SYNCOPE AND SEIZURES*

BY

JOHN KERSHMAN

From the Department of Neurology and Neurosurgery, McGill University, and the Montreal Neurological Institute, and from the Queen Mary Veterans' Hospital, Montreal, Canada

Introduction

Syncope is a clinical syndrome usually caused by vasomotor, reflex, or psychogenic disturbances. Various authors have emphasized that syncope or fainting is sometimes difficult to distinguish from epilepsy (Weiss, 1935, 1942; Rossen, 1947), and it has long been suggested that in some instances (Gowers, 1907; Wilson, 1928; Baxter and others, 1944) syncopal attacks might be the manifestation of an epileptic disorder. In patients with syncope the electro-encephalogram between attacks is normal (Levin and others, 1945; Sugar, 1945), although the period of unconsciousness is accompanied by high-voltage slow waves which are reversible (Forster and others, 1942; Engel, 1945). In contrast, 90 to 95 per cent. of patients with clinical epilepsy have an abnormal inter-seizure record (Jasper and Kershman, 1941, 1944; Gibbs and others, 1943).

The present report deals with a group of 114 patients who had a history of syncopal attacks or similar episodes without loss of consciousness, and all of them had abnormal electro-encephalograms between attacks. None of these patients had a definite convulsive seizure. The problems of diagnosis and relation to clinical epilepsy will be discussed.

Material and Methods

Most of these 114 patients were members of the Canadian Armed Services, and 85 per cent. were between 18 and 30 years of age. Over 90 per cent. were men, and those with any evidence of other organic disease were excluded. Patients who had a history of at least one convulsive seizure were also excluded and are described in a separate study (Kershman and Elvidge, 1948).

The method of electro-encephalogram (E.E.G.) examination was essentially the same as described previously (Jasper, Kershman, and Elvidge, 1940; Jasper and Kershman, 1941). With each patient a minimum total time of thirty minutes was recorded,

various parts of the head being symmetrically explored with scalp-to-scalp and scalp-to-ear records. Hyperventilation was carried out for three minutes and the record continued for two minutes after. If the record was on the borderline of normal, it was repeated after hydration and pitressin, using the regime outlined by Penfield and Erickson (1941). In patients who had a history that alcohol was a precipitating factor in the attacks, the following was frequently carried out in addition to the standard E.E.G. The patient was given one ounce of whisky in a glass of sweetened fruit juice, and this was repeated after one and two hours. An E.E.G. was started within half an hour after the last drink.

The criteria for abnormality in the E.E.G. record are based on the author's experience with many thousands of normal and abnormal tracings in a wide variety of neurological and psychiatric conditions and in normal persons.

Abnormalities were classified as focal, diffuse, or bilaterally synchronous in accordance with the scheme previously described (Jasper and Kershman, 1941). This is preferred because it provides a better understanding of the nature of the abnormal discharges, but it does not differ as far as normal and abnormal criteria are concerned from other classifications, such as that proposed by Gibbs and others (1943). Frequencies slower than 7.5 per second and faster than 12.5 per second were considered abnormal if their amplitude was larger than the background alpha.

Results

Clinically the 114 patients could be divided into two groups: (a) in 92 patients there was a history of at least one attack in which loss of consciousness occurred; (b) in 22 patients there was no history of loss of consciousness.

In both groups the distribution of the various types of E.E.G. abnormality was surprisingly similar.

A. Spells with Loss of Consciousness.—In this group of ninety-two patients who had syncopal spells the commonest E.E.G. abnormality was a diffuse dysrhythmia which occurred in 65 per cent. (Table I). This consisted of mixed random slow

*Read at the 104th Annual Meeting of the American Psychiatric Association, Washington, May 17-20, 1948.

waves usually varying between 2 to 6 per second, or mixed fast and slow waves, with fast frequencies occasionally predominating. Characteristically in this group there was almost a complete absence of normal alpha frequencies (7.5 to 12.5 per second).

Bilaterally synchronous abnormalities were present in 29 per cent., the commonest form (17 per cent.) being 6 per second rhythms and 4, 5, and 7 per second variants. Typical 3 per second slow wave and spike discharges were infrequent, being seen in only 5.5 per cent. and variants of this activity occurred in 6.5 per cent.

