide, who then dies.

There were many events which, on repeated questioning, the patient could never remember. There was total absence of recall from the time of falling asleep until seeing his mother-in-law's face in her living room. The police deduced this period to include getting up off the couch at his home; putting on his shoes and jacket; leaving without locking the door (about which normally he was fastidious); driving his car a distance of some 23 km, which usually takes 10–15 minutes, depending on traffic and has up to three traffic lights, depending on routing; entering his parents-in-law's home; struggling with his father-in-law, who was strangled unconscious; and struggling with his mother-in-law and repeatedly stabbing her. After awakening and seeing his mother-in-law's face and during the period of patchy amnesia mentioned, Ken could not recall climbing the stairs or going down them, exiting the apartment and going to his parked car, whether the keys were in the ignition or not, which of the two main routes he took to the police station or any pain in his severely injured hands until he had been at the station for several minutes. The details of what was and what was not recalled remained consistent during at least seven interviews by physicians, psychologists, police personnel and lawyers.

Under police escort, Ken was subsequently taken to Sunnybrook Medical Centre for repair of his hand injuries. Initial psychiatric assessment of his mental status was done to determine his ability to give consent for surgery. Shortly after arrival he was interviewed by police and charged with first degree murder. Ken was noted by the physician in emergency to be a sad, remorseful and perplexed 225-lb male with severe hand wounds. He was initially assessed by a resident in psychiatry and tentatively diagnosed as being a pathological gambler and suffering from psychogenic amnesia and depression, but not having any psychotic features. He signed the consent form. Surgical repair was then done of the severed flexor tendons of his right middle, ring and small fingers and his left ring and small fingers. On May 27, he was transferred to Don Jail and then to Toronto East Detention Centre. While in jail, additional medical and psychiatric assessments were carried out at the request of his defense lawyers.

An autopsy report indicated that the mother-in-law had received five stab wounds into the chest and neck and had been brutally beaten with a blunt instrument, which had fractured her skull and caused a subarachnoid hemorrhage.

Medical investigation of the patient

The main diagnostic possibilities that were considered initially were an acute psychotic episode under

extreme stress, aggression during an amnesic drug-related state, volitional homicide with stress-induced amnesia and complex partial epileptic seizures with automatic behavior.

A past medical history was taken and included the usual childhood illnesses. In April 1984, mild hypertension (BP 150/105) was noted, as was a temporary weight gain from 212 lb the previous year to 249 lb. A right inguinal hernia had been repaired in October 1984. In May 1986, he had been treated for heartburn by his family practitioner. Then, as mentioned, in May 1987, he was seen for left chest pain, shortness of breath and vomiting at the emergency room of a local community hospital, with nothing abnormal found. There was no history of prior violent behavior.

The possibility that the events were drug-related received no support. Ken was only a very occasional drinker, mainly of beer. He used marijuana 2–4 times per year when out with male friends. In high school he had taken 'acid' three or four times, which repeatedly induced 1–2 nights of total insomnia, but otherwise was without effect. Cocaine had been tried once in early March 1987 without effect. There was no evidence of recent drug intake at the time of the homicide and Ken denied such intake.

Epilepsy and organic brain pathology were excluded by a neurological consultation (J.E.). Neurological examination was entirely normal other than sensory deficits in four fingers related to severed digital nerves. There was no personal or family history of epilepsy. Electroencephalograms (EEGs) were normal, as was a contrast-enhanced computerized tomographic (CT) scan.

Four psychiatrists were involved in further assessing the patient. They included two senior forensic psychiatrists, R.H. and B.O., the latter involved in a Canadian precedent-setting case involving automatism²; the general psychiatrist who did the initial assessment (R.B.); and a psychiatrist with particular expertise in aggression (F.E.). All found evidence for depression and anxiety, but none for dissociative features or for thought disorder, delusions, hallucinations, paranoid ideation or other suggestions of psychosis. No prior history existed for any of the latter, for problems with controlling aggression or for fugue states, multiple personality disorder, psychogenic amnesic episodes or other psychiatric dissociative states. There was also no suggestion of any motivation or personal gain, financial or other, for violence against his wife's parents with whom he had been particularly close. In all contacts with police, prison authorities and medical personnel, Ken firmly denied any homicidal intent or plan and

TABLE 1. *Psychological tests administered*

Beck Depression and Hopelessness Scale
Wechsler Adult Intelligence Scale-Revised (WAIS-R)
Forer Structured Sentence Completion Test
Rorschach Psychodiagnostic
Test of Oral Reading, Durrel Analysis of Reading Difficulty
Monroe/Sherman Reading, Diagnostic and Achievement Test
Paragraph Meaning
Writing Sample
Ravens Standard Progressive Matrices A, B, C, D, E
Minnesota Multiphasic Personality Inventory with Research
Scales: June 20, 1987; August 20, 1987; April 27, 1988; and
October 22, 1990
Minnesota Multiphasic Personality Inventory-Fowler Correctional
Report
Career Assessment Inventory
Social History
Psychological/Social History
Medical History Survey
California Psychological Inventory
Basic Personality Inventory
Eynsenck Personality Questionnaire
IPAT Depression Scale
IPAT Anxiety Scale
Personality Research Form-Extended
State-Trait Anxiety Inventory-Form Y
Computerized Visual Search Task

was perplexed, horrified and very remorseful about what had happened. Evidence was clear that these features were already present when Ken arrived in a confused state at the police station immediately after the homicide.

An in-depth psychological assessment was performed (by G.T.), which involved a number of tests done over a 4-month period. These tests are listed in Table 1. The initial examination of Ken took place within the first 24 hours of his arrest, and he was reported to be in a deep state of emotional despair, bewilderment, anxiety and fear. Psychometric test results complemented this clinical impression. The Beck Depression and Hopelessness Scale recorded raw scores of 45 and 18 for depression and hopelessness, respectively, putting Ken approximately within the 99th percentile on each dimension.

