REFLECTIONS ON ONE HUNDRED CAPITAL CASES SUBMITTED TO ELECTROENCEPHALOGRAPHY.*

By DENIS HILL, M.B., F.R.C.P.,

Senior Lecturer, Department of Clinical Neurophysiology, Institute of Psychiatry, University of London; Physician in Psychological Medicine, King's College Hospital,

and

D. A. POND, M.R.C.P., D.P.M.,

Senior Lecturer, Department of Clinical Neurophysiology, Institute of Psychiatry, University of London.

DURING the last eight years the E.E.G.'s of over 100 persons awaiting trial on charges of murder have been examined, at first at Sutton and since 1947 at the Maudsley Hospital. While a few cases were seen during the war, the majority of these prisoners have been examined since the end of hostilities and about 50 of them between 1948–1950. It is difficult to assess to what extent this group constitutes a cross-section of the murderer population. During the four years 1945–48 inclusive some 300 prisoners were committed for trial at Assizes over the whole country on the charge of murder and this is the stage at which the majority of our subjects have been examined.† Some 50 prisoners were examined during this period so that approximately one-sixth of all cases have been seen here. There were no formal criteria of selection, which was usually made by the prison medical officers, but inevitably there has been a greater concentration within the group of individuals suspected of epilepsy or brain disease. Nevertheless, in the last two years the majority of prisoners accused of murder in the London area and home counties have been examined. At the time when the examinations were made, we were supplied in each case with full clinical details and some information regarding the alleged crime by the prison medical officer. By far the largest number of such prisoners has come to us from Brixton Prison. We are greatly indebted to Dr. J. C. Matheson, Dr. Hugh Grierson, Dr. F. H. Taylor, as well as to medical officers of other prisons throughout the country, who have given us all the information available and have collaborated with us in an invaluable way in our investigations.

Stafford-Clark and Taylor (1949) have reviewed the first 64 of these cases and published their findings. These results were presented as evidence before the Royal Commission on Capital Punishment, and the series was then increased to 94 cases by the inclusion of a further 30 examined since Stafford-Clark and

* Based on papers given at the Annual General Meeting of the R.M.P.A. at Leicester, July, 1950.

† Evidence presented before the Royal Commission on Capital Punishment 1–2.

https://doi.org/10.1192/bjp.98.410.23 Published online by Cambridge University Press

Taylor had made their study of the material. This second group was studied clinically by Dr. Taylor and Dr. Matheson of Brixton Prison. These 94 cases constitute the material which, until now, has been worked up from the clinical point of view as far as it will be possible to do so. However, since then more than a further 15 cases have been added, although the historical data on some of them are not yet complete. While the total number (of prisoners) is now over 110, it is only possible to include 105 of them for most purposes in this paper.

The Clinical Histories.

Only 6 women have been examined. The series includes normal, abnormal and psychopathic personalities, individuals suffering from psychoses, mainly schizophrenic or depressive and a number of mental defectives, epileptics and men suffering from organic states of various kinds. The age range varies from 12 to 59 years but the majority of the crimes were committed by men between the ages of 20 and 30 years (55 cases). Thirteen of the prisoners were under the age of 20 years.

In 37 cases the family histories showed significant morbidity. Of the first degree relatives, in 13 cases suicide or psychosis had occurred; there were 5 cases of epilepsy. Of the fathers of these prisoners, 9 were alcoholic, 1 was epileptic, 3 were insane. While in many cases the early environments were no doubt disturbed, in only 8 cases were the prisoners illegitimate or came from broken homes. Ten had been either in Borstal or Home Office schools. Curiously, the incidence of physical deformities among these murderers was high, being present in 13 cases. There were 2 cases of psoriasis, 2 of deafness (1 using a hearing aid), 4 were lame, 1 had much reduced vision, 1 severe disseminated sclerosis with ataxic gait, and there were cases with amputated fingers, facial palsy and paralysis of an arm from injury.

Assessment of personality is always a difficult matter under the conditions that obtain before a murder trial, owing to the conflicting interests which are evident, but 30 of these prisoners were regarded as having personalities within normal range, 38 others were classified as either abnormal or psychopathic. In 9, previous convictions in the courts were known; 10 had defect of intelligence amounting to borderline mental deficiency. In 15, definite epileptic seizures were known to have occurred, 16 were finally categorized as suffering from depressive or schizophrenic psychoses and 6 from organic cerebral states. This list is an under- rather than over-estimate of the morbid factors in these cases, and it makes a strong case for the view that this group of capital cases is a psychiatrically abnormal population.

Type of Crime.

In their paper, Stafford Clark and Taylor (1949) divided the prisoners according to the crimes of which they stood charged, into 5 groups, a division which proved very successful. These groups were:

(1) Killing incidental to the commission of another crime or in self-defence.

https://doi.org/10.1192/bjp.98.410.23 Published online by Cambridge University Press

(2) Killing in which a clear motive was apparent or which resulted from violence during the commission of another crime.