TABLE I
SYNCOPE SPELLS WITH LOSS OF CONSCIOUSNESS

Type of E.E.G. abnormality	No.	%
Diffuse dysrhythmia	60	65
Bilaterally synchronous disturbances	26	29
3/sec. wave and spike	5	5.5
3/sec. variants	6	6.5
6/sec. rhythms and variants	15	17
Focal abnormality	6	6
Total ..	92	100

In 6 per cent. the pathological E.E.G. activity could be localized to a discrete cortical area, and in every instance it was in the temporal region as far as could be determined from scalp electrodes.

EXAMPLES

1. *F.R.B. Syncopal Spells with Diffuse Slow Dysrhythmia.*—This patient, a sergeant-navigator on operational duty in England, was repatriated because of two spells of unconsciousness in three years. The first occurred during training after he had been working all night. Shortly after he had his breakfast, while reading the newspaper, he suddenly felt a choking sensation, stood up and fell unconscious. He had urinary in-

continence and recovered about fifteen minutes later feeling weak and dizzy. His mother, who witnessed the attack, said that no convulsive movements occurred. The second attack happened late at night while reading. His eyes felt tired and he recalled some twitching of his lips. His air-crew comrades who saw the spell did not notice any convulsive movements but again there was urinary incontinence. There was no history of childhood seizures, no family history of epilepsy or fainting, and no history of head injury.

The E.E.G. (Fig. 1) showed diffuse slow irregularity in all head regions with no appreciable alpha. There was a definite increase in voltage and amount of abnormality with hydration. It should be emphasized that in this and subsequent examples, the E.E.G. records were taken from interseizure periods and no patient had a record during one of the actual spells described.

2. *N.W.P. Fainting Spells with Mixed Fast and Slow Dysrhythmia.*—This patient was a 29-year-old airframe mechanic referred because of fainting spells. There were about six in the past year and a half, and usually they came on when he was tired or after standing a long time at roll call, but they also occurred without any obvious cause. He gave a history of fainting easily when he cut himself and bled even slightly, or when he saw anybody else hurt. He complained of dizziness on bending over, excessive sweating, headaches, dizzy spells, blurring of vision, and heartburn with gastric pain for the past three years, usually after meals. A barium series of the gastro-intestinal tract was normal. His pulse was rapid and there was a coarse tremor of the outstretched hands. A diagnosis of anxiety neurosis had been made.

The E.E.G. (Fig. 2) showed mixed fast and slow waves, very little alpha, and a sharp increase in the abnormal activity with hyperventilation.

Comment.—A history of vasomotor instability, nervousness, postural dizziness, and frank anxiety states was quite common in patients of this group with syncope and diffuse dysrhythmia. Often the spells occurred only under special conditions of stress and fatigue, but in other cases there were no

FIG. 1.—Patient F.R.B. Syncope with diffuse slow dysrhythmia. LO-LE is the record from the left occiput to the left ear lobe. RO-RE is the record from the right occiput to the right ear lobe. The first two lines show the generalized slow irregularity in the resting record. The lower two lines show the increase in abnormality after hydration.

FIG. 2.—Patient N.W.P. Fainting spells with mixed fast and slow dysrhythmia. LF-LE is the E.E.G. from the left frontal region to the left ear lobe; RF-RE is the homologous record from the right side. The lower two lines show the marked increase in voltage and amount of abnormality with rhythmic bisynchronous tendencies after two minutes hyperventilation.

obvious precipitating factors, and there might be a vague history of fainting spells in childhood. In many patients the syncope was preceded by a brief aura of "dizziness," "blackness," "blurring of vision," or "billiousness," and these complaints sometimes occurred without loss of consciousness.

3. *G.E.S. Syncope with Bilaterally Synchronous 6 per second Waves.*—This patient was a 20-year-old airman referred because of a single fainting attack which occurred in the dentist's chair after he had had his tooth drilled. He stated that he had always been fearful of the dentist's drill since early childhood. There was a history of frequent head injuries and one maternal cousin had a history of epilepsy.

The E.E.G. (Fig. 3) was characterized by very frequent bursts of rhythmic 6 per second discharges. The amount and voltage increased with hyperventilation.

Comment.—Patients in this group with syncope and 6 per second abnormalities also frequently had precipitating factors of an emotional or painful nature. They often complained of dizziness, or "fogginess inside their head," as an aura or occurring without syncope.