The first of four Minnesota Multiphasic Personality Inventory (MMPI) administrations (Fig. 1) confirmed findings of high depression and anxiety. The profile configuration and scale elevations were consistent with a "cry for help". The intensity of his depression and anxiety was consistent with an acute state of emotional turmoil. The emotional turmoil and general disorganization of personality were judged to be due to the confusion related to his immediate situation. At the time of the initial assessment, his personality profile included the self-perception that he was an inept, inadequate and incompetent person, who felt that life was a burden and not worthwhile. Premorbid personality characteristics, including the tendency to worry, self-

² *Raby v. The Queen* 1980, 2S.C.R.513, 54 C.C.C. (2d) (S.C.C.).

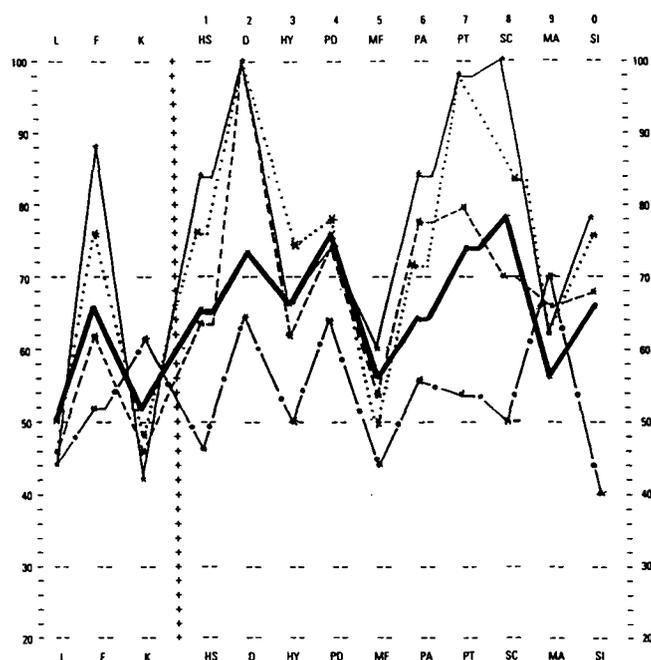


FIG. 1. Minnesota Multiphasic Personality Inventory results on Ken Parks on June 20, 1987 (continuous line), August 28, 1987 (dotted line), April 27, 1988 (dashed line) and October 22, 1990 (dot and dash line) compared to group mean data for somnambulists of Sours et al. (13) (dark continuous line). The homicide was on May 22, 1987. The individual scales are L, F and K (validity scales); HS (hypochondriasis), D (depression), HY (hysteria), PD (psychopathic deviate), MF (masculinity-femininity), PA (paranoia), PT (psychasthenia), SC (schizophrenia), MA (mania) and SI (social introversion/extroversion).

blame and self-pity, were significantly magnified, as was a tendency to be socially isolated and withdrawn. Enduring personality characteristics, as measured over time, were judged to be consistent with a tense, unhappy and discouraged individual. Chronic feelings of inadequacy, depression and rigidity had affected his efficiency, initiative and self-confidence. These characteristics, although uncomfortable and distressing for him, would not necessarily have interfered with his ability to carry out responsibilities. Difficulty expressing emotion and difficulty with self-disclosure would be reinforced by his tendencies to be both self-critical and self-conscious.

Results of the second and third administrations of the MMPI demonstrated very little difference. A fourth MMPI completed 40 months after the act showed a relatively normal profile, indicating a recovery from the mental confusion and depression and a return of energy and social responsiveness. The validity and clinical scale configuration of each of Ken's MMPIs were later compared to the MMPI profile of a typical group of somnambulists reported by Sours et al. (13) and demonstrated significant similarities.

Intellectually, Ken fell within the average range. Results of the Wechsler Adult Intelligence Scale-Revised

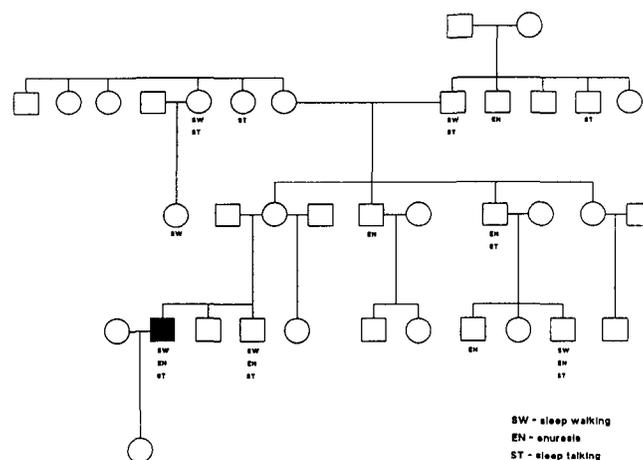


FIG. 2. Family pedigree showing extensive known occurrence of sleepwalking, night terrors, deep sleep with confusional awakenings, sleep talking and bedwetting. (Propositus Ken in black, males as squares, females as circles.)

(WAIS-R) placed his verbal intellectual abilities within the 45th percentile and his nonverbal abilities within the 42nd percentile. Oral reading and comprehension were consistent with his education.

In the absence of any evident etiology and given the timing and nature of the events in combination with Ken's personal history of sleepwalking, the team of psychiatrists, psychologist and neurologist began to wonder whether a sleep disorder might not be involved. Independent assessment by a sleep disorders specialist was recommended to Ken's defense lawyer. This led to the investigation of the possible roles of somnambulism, REM sleep behavior disorder and nocturnal dissociative disorder in the homicide.

The sleep specialist consulted (R.B.) was also initially skeptical that such events could have occurred during an episode of somnambulism. Nevertheless, a full sleep disorder work-up was certainly indicated. A more detailed personal and family sleep/wake history was taken from the accused and later from family members and from cell mates in the detention center. The patient had been a severe bedwetter until 11-12 years of age, a deep sleeper who was very hard to awaken and who had rare dream recall, a chronic sleep talker and an occasional sleepwalker from early childhood. On one occasion one of his brothers had caught him by the leg while sleepwalking and about to exit a window. During incarceration, two cell mates described Ken as having 30-60-second episodes of sitting up in bed with eyes open, mumbling and lying down again, during which time he was neither behaviorally awake nor responsive to questions. There were also occasional episodes of awakening with fright at night associated with palpitations and a feeling of heaviness in the chest, but without screaming; these were suggestive of incomplete sleep terrors.

TABLE 2. Sleep measures during initial incarceration in detention center and after long-term oxazepam administration

	Jan 22, 1988	Jan 23, 1988	July 25, 1989 ^a	Normal range ^b
Time in bed (minutes)	343.3	393.7	436.0	420-460
Sleep period duration (minutes)	321.3	249.0	349.5	403-446
Total sleep time (minutes)	287.0	229.3	361.0	397-441
Sleep efficiency (%)	89.3	92.1	91.5	89-100
Sleep latency (minutes)	21.7	144.3	23.0	5-32
SWS latency (minutes)	10.0	9.7	24.0	10-31
REM latency (minutes)	100.3	100.0	131.5	56-120
Waking after sleep onset (%)	10.7	7.9	8.5	0-4
Stage 1 (%)	8.8	14.7	17.6	2-7
Stage 2 (%)	34.9	45.5	54.8	38-53
Stage 3 (%)	13.0	10.8	0.8	4-8
Stage 4 (%)	15.1	12.6	0.0	8-20
REM sleep (%)	17.5	8.7	18.4	18-30
REM period efficiency (%)	97.0	76.0	99.0	80-100
Mean REM period duration (minutes)	19.2	14.8	24.3	18-40
Mean cycle length (minutes)	87.3	147.3	117.5	80-135
No. awakenings > 1 minute	7	10	7	0-7
No. stage shifts	128	170	148	25-60
No. stage shifts/hour	23.9	41.0	22.5	4-8
No. SWS-to-wake awakenings	5	8	0	0-3

^a A repeat follow-up recording the next night on July 26, 1989 contained essentially identical findings.

^b Normal values for patient's age and sex are from published sources [especially Williams et al. (39)] and from the data bank of the Ottawa General Hospital sleep laboratories.

The family history contained a very high frequency of a variety of parasomnias, including sleepwalking, sleep talking, enuresis and night terrors, as well as unusually deep sleep. Their distribution across the family members is illustrated in Fig. 2.

Two overnight polysomnograms (PSGs) were done in the detention center using equipment moved from Ottawa. At this time Ken had been receiving oxazepam 30 mg hs for several nights. The first study (January 22, 1988) was done to assess overall sleep architecture and to rule out the possibility of coexistent sleep apnea, periodic leg movements or other sleep pathology. It included an EEG, electrooculogram (EOG), submental electromyogram (EMG), precordial electrocardiogram (EKG), bilateral nasal and oral upper airflow, chest and abdominal movement (Respirace), transcutaneous O₂ saturation monitoring, and bilateral anterior tibialis superficial EMG leads. The recording contained only a single obstructive apnea (duration 14 seconds) and eight obstructive hypopneas (maximum duration 22 seconds), giving normal apnea and apnea + hypopnea indices of 0.2/hour and 2.9/hour, respectively. No periodic movements in sleep were present. Sleep architecture scored using Rechtschaffen and Kales criteria (14), however, was abnormal. The main features were somewhat high amounts of wakefulness after sleep onset (11%), frequent stage shifts (128/hour), some increase in stage 1 drowsiness (9%), high amounts of slow-wave sleep (SWS, 28%), marked instability of SWS with frequent shifts to lighter sleep, high amounts of hypersynchronous delta activity within SWS and quite frequent (n = 5) direct transitions from SWS to

full wakefulness (of at least 1-minute duration). The complete sleep measures are provided in Table 2 and a sleep histogram is shown in Fig. 2.

The second night (January 23, 1988) included a schedule of two forced awakenings in SWS plus one in REM sleep to determine whether confusional episodes could be induced. The PSG comprised six EEG derivations (right and left referential central, occipital and mid-temporal), EOG, submental EMG and EKG. In addition to the three induced arousals, the PSG again showed frequent stage shifts especially within SWS sleep (Table 2, Fig. 3), a high number of SWS-to-wake arousals (eight in total, of which two were experimentally

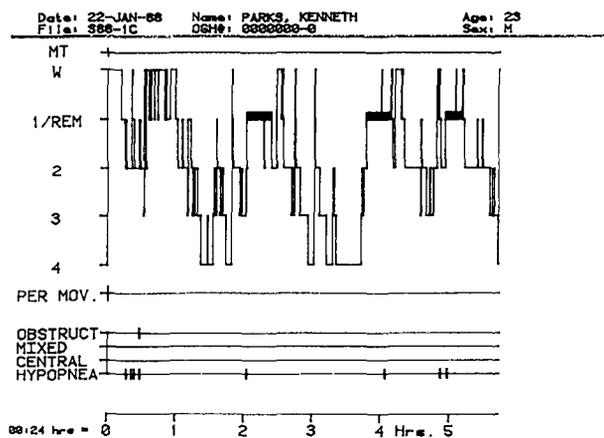


FIG. 3. Sleep histogram on first night in detention center. It shows state instability (especially of nonrapid eye movement sleep), five direct SWS-to-wake arousals (at about 0.4, 1.8, 2.8, 3.2 and 5.8 hours after sleep onset) and high amounts of SWS.