FIG. 3.—Patient G.E.S. Syncope with bilaterally synchronous paroxysmal 6 per second waves. LF-LE is the record from the left frontal region to the left ear lobe; RF-RE is the homologous record from the right side.

4. *R.A.C. Fainting Spell with 3 per second Abnormalities.*—This airman, aged 21, was referred because of a single fainting spell which occurred after he had given blood at a Red Cross donor clinic. Loss of consciousness lasted several minutes and was not accompanied by convulsive movements.

The E.E.G. at rest was normal (Fig. 4). After one minute of hyperventilation, paroxysmal bisynchronous 2 to 3 per second waves appeared which quickly formed rhythmic patterns. Some of this abnormality was still present one and a half minutes after the end of over-breathing. Hyperventilation was repeated after 75 g. of glucose and showed the same effect.

Comment.—Patients in this group with 3 per second abnormalities did not usually have the auras, vasomotor complaints, or symptoms of anxiety commonly seen in the patients with diffuse dysrhythmias and those with 6 per second abnormality.

There were six patients with syncopal spells who had a focal abnormality. In all of them, slow waves were present in and around the right temporal region.

5. *G.R.C. Focal Right Temporal Abnormality.*—This patient was a 24-year-old Flying Officer who was sent home from active duty in England because of three spells, all occurring during flying. In one of them, he suddenly fainted after complaining of a midfrontal headache for about half an hour. In the other two, he had the same headache followed by what was described as bizarre behaviour lasting for two hours. He had no recollection of these episodes other than the headache. Because of the spells, an R.A.F. psychiatrist in England repatriated him with the diagnosis of "constitutional neurosis."

The *E.E.G.* (Fig. 5) showed a clear focus of slow wave activity localized to the right temporal region.

Comment.—Periods of mental confusion and bizarre behaviour were frequent in these patients

and it seems clear from the history and the *E.E.G.* that these were probably ictal automatisms, originating from the temporal region.

B. Spells Without Loss of Consciousness.—In twenty-two patients, there were *episodic disturbances* which were never accompanied by either loss of consciousness or a convulsion. These episodes were similar to the auras seen in many of the ninety-two patients described above with syncope, and often occurred without loss of consciousness in the same patients. Engel (1945) and Stead (1947) have described similar phenomena as "fainting reactions." There were periods of sudden transient dizziness, blurring of vision,

Fig. 4.—Patient R.A.C. Fainting spell with bilaterally synchronous 3 per second waves. LF and RF are the left and right frontal regions, LO and RO are the left and right occipital regions; LE and RE refer to the left and right ear lobes. The upper four lines are the resting record. This is followed by strips at one minute of hyperventilation and at three minutes of hyperventilation showing pathological discharges of bilaterally synchronous high voltage 2 to 3 per second rhythmic waves. Slow irregular waves were still present one and a half minutes after the end of overbreathing as shown in the lower four lines.

FIG. 5.—Patient G.R.C. Focal right temporal lobe discharges. LC-LT is the E.E.G. from the left central to the left temporal region; LT-LE is left temporal to the left ear lobe; RC-RT and RT-RE are the homologous regions on the right side and show slow waves at 1 to 2 per second localized to the right temporal region. The spells consisted of headache and automatisms, and on one occasion there was loss of consciousness.

sometimes accompanied by abdominal sensations (similar to the patients described by Moore (1948)), feelings of weakness without loss of consciousness, or "blackout." The term "blackout" is a by-product of the last war and many patients used it to describe a variety of different subjective feelings. It should be emphasized that only a few of the very many who described this symptom had an abnormal E.E.G. and came into this group under discussion.

Just as in the group with loss of consciousness, the commonest E.E.G. abnormality was a diffuse dysrhythmia, occurring in the same proportion, or 64 per cent. (Table 2). Bilaterally synchronous abnormalities were present in 36 per cent., the commonest (31 per cent.) being bisynchronous 6 per second rhythms and its variants. There were no typical 3 per second wave and spike patterns, and only one patient showed a variant of this abnormality.

EXAMPLES

6. *B.P.O'C. Spells with Diffuse Dysrhythmia.*—This airman aged 19 was referred because of spells of dizziness, weakness, nausea, sweating, and "things go black

sometimes." These spells occurred about once a month for the past three years and lasted from a few seconds to a few minutes. There was a family history of instability and the patient showed maladjustment in his childhood and work history. A tentative diagnosis of "anxiety neurosis with petit mal" was made.