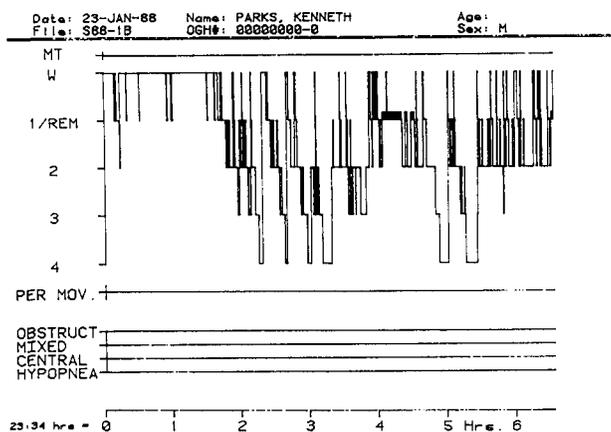


FIG. 4. Sleep histogram of subsequent detention center night, which included three forced arousals. It shows greater sleep onset insomnia, high instability of nonrapid eye movement sleep and eight direct SWS-to-wake arousals (two of which were experimentally induced), plus a forced arousal in the single REM period.

induced), frequent bursts of hypersynchronous delta activity, and overall high amounts of SWS. Unlike the first night, the second was associated with considerable sleep onset insomnia. The initial induced SWS awakening was at 1:53 a.m. Ken awoke quickly and was only slightly confused, was able to give his name and age correctly, but had difficulty remembering his address. He did not recall any prior within-sleep mental activity and was uncertain whether he had slept despite 9 minutes of prior SWS. The second induced SWS arousal was at 4:37 a.m. Once more he awoke rapidly and did not recall prior mental activity. An REM sleep arousal at 6:10 a.m. was associated with immediate full alertness; again no dream or other mental activity was reported.

In both sleep studies, all six EEG leads were recorded. At no time were any EEG discharges recorded. REM sleep did not show unusual features in either PSG. In particular, there was no suggestion in submental or (on the first study) in anterior tibialis EMGs that maintained muscle tone or excessive myoclonus, as may be seen in patients with REM sleep behavior disorder, were present. No unusual behaviors occurred during periods of nocturnal awakening.

Final diagnosis and legal argument

Given the absence of any motive, the affection in which his parents-in-law were held, the evident sincerity of the patient's grief, the lack of evidence for other medical causes (drug-related, psychotic, epileptic, organic central nervous system (CNS), diurnal or nocturnal psychogenic dissociative states or REM sleep behavior disorder) and given the very strong anamnestic and laboratory evidence compatible with, and

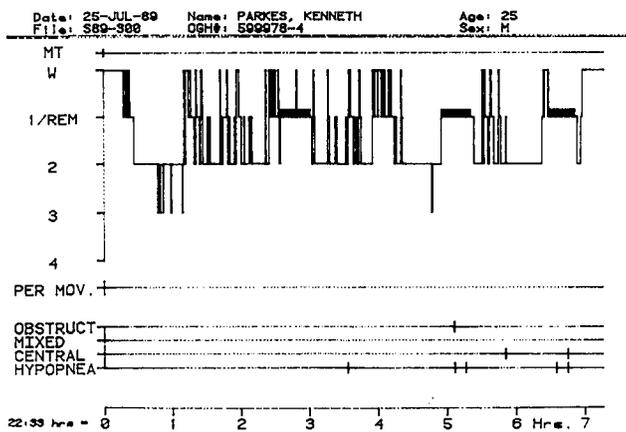


FIG. 5. Follow-up PSG some 18 months later, showing suppression of SWS (on chronic benzodiazepine therapy) with maintenance of sleep fragmentation.

indeed in favor of, somnambulism, it was concluded that it was most likely that the assault (father-in-law) and homicide (mother-in-law) had occurred during an episode of sleepwalking.

The predisposing factors for a diagnosis of somnambulism were considered to include a very strong family and personal history of sleepwalking, as well as a history enuresis nocturna, sleep talking and unusually deep sleep. Possible triggering factors for sleepwalking to occur that night did exist and included pressure for deep sleep (related to recovery from marked prior sleep deprivation and the additional effects of considerable physical exertion) coupled with arousing factors leading to sleep disruption (marked stress related to preparing to confess and discuss his compulsive gambling and embezzlement the next day with his parents-in-law and his grandmother). The duration, which could have been as short as 25–30 minutes, and the phenomenology of the episode were all considered compatible with this interpretation. All documents of the case were later independently reviewed by Dr. Rosalind Cartwright, Rush-Presbyterian–St. Lukes Medical Center, Chicago, who also interviewed Ken at the detention center and came to the same conclusion. REM sleep behavior disorder and nocturnal dissociative disorder appeared highly unlikely for reasons discussed below.

The legal defense was, therefore, one of homicide during noninsane automatism as part of a presumed episode of somnambulism. It was argued that the defendant did not have any preexisting "disease of the mind" within the meaning of Section 16(2) of the Canadian Criminal Code. There was no evidence for psychosis or other mental pathology. Moreover, it was believed that the clustering of such a number of triggering factors was extremely unlikely to occur again, so that the probability of recurrence of sleepwalking with aggression was considered extremely remote.

On May 25, 1988, the jury rendered a verdict of not guilty. Shortly thereafter Ken was also acquitted of the attempted murder of his father-in-law.

Follow-up since trial

Since discharge from a year of custody, Ken has been receiving psychotherapy from a psychiatrist to help him adjust to his new life and has continued to receive the benzodiazepine oxazepam at bedtime. No further sleepwalking has occurred, although there have been a few episodes of sitting up in sleep. There have also been no further signs of any daytime or nighttime violence. Two follow-up PSGs were done some 18 months after the initial ones (Table 2). Both showed somewhat fragmented sleep with almost total suppression of SWS (due to long-term benzodiazepine intake) and no behavioral automatisms in sleep. After the acquittal, the crown attorney appealed the trial judge's determination that somnambulism was a form of noninsane automatism to the Court of Appeal and the Supreme Court of Canada. Both appellate courts upheld the original decision.³

DISCUSSION

The diagnosis

It is evident that no formal proof of etiology can be obtained in cases such as Ken Parks', because a description by others of the behavior at the time is almost inevitably unavailable and, of course, no concurrent objective documentation of the patient's state can be made. The conclusion that sleepwalking was the most probable state at the time of the homicide was, on face value, initially considered unlikely by the sleep specialists involved; indeed they repeatedly attempted to lead Ken into statements that would be inconsistent with this diagnosis. Such efforts were unsuccessful.

To help arrive at a presumed explanation of the events, useful guidelines for investigation and differential diagnosis are available in Mahowald et al. (15). Part of the process involves assessing information that excludes some diagnoses while evaluating evidence in favor of others. A list of diagnostic possibilities in our patient is summarized in Table 3 [modified from Mahowald et al. (15)].

Considering first the neurological possibilities, no features evoked epilepsy. Specifically, there were no known daytime or nocturnal seizures in the patient's past, no family history of epilepsy and the EEGs in both wakefulness and sleep consistently lacked the

TABLE 3. *Differential diagnosis of state during the homicide*

I. Neurological
1. Epilepsy (ictal or postictal event)
2. Vascular (transient global amnesia)
3. Organic brain syndrome
4. Mass lesion (deep midline, increased intracranial press)
5. Head trauma
6. CNS infection (encephalitis, especially limbic)
7. Toxic/metabolic/endocrine CNS disorder
8. Drug related, intake or withdrawal
II. Psychiatric (dissociative states that may arise from sleep)
1. Psychogenic amnesia
2. Multiple personality disorder
3. Fugue state
III. Volitional waking behavior
IV. Sleep disorders
1. REM sleep behavior disorder
2. Sleep drunkenness
a. Idiopathic CNS hypersomnia and narcolepsy
b. Sleep apnea
c. Recovery from sleep deprivation
3. Sleep terrors
4. Sleep walking

presence of potentially epileptic discharges as documented in patients with nocturnal seizures (2,16) and, more particularly, in the nocturnal epileptic wanderings described by Pedley and Guilleminault (17). Vascular lesions, organic brain syndrome, mass lesions, CNS infection, and metabolic and endocrine disorders were ruled out by the combination of repeated general physical examinations, a detailed neurological examination, extensive laboratory testing, neuropsychological testing and enhanced CT scan. There was no evidence whatsoever for recent drug or alcohol intake.

Intensive psychiatric examination revealed no evidence for any psychiatric disorder other than reactive depression. Specifically, there was no evidence for psychosis or for dissociative personality features on assessment either by the initial psychiatric interview prior to hand surgery, or on subsequent detailed evaluation by four well-qualified consultant psychiatrists with extensive experience in psychogenic dissociative disorders, psychosis and aggression. This was also the conclusion of the psychologist who, on testing, found evidence for high levels of depression and anxiety but none for dissociative tendencies. It therefore seems very unlikely that the events represented either psychosis or one of the dissociative episodes beginning in periods of nocturnal wakefulness, which may stimulate somnambulism (18,19) and which almost always occur in patients with a history of severe childhood physical and/or sexual abuse (19), features lacking in Ken's case.

The possibility of conscious and volitional murder with a fabricated story was, of course, carefully considered throughout the assessments. However, there

³ (1990) 56 C.C.C.m (3rd) 449 (O.C.A.); *R. v. Parks* (1992), 75 C.C.C.(3d) 287 (S.C.C.).

was no evidence for any animosity between Ken and his parents-in-law; indeed, he had been particularly close to them. There was also no motive and certainly no personal gain. After regaining sufficient awareness, he had driven apparently directly to the local police station in a totally confused and horrified state. Ken remained entirely consistent in his recounting of his recollection of events, despite efforts by medical investigators to try and lead him into inconsistencies. All involved were struck by his evident confusion and grief concerning such horrible events for which he maintained that he had no recall. This lack of support for other mechanisms is what led eventually to the consideration of a sleep disorder being involved in the genesis of events.

None of the information pointed to REM sleep disorder. Previous parasomnias had always occurred in the first portion of the night. The patient was a very deep sleeper and a nonrecaller of dreams. There was no past history of unusual florid behaviors in sleep, such as waving of arms, gesturing and so forth. (There was, however, a history of sleep talking, which can occur in REM sleep behavior disorder.) Prior nocturnal ambulatory behavior was of the relatively quiet kind and lacked the more vivid movements and frequent evident myoclonus typical of the latter. Repeated PSGs did not show any of the polygraphic features of REM sleep behavior disorder; and, upon attempts to awaken the subject, deep sleep and lack of reporting of prior mental activity were confirmed.

Sleep drunkenness would not be an adequate explanation. Usually the confusional awakenings last only a few minutes, whereas the events in question must have taken at least 15–25 minutes. There was no personal or family history suggestive of idiopathic CNS hypersomnia or narcolepsy–cataplexy syndrome, conditions that can be associated with sleep drunkenness. The polysomnograms were not characteristic of either diagnosis. Sleep apnea was excluded by respiratory monitoring during PSG. Although prior sleep deprivation can also lead to sleep drunkenness, and the patient certainly had a significant sleep debt, the confusion remains too brief to explain the events.

Concurrence with a sleep terror can be considered most unlikely as well. The patient had a history suggestive of this parasomnia; however, sleep terrors typically last less than 5 minutes, with the patient typically remaining in bed unless development directly into somnambulism occurs.

By comparison to all of the above explanations, the evidence was considered consistent and indeed strong for sleepwalking. The patient had a personal past history of sleepwalking, of enuresis nocturna until a late age, of deep sleep with difficulties in awakening, of sleep talking and, as mentioned, of possible sleep ter-

rors. There is evidence that sleepwalkers have a higher than normal incidence of enuresis (20), sleep talking (21) and sleep terrors (22). Sleepwalkers are characteristically deep sleepers, are hard to awaken and have low dream recall (23), all features evident in our patient. The presence in sleepwalkers of episodes consisting of sitting up with eyes open while fully asleep is well documented and has been objectively recorded during continuing SWS (2,24). This phenomenon appears to be a “forme fruste” of full blown somnambulism.

The remarkable strong family history of somnambulism and related parasomnias (cf. Fig. 2) is also relevant. It is known that somnambulism has a strong genetic component (20,25,26) and that relatives of sleepwalkers have a heightened incidence of sleep terrors (20), enuresis (27) and sleep talking (28).