The E.E.G. (Fig. 6) showed a poorly organized background containing very little normal alpha and there was slow activity with waves at 2 to 6 per second showing only occasional rhythmic tendencies.

7. *A.G. Spells with Bisynchronous 6 per second Waves.*—This patient, aged 26, was referred for spells of giddiness with sweating which came on every two to three weeks for the past few years, lasting about one to two minutes. At times, the spells were accompanied by what he described as "blackouts" in which he fell to the ground, but careful questioning showed that he did not lose consciousness. There was a history of emotional instability in childhood and periods of irritability at the time of referral, as well as frequent frontal and generalized headaches.

E.E.G. (Fig. 7). The resting record showed a poorly organized alpha with low voltage 6 per second paroxysmal waves. The latter were increased with hyperventilation and persisted quite a long time after.

FIG. 6.—Patient B.P.O'C. Spells of weakness, nausea and dizziness with diffuse dysrhythmia. LF-LC is the E.E.G. from the left frontal to left central regions, RF-RC from the right homologous area, LP-LO from the left parietal to left occipital regions and RP-RO from the right homologous region.

Comment.—The predominant symptoms of the patients in this group were dizziness, sweating, nausea, and weakness which came on suddenly and usually without any obvious cause. These might be described as periodic episodes of vasomotor hyperactivity, and it was often accompanied by subjective anxiety.

The next example illustrates that in one patient of this group a generalized convulsion could be precipitated under hydration although it had never occurred spontaneously.

TABLE II
EPISODIC DISTURBANCES WITHOUT LOSS
OF CONSCIOUSNESS

Type of E.E.G. abnormality	No.	%
Diffuse dysrhythmia	14	64
Bilaterally synchronous disturbances	8	36
3/sec. wave and spike	0	0
3/sec. variants	1	5
6/sec. rhythms and variants	7	31
Focal abnormality	0	0
Total ..	22	100

8. *T.D.E. Dizzy Spells with Diffuse Dysrhythmia and Convulsion under Hydration.*—This airman, aged 18, complained of spells which occurred very frequently—about six to seven times a week for the past year. The spells were described as “dizziness” or “moments of blankness.” He could usually feel the spell coming on and it lasted from one to a few minutes; after it he felt slightly depressed.

Hydration was carried out to see if these attacks could be witnessed, and E.E.G. examination was done before and after. During the hydration test, a seizure was observed by the nurse as follows: The patient appeared confused for a few moments and this was followed by a generalized tonic convulsion, then a mild clonic phase.

After this, he went into a deep sleep from which he could not be roused for about half an hour.

The resting E.E.G. (Fig. 8) showed a poorly organized background consisting largely of irregular slow waves. With hyperventilation there was a rapid increase in slow wave discharges with a tendency for them to become rhythmic and paroxysmal. During hydration, the E.E.G. showed diffuse irregular slow waves and with hyperventilation, there were high voltage 3 to 6 per second waves which frequently became rhythmic and persisted longer than half a minute after overbreathing stopped.

Comment.—It is apparent that this example is a link between patients who have mild transient episodes without loss of consciousness and those who under certain circumstances (hydration in this instance) may have a generalized convulsion with loss of consciousness. Both groups have a similar type of diffuse E.E.G. dysrhythmia and the convulsion is a more severe clinical manifestation of the same disorder which causes the sudden transient dizziness or “moments of blankness.”

Discussion

The association between interseizure E.E.G. abnormalities and syncopal spells confirms what has long been suspected, namely, that in some patients syncope may be primarily cerebral in origin and epileptic in character.

In syncope from any other cause, loss of consciousness is secondary to cerebral ischemia resulting from a sudden decrease in intracranial blood supply (Weiss, 1935; Rossen, 1947; Engel, 1945). This change is accompanied by the sudden appearance of E.E.G. abnormalities which disappear with the return of consciousness. However, the patients described in this report had a pathological E.E.G. between spells, the abnormalities were of the same kind as occur in clinical epilepsy and responded in the same way by increasing during hyperventilation and hydration.

FIG. 7.—Patient A.G. Spells of giddiness, sweating, and “blackout” with 6 per second waves. The markings are similar to previous records. The lower two lines show the persistence of exaggerated amount of abnormality one and a half minutes after the end of hyperventilation.

FIG. 8.—Patient T.D.E. Spells of dizziness and moments of blankness with diffuse dysrhythmia and convulsion under hydration. LF and LO are left frontal and occipital records to the left ear. RF and RO are right homologous records. Under hydration and 2 minutes of hyperventilation as shown in the lower four lines the slow waves become much higher in voltage and organized into rhythmic bisynchronous patterns.

The occurrence of a pathological E.E.G. in the resting state is of decisive value in differentiating between simple syncope and epileptic states (Schwab, 1943; Silverman, 1944; Roseman, 1944) and in patients suspected of epilepsy, even minute and evanescent E.E.G. disturbances (Williams, 1944) may indicate epileptic activity.

Clinically, the patterns of the spells are exactly like the vagal and vasovagal attacks described by Gowers (1907), including the fact that they often occur with physical and emotional strain and are frequently seen in patients with neuroses. Of particular historical interest, is the fact that in a footnote Gowers stated that "some of the symptoms have been described in other associations by Freud . . . and others, especially in connexion with 'neurasthenia'!"

Wilson (1928, 1940) has suggested that such spells are due to discharges from the neurosympathetic ganglia around the third and fourth ventricles and proposed the term "periventricular epilepsy." The character of the E.E.G. abnormalities seen in many of these patients lends considerable support to this hypothesis. Most commonly (in 65 per cent.) the alpha rhythm was absent and replaced by diffuse slow waves or mixed fast and slow activity. Experimentally, bilateral disappearance of the cortical alpha occurs following hypothalamic lesions (Keenard, 1943; Obrador, 1943) and it is replaced by generalized irregular slow waves. Electrical stimulation of the hypothalamus (Grinker and Serota, 1938; Murphy and Gellhorn,

1945 a and b) produces a marked generalized excitatory effect over the entire cortex bilaterally with facilitation to simultaneous subclinical cortical stimulation. Localization of the functional disorder to the hypothalamus in these patients would explain both the E.E.G. findings and the clinical manifestations.

The second largest group of patients (22 per cent.) had bisynchronous 6 per second waves and variants, and it has recently been shown both clinically (Cobb, 1944; Walter and Dovey, 1944; Lennox and Brody, 1946) and experimentally (Jasper and Drooglever-Fortuyn (1947) that this type of abnormality is also subcortical in origin.

In a small number (6 per cent.), the abnormal discharges were localized to the temporal region and episodes of bizarre behaviour occurred which were probably ictal automatisms, in addition to spells with loss of consciousness. It is of interest that from the nature of these spells, they would be called "psychomotor seizures" according to the classification of Gibbs and others (1938), yet 4 to 7 per second waves were not the most prominent feature of the interseizure record. The abnormality was mainly random 1 to 3 per second slow waves with some sharp discharges.

It is felt that the twenty-two patients without loss of consciousness had a milder type of the same disorder as was present in the ninety-two who had a history of loss of consciousness. A more severe manifestation is the appearance of generalized convulsions which occurred in one instance

(example 8, T.D.E.) during hydration. A group of patients with similar E.E.G. abnormalities in whom infrequent convulsions occurred spontaneously are reported elsewhere (Kershman and Elvidge, 1948).

The question of a name for this syndrome requires consideration. A year ago similar patients were reported (Goodwin, 1947; Proctor, 1947) who showed vasomotor instability, changes in consciousness, and variations in the E.E.G. They were included with a group of patients who had other and quite different clinical manifestations, such as headache, personality disorders, grand mal, and a condition called "hysteroid Jacksonian" attacks. Because the E.E.G. between spells showed what was described as "psychomotor activity" and "alpha variants," the term "epileptiform syndrome" was applied to all these conditions.

The term "psychomotor activity" is derived from Gibbs and others (1937) who discovered that clinical "psychomotor attacks" were accompanied by slowing of the electrical activity of the brain (usually illustrated by high voltage 4 to 7 per second waves). This E.E.G. pattern was called "psychomotor discharge" and the name became attached to 4 to 7 per second waves wherever and whenever they occurred. The increasing use of electro-encephalography in a wide variety of different neurological and psychiatric conditions has demonstrated similar abnormalities in many of them. As a result, many clinical states, including headache, behaviour problems in children, emotional instability, psychopathic personality, etc., showing so-called "psychomotor discharge" have been referred to as "epileptoid," "epileptiform," or "epileptic equivalents." By gradual extension these conditions have been allied to what Gowers described as "the borderland of epilepsy."