The known phenomenological details of the episode fit readily into this presumed mechanism. Behavior atypical for the patient in wakefulness took place and included not locking the apartment door and the presence of aggression in a normally passive individual. Total amnesia was present until the moment of awakening. The patchy memory from the first awakening until the interview in the police station probably relates either to a subsequent partial sleep state in which only the more intense experiences were recalled, or the presence at that time of fluctuations in and out of full awareness related to “waxing and waning” of vigilance (29) or to repeated “microsleeps” (30).

The timing of the known major events during the episode also fit well. He fell asleep around 1:30 a.m. and arrived at the police station at 4:15 a.m., i.e. some 2 hours 45 minutes later. The episode therefore certainly began during the first 3 hours of sleep, when somnambulism typically occurs (2,26,31). The time interval from the moment of falling asleep until he awoke and saw his mother-in-law is impossible to calculate with certainty but could well have been under 30 minutes allowing another 5–7 minutes necessary to drive to the police station (the first moment at which time is accurately known). This interval does not exceed the maximum duration of confirmed sleepwalking episodes. The absence of any pain well after the wounds were incurred is also of possible relevance, as there is some evidence that analgesia is present during sleepwalking (32). In one episode of presumed somnambulism a man stabbed himself four times in his sleep and bled to death (33).

Polysomnographic findings were also consistent with this presumed mechanism. As well as giving no support for other sleep disorders, they contained features typical of sleepwalkers on nonevent nights. Despite receiving the SWS-suppressing benzodiazepine oxazepam for several nights prior to and during PSG, there

were unusually high levels of SWS, typical of the deep sleep of sleepwalkers. Frequent brief microarousals following one or several delta waves were seen in the PSG and have been reported in sleepwalkers (34). There were also frequent full-blown SWS-to-wake transitions, which in normal sleepers seldom exceed 1–2 per night but are elevated during nonevent nights in patients with both SWS arousal disorders of somnambulism and sleep terror types (35–37). Finally, there was an abnormally high amount of hypersynchronous delta EEG activity, a characteristic of sleepwalkers first noted by Jacobson et al. (24) and subsequently confirmed by others (37,38).

These typical polysomnographic features of sleepwalkers suggest the coexistence of both pressure for deep sleep (SWS) and of heightened arousal causing inability to sustain such sleep. This association forms part of the physiopathogenesis of sleepwalking and reflects the combined importance (35,36) of factors leading to unusually deep sleep (constitutional deep sleeper, recovery from sleep deprivation, excessive fatigue, sedatives, etc.) and others that fragment sleep (e.g. stress, pain, alcohol), several of which were definitely involved in our patient.

Although we are convinced that the homicide almost certainly occurred during somnambulism, two major issues remain obscure. First, why did Ken go to his parents-in-law's residence? We believe most likely this was because his planned visit the next day was a major stressful event that was probably on his mind while falling asleep. Secondly, why did the aggression occur? We suspect, but have no evidence either for or against this explanation, that our patient was discovered wandering around in his parents-in-law's residence, that his behavior was resisted and that aggression was a response to such impediment. In epileptics, for comparison, seizures with assault as a primary direct expression of the attack are exceedingly rare. Indeed, fewer than a half dozen cases of true "ictal aggression" have been reported including the cases of Marsh (39), Mark and Ervin (40) and Saint-Hilaire et al. (41). In almost all cases related to epileptic seizures, aggression represents the response of a confused and incompletely conscious individual to having internally driven behavior impeded or frustrated. An equivalent careful study of the mechanisms of aggression in somnambulists has not been made.

In any event, the features of our patient appear to meet all seven criteria of Mahowald et al. (15) for legal evaluation of the cause of sleep-related violence. (i) There was reason to suspect the sleep disorder (sleepwalking) on both history and sleep laboratory evaluation. (ii) The duration was compatible with the presumed diagnosis. (iii) The behavior was seemingly senseless and without motivation. (iv) Immediately

afterwards there was perplexity and horror with no attempt to conceal or cover up the events. (v) There was amnesia for most of the events. (vi) The events fit the timing after sleep onset and the duration of the proposed explanation. (vii) Events were related to prior sleep deprivation, which can facilitate attacks.

The nature of sleepwalking and the legal defense

Somnambulism represents a remarkable state, combining an apparent level of consciousness (self-awareness) and an EEG that resemble sleep, along with organized behaviors that sometimes approach the complexity of wakefulness. Although in sleepwalking the eyes are typically open, the individual does not fully incorporate environmental stimuli. Shakespeare fully recognized this in describing Lady Macbeth's sleepwalking (42). The Doctor-in-Physic remarked on observing Lady Macbeth that "her eyes are open", to which the Lady-in-Waiting (who had observed many such episodes) answered "Aye, but their sense is shut".

As well as the sleepwalker being incompletely aware of the environment, it is in general not readily possible to deflect the person from the ongoing behavior, which appears to be essentially preprogrammed and having to "run itself out". There is no evidence that a somnambulist during sleepwalking can either execute a conscious intent from prior wakefulness or can create an intent. Because of these features, the episodes have been classed medically as a form of automatic behavior. Indeed phenomenologically indistinguishable complex amnesic automatism are seen in a number of medical conditions in which conscious awareness is impaired at a level permitting elaboration of such behaviors. These include some psychotic fugue states, drug-related states, certain trance states, temporal and frontal lobe epileptic seizures, and nonconvulsive status epilepticus ("absence status").

From a medical-legal viewpoint, the requirements of legal "automatism" are satisfied because the behavior is unconscious and involuntary. This is summarized in the ruling of the Supreme Court of Canada, which quoted from a statement of Mr. Justice Dickson, dissenting in *R. v. Rabey*:

Although the word 'automatism' made its way but lately to the legal stage, it is a basic principle that absence of volition in respect of the act involved is always a defence to a crime. A defence that the act is involuntary entitles the accused to a complete and unqualified acquittal. That the defence of automatism exists as a middle ground between criminal responsibility and legal insanity is beyond question. Although spoken of as a defence, in the sense that it is raised by the accused, the Crown always bears the burden of proving a voluntary act.