It is felt that the term "psychomotor activity" as applied to the E.E.G. is quite misleading in its implications. Frequencies at 4 to 7 per second commonly occur in a wide variety of conditions without any suggestion of clinical epilepsy (Jasper, Kershman, and Elvidge, 1940; Cobb, 1944; Walter and Dovey, 1944; Finley and Dynes, 1942). The commonest form of abnormality in any kind of intracranial neoplasm, for example, was 4 to 7 per second activity (Kershman, Conde, and Gibson, in the press) and bore no relation to the occurrence of "psychomotor" or any other type of epilepsy. So-called "psychomotor epilepsy" or automatisms may be either ictal or post-ictal and related to lesions involving either the temporal or frontal regions (Penfield and Erickson, 1941; Penfield, in the press). In many instances, as illustrated by example 5, G.A.C. above, patients with spells that might be called "psychomotor" do not have 4 to 7

per second waves between attacks and may only show slower activity, sharp waves, or spikes localized to the temporal regions (Jasper and Kershman, 1941).

In clinical epilepsy, the chief value of the E.E.G. is to localize, if possible, the source of the "abnormal excessive neuronal discharge," and if properly used it does so in very many instances. What the relation is between the electrical activity and the occurrence of a clinical seizure is not known. Until this is clearer, as well as for other reasons, it would seem inadvisable to extend the clinical meaning of the term "epilepsy" to embrace a number of different conditions in which there may be E.E.G. abnormality; especially if the clinical manifestations do not have the periodic and explosive quality of a seizure and the form of the E.E.G. abnormality is not exclusive to epileptic states. In the case of "alpha variants" it is not even certain that an E.E.G. abnormality is present.

There still remains the problem of terminology for the syndrome consisting of syncopal spells with an abnormal E.E.G. and epileptic origin. Though the aetiology is not known, it is probably related to cryptogenic or idiopathic epilepsy.

In most of these patients, however, the syncopal spells were infrequent and no convulsions had occurred. The term "epilepsy" carries with it important personal, social, and economic stigma which, though frequently unjustified, must be faced realistically by the physician who attaches the label to a patient. For these reasons the term "cerebral syncopal seizures" or "encephaloscope" is suggested. This designation is descriptive of the origin and clinical nature of the seizure. It is felt that the condition has its localization in or near the hypothalamus and is related to other forms of idiopathic epilepsy. If the attacks become frequent and convulsive, as it may in some instances, then the term idiopathic epilepsy becomes inevitable.

Summary and Conclusions

1. One hundred and fourteen patients have been described having syncopal spells and episodes of transient dizziness, blurring of vision, "blackout," abdominal sensations, and weakness with or without loss of consciousness. No definite convulsions occurred in any of them although in one instance a seizure was produced during the hydration and pitressin test.

2. All these patients had pathological E.E.G. records between spells, the commonest type of abnormality being a diffuse dysrhythmia (65 per cent.).

3. These spells were essentially the same as the vagal and vasovagal attacks described by Gowers

and the E.E.G. disturbances indicate that they are fundamentally epileptic in character.

4. The form of the pathological E.E.G. abnormality and the character of the spells suggest a subcortical and probably hypothalamic origin.

5. For this reason, and the fact that convulsive seizures do not occur, and also because of the personal and social stigmata attached to the diagnosis of epilepsy, the term "encephalosyncope" is suggested as a diagnosis for these patients. It is in effect a mild form of idiopathic epilepsy.

6. In several instances a focal abnormality in the temporal region can be isolated by the E.E.G. and these patients have ictal automatisms. These are cases of focal cortical temporal lobe seizures.

7. The term "psychomotor discharges" is misleading when used to describe an E.E.G. abnormality since so-called "psychomotor" attacks are not always associated with such discharges and vice versa. Attempts to correlate this pattern of E.E.G. abnormality with clinical syndromes may lead to considerable confusion.

REFERENCES

- Baxter, N. E., White, C. S., Watts, D. T., and Abbott, W. D. (1944). *Nav. med. Bull., Wash.*, **42**, 1103.
- Cobb, W. A. (1944). *J. Neurol. Psychiat., Lond.*, n.s. **7**, 96.
- Engel, G. L. (1945). *J. Mt. Sinai Hosp.*, **12**, 170.
- Finley, K. H., and Dynes, J. B. (1942). *Brain*, **65**, 256.
- Forster, F. M., Roseman, E., and Gibbs, F. A. (1942). *Arch. Neurol. Psychiat., Chicago*, **48**, 957.
- Gibbs, F. A., Gibbs, E. L., and Lennox, W. G. (1937). *Brain*, **60**, 377.
- , —, — (1938). *Arch. Neurol. Psychiat., Chicago*, **39**, 298.
- , —, — (1943). *Ibid.*, **50**, 111.
- Goodwin, J. E. (1947). *Amer. J. Psychiat.*, **104**, 369.
- Gowers, W. R. (1907). "Borderland of epilepsy: faints, vagal attacks, vertigo, migraine, sleep symptoms and their treatment." J. and A. Churchill, London.
- Grinker, R. B., and Serota, H. M. (1938). *J. Neurophysiol.*, **1**, 573.
- Jasper, H. H., and Droogleever-Fortuyn, J. (1947). *Res. publ. Ass. nerv. ment. Dis.*, **26**, 272.
- , and Kershman, J. (1941). *Arch. Neurol. Psychiat., Chicago*, **45**, 903.
- , — (1944). Proc. Fifth Meeting, Associate Committee med. Res., Report No. C6123, N.R.C. (Canada).
- , —, and Elvidge, A. (1940). *Arch. Neurol. Psychiat., Chicago*, **44**, 328.
- Kennard, M. A. (1943). *J. Neurophysiol.*, **6**, 405.
- Kershman, J., Conde, A., and Gibson, W. (to be published). "EEG in the differential diagnosis of supratentorial tumours."
- , and Elvidge, A. R. (1948). *Trans. Amer. neurol. Ass.*,
- Lennox, M., and Brody, B. S. (1946). *J. nerv. ment. Dis.*, **104**, 237.
- Levin, S., Katz, J., and Greenblatt, M. (1945). *Amer. J. Psychiat.*, **102**, 30f.
- Moore, M. T. (1948). *Rev. Gastroent.*, **15**, 381.
- Murphy, J. P., and Gellhorn, E. (1945a). *J. Neurophysiol.*, **8**, 341.
- , — (1945b). *J. Neurophysiol.*, **8**, 431.
- Obrador, S. (1943). *Ibid.*, **6**, 81.
- Penfield, W. G. "Classification of the Epilepsies." *Arch. Neurol. Psychiat., Chicago*. To be published. (Read at Montreal Medico-Chirurgical Society, Dec. 1946.)
- , and Erickson, T. C. (1941). "Epilepsy and Cerebral Localization." Charles C. Thomas, Springfield, Illinois.
- Proctor, L. D. (1947). *Amer. J. Psychiat.*, **104**, 380.
- Roseman, E. (1944). *Ibid.*, **101**, 349.
- Rossen, R. (1947). *Ibid.*, **104**, 391.
- Schwab, R. S. (1943). *J. nerv. ment. Dis.*, **98**, 68.
- Silverman, D. (1944). *War Med.*, **5**, 163.
- Stead, E. A. Jr. (1947). "Fainting" in "Signs and Symptoms." Ed. Cyril M. MacBride. J. P. Lippincott Co., Philadelphia.
- Sugar, O. (1945). *War Med.*, **8**, 9.
- Walter, W. G., and Dovey, V. J. (1944). *J. Neurol. Neurosurg. Psychiat.*, n.s. **7**, 57.
- Weiss, S. (1935). "Syncope and Related Syndromes." In Oxford Medicine, Oxford University Press, New York. Vol. 2, Chap. 8A, p. 250.
- (1942). *J. Amer. med. Ass.*, **118**, 529.
- Williams, D. (1944). *Brain*, **67**, 10.
- Wilson, S. A. K. (1928). *J. Neurol. Psychopath.*, **8**, 223.
- (1940). "Neurology." Ed. A. N. Bruce. Edward Arnold, London. 2 vols.