At trial the defense presented evidence that Ken Parks was in a presumed state of sleepwalking at the time of

the homicide and that sleepwalking is a form of automatism in which volition is absent. As this was the only live issue in the trial, the jury's acquittal on the charge of murder clearly reflects their acceptance of this evidence. This conclusion was not challenged by the prosecution on appeal. The issue before the Ontario Court of Appeal and the Supreme Court of Canada related to whether sleepwalking in this case should be classed as insane or noninsane automatism. The classification is of major importance to the legal outcome of the trial. If the classification of sleepwalking is that of noninsane automatism, the accused is entitled to a full acquittal and is therefore set free. However, if the automatic acts in question are considered to spring from a "disease of the mind", they are classed as insane automatism and the individual is then subject to a regime of mandatory hospitalization in an institution for the criminally insane for an indefinite period of time. The legal concepts of "disease of the mind" and "insanity" are not precisely those of medical science which, in any event, evolve over time. Although these concepts take the latter into account, the legal concept embraces two further policy components, the intent of each being the protection of the public.

The first policy component is the legal theory of "continuing danger". It holds that any condition likely to present a recurrent danger to the public should be treated as insanity. As applied to this instance of violence during presumed sleepwalking the core issue, of course, was the probability of future repetition. The defense presented expert testimony supporting two main arguments to show that the likelihood of recurrent violent somnambulism was insignificant. The first was that, in Ken's case, sleepwalking was both rare and was triggered by a highly unusual combination of marked sleep deprivation and overwhelming stress; the latter were considered extremely unlikely to recur together. It was noted that, whereas no specific medication yet exists for somnambulism, avoidance of the apparent precipitating factors (sleep deprivation and stress), normal sleep hygienic measures plus drug treatment (e.g. oxazepam) to consolidate sleep and reduce deep sleep should be sufficient to avoid any recurrence. The other argument presented was the fact that there are no documented cases of repeated violent somnambulism in the literature, so that recurrence, in general, must be exceptional.

The second policy component is that of "internal causes" or "disease of the mind". This theory holds that recurrence is more likely if the events spring from an internal cause (indicating a weakness in this respect) rather than from an external cause, such as a head injury or drug intake. The defense provided expert testimony that sleepwalking does not express a "disease of the mind" such as is present, for example, in

various forms of mental illness. It was argued that there is no evidence that sleepwalkers show any consistent features of a "disease of the mind" during wakefulness and that sleepwalking itself is not a disease but, rather, a disorder of sleep. Specifically, it was argued that in sleepwalking the brain does not awaken and that the state of mind at the time is that of being asleep, in itself a normal condition.

The prosecution did not contradict the expert evidence given nor did it make an effort to prove volition on the part of the accused. The Supreme Court of Canada found sleepwalking to be a form of noninsane automatism. It accepted the medical testimony that the probability of recurrent violent somnambulism was infinitesimal, and that somnambulism does not express a "disease of the mind". The judges noted that "because the medical evidence has an impact on the police inquiry, in another case with different evidence sleepwalking might be found to be a disease of the mind". Other details are available in their judgement. In their closing remarks they noted:

It may be that some will regard the exoneration of an accused through a defence of somnambulism as an impairment of the credibility of our justice system. Those who hold this view would also reject insane automatism as an excuse from criminal responsibility. However, these views are contrary to certain fundamental precepts of our criminal law: only those who act voluntarily with the requisite intent should be punished by criminal sanction.

It is of interest that the Court of Appeal in England contemporaneously decided on the same issue in the case of the violent somnambulism of a Mr. Barry Burgess. Their decision was in favor of insane automatism. There are many differences between the two cases. The fundamental legal argument used was based on the evidence of Dr. Peter Fenwick, who has elaborated his belief elsewhere (43) that somnambulism expresses a "disease of the mind". We do not agree with this opinion and would not wish to see patients with an episode of somnambulism with violence incarcerated in an institution for the criminally insane.

A final concern of the law and of others has been whether somnambulism could be easily feigned. If so, one might expect a flood of defenses on that basis. First, it should be noted that for more than a century somnambulism has been generally classed as noninsane automatism and that no rash of such defenses has occurred. Secondly, we feel certain that it would be extremely difficult for anyone to create a convincing and verifiable personal and family history of somnambulism or the objective polysomnographic features characterizing the condition. Moreover, someone simulating a sleepwalking episode would almost certainly report features incompatible with this diagnosis.

Acknowledgements: Genetic consultation was generously given by Roberta Palmer, Ph.D., Center for Human Genetics and Department of Psychiatry, McGill University. The authors also thank Pierre Duchesne for his technical assistance and Barbara Reynolds for assistance in typing the manuscript.

REFERENCES

- Howard C, D'Orban PT. Violence in sleep: medico-legal issues and two case reports. *Psychol Med* 1987;17:915-25.
- Gastaut H, Broughton R. A clinical and polygraphic study of episodic phenomena during sleep—the Sakel Lecture. *Recent Adv Biol Psychiatry* 1965;7:197-221.
- Walker N. *Crime and insanity in England*. Edinburgh: University of Edinburgh Press, 1968.
- Yellowless D. Homicide by a somnambulist. *J Ment Sci* 1878;24:451-8.
- Hartmann E. Two case reports: night terrors with sleep-walking—a potentially lethal disorder. *J Nerv Ment Dis* 1983;171:503-5.
- Morris N. Somnambulist homicide: ghosts, spiders and North Koreans. *Res Judicatae* 1951;5:29-33.
- Luchins DJ, Sherwood PM, Gillin C, Mendelson WB, Wyatt RJ. Filicide during psychotropic-induced somnambulism: a case report. *Am J Psychiatry* 1978;135:1404-5.
- The Times, February 17, 1961 (p. 5).
- Watkins L. *The sleepwalk killers*. London: Everest Books, 1976.
- Scott AIF. Attempted strangulation during phenothiazine-induced sleepwalking and night terrors. *Br J Psychiatry* 1988;153:692-4.
- Oswald I, Evans J. Serious violence during sleep walking. *Br J Psychiatry* 1985;147:688-91.
- Schenck CH, Milner DM, Hurwitz TD, Bundlie SR, Mahowald MW. A polysomnographic and clinical report on sleep-related injury in 100 adult patients. *Am J Psychiatry* 1989;146:1166-73.
- Sours JA, Frumkin P, Indermill RR. Somnambulism: its clinical significance and dynamic meaning in late adolescence and adulthood. *Arch Gen Psychiatry* 1963;9:400-13.
- Rechtschaffen A, Kales A, eds. *A manual of standardized terminology, techniques and scoring system for sleep stages of human subjects*. Washington, DC: Institute of Health Publication No. 204, U.S. Government Printing Office.
- Mahowald MW, Bundlie SR, Hurwitz TD, Schenck CH. Sleep violence: forensic science implications: polygraphic and video documentation. *J Forensic Sci* 1990;35:413-32.
- Broughton R. Childhood sleepwalking, sleep terrors and enuresis nocturna: their differentiation from nocturnal epileptic seizures. In: Popoviciu L, Asgian B, Badiu B, eds. *Sleep 1978*. Basel: Karger, 1980:103-11.
- Pedley T, Guilleminault C. Episodic nocturnal wanderings responsive to anticonvulsive drug therapy. *Ann Neurol* 1977;2:30-5.
- Fleming J. Dissociative episodes presenting as somnambulism: a case report. *Sleep Res* 1987;16:263.
- Schenck CH, Milner DM, Hurwitz TD, Mahowald MW. Dissociative disorders presenting as somnambulism: polysomnographic, video and clinical documentation (8 cases). *Dissociation* 1989;2:194-204.
- Spinweber CL, Greenberger D. Somnambulists and enuretics in the navy: MMPI, sleep questionnaire and sleep history data. *Sleep Res* 1984;13:168.
- Sours JA, Frumkin P, Indermill RR. Somnambulism: its clinical significance and dynamic meaning in late adolescence and adulthood. *Arch Gen Psychiatry* 1963;9:112-25.
- Kales A, Soldatos CR, Caldwell AB, et al. Somnambulism: clinical characteristics and personality patterns. *Arch Gen Psychiatry* 1980;37:1406-10.
- Jacobson A, Kales A. Somnambulism: all-night EEG and related studies. In: Kety SS, Evarts EV, Williams HL, eds. *Sleep and altered states of consciousness*. Baltimore: Williams and Wilkins, ARNMD Res. Publ. 1967:424-55.
- Jacobson A, Kales A, Lehmann D, Zweigig JR. Somnambulism: all-night electroencephalographic studies. *Science* 1965;148:975-7.
- Abe K, Shimakawa M. Predisposition to sleepwalking. *Psychiatr Neurol* 1966;152:306-12.
- Bakwin H. Sleepwalking in twins. *Lancet* 1970;ii:336-77.
- Pierce CM, Lipcon HH. Clinical relationship of enuresis to sleepwalking and epilepsy. *Arch Neurol Psychiatry* 1956;76:310-6.
- Abe K, Amatori M, Oda N. Sleepwalking and recurrent sleep-talking in children of childhood sleepwalkers. *Am J Psychiatry* 1984;141:800-1.
- Valley V, Broughton R. The physiological (EEG) nature of drowsiness and its relation to performance deficits in narcoleptics. *Electroencephalogr Clin Neurophysiol* 1983;55:243-51.
- Guilleminault C, Billiard M, Montplaisir J, Dement WC. Altered states of consciousness in disorders of daytime sleepiness. *J Neurol Sci* 1975;26:377-93.
- Broughton R. Sleep disorders: disorders of arousal? *Science* 1968;159:1070-8.
- de Manacéine M. *Sleep. Its physiology, pathology, hygiene and psychology*. London: Walter Scott, 1914:126.
- Podolsky E. Somnambulist homicide. *Am J Psychiatry* 121:191-2.
- Halasz P, Ujszaszi J, Gadoros J. Are microarousals preceded by electroencephalographic slow wave synchronization precursors of confusional awakenings? *Sleep* 1985;8:231-8.
- Broughton R. Motorische und Verhaltens—Parasomnien (Motor and behavioral parasomnias). In: Meier-Ewert K-H, Schulz H, eds. *Schlaf und Schlafstörungen*. Heidelberg: Springer-Verlag, 1990:121-31. [In German.]
- Broughton R. Phasic and dynamic aspects of sleep: a symposium review. In: Terzano MG, Halasz P, Declerck AC, eds. *Phasic and dynamic aspects of sleep*. New York: Raven, 1991:185-205.
- Blatt I, Peled R, Gadoth N, Lavie P. The value of sleep recording in evaluating somnambulism in young adults. *Electroencephalogr Clin Neurophysiol* 1991;78:407-12.
- Kales A, Jacobson A, Paulson MJ, Kales JD, Walter RD. Somnambulism: psychophysiological correlates. *Arch Gen Psychiatry* 1966;14:586-604.
- Marsh GG. Neuropsychological syndrome in a patient with episodic howling and violent motor behavior. *J Neurol Neurosurg Psychiatry* 1978;41:366-9.
- Mark VH, Ervin FR. *Violence and the brain*. New York: Harper and Row, 1970.
- Saint-Hilaire JM, Gilbert M, Bouvier G, Barbeau A. Epilepsy with aggression: two cases with depth electrode studies. In: Robb P, ed. *Epilepsy updated: causes and treatment*. Chicago/New York: Year Book Medical Publ., 1980:145-76.
- Shakespeare W. *Macbeth*. New York: Bantam, 1988.
- Fenwick P. Automatism, medicine and the law. *Psychol Med Monograph* 1990;17(Suppl):1-27.
- Williams RL, Karacan I, Hirsch CJ. *EEG of human sleep: clinical applications*. New York: Wiley, 1974.