(3) Killing which was apparently motiveless, or in which the motive was very slight.

(4) Killing with a strong sexual element—a group which included only those in which sexual activities of some kind occurred at the time of murder.

(5) The killings by insane persons who were either unfit to plead or were found insane at trial or later at a statutory enquiry.

Using this grouping, the further 30 cases already mentioned were added by Dr. Taylor and one of us (D. H.) with Dr. Matheson's help.

Fig. 1 shows the number of cases in each of these groups and the incidence of abnormal E.E.G.s among them.

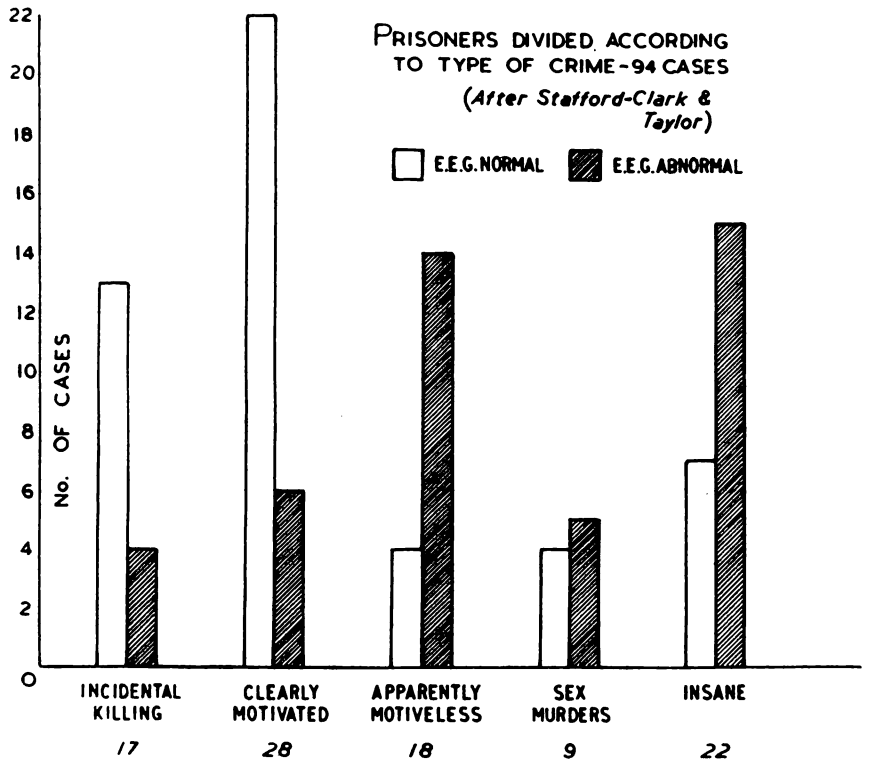

FIG. 1.

These results on the larger series only underline the findings of Stafford-Clark and Taylor. They show, as one would expect, that the "accidental" murders are committed by men among whom there is no greater evidence of E.E.G. abnormality than among the normal population. The "clearly motivated" murders are committed by a group of men among whom the incidence of E.E.G. abnormality is about the same as the neurotic population, or the prison population in America (Silverman, 1943 and Gibbs *et al.*, 1942).

The insane group contains more persons with abnormal E.E.G.s than normal ones and as a group compare probably with the admission ward of a mental hospital. The sex murderers are too small a group to consider, and the most important observation which was made by Stafford-Clark and Taylor, is the very high incidence of abnormal E.E.G.s among Group 3, the prisoners whose crimes were apparently motiveless or with very slight motive. The crimes in many of these cases were indeed remarkable. Eighteen of the 94 murders were in this group. Two were detailed by Stafford-Clark and Taylor. Further examples are :

CASE 3.—A man, aged 22, of low average intelligence was looking after his 2-year-old step-daughter while his wife was out. The child would not stop crying so he picked her up by the heels and swung her round so that her head struck the fire grate. He also kicked and punched her, so that she died of her injuries.

CASE 12.—A soldier, aged 23, of dull intelligence, who had once attempted suicide, had marched 10 miles and was on guard duty one night in 1942. On leaving guard he went to the cook-house and called " Is there any tea, George, lad? " The cook replied, " No—get on your duty." The soldier then swore and fired his rifle at close quarters into the cook's abdomen, killing him. When later the officer asked who fired, the young soldier came forward.

CASE 34.—A young man of 22 had deserted from the R.A.F. He and his wife and baby went to stay in the house of a former mistress. In the presence of his wife he battered in the head of this woman with a hammer while she sat in a chair, and then killed the woman's baby who was crying. The victim had told him not to play the fool with the light switch which he had been turning on and off to irritate her.

THE ELECTROENCEPHALOGRAPHIC FINDINGS.

Of the 105 cases, 55 had normal and 50 abnormal E.E.G.s. The percentage abnormality falls off with age until the age group of 40-year-olds is reached when there is again a slight increase in E.E.G. abnormality (Fig. 2). This type of distribution curve is very similar to the curve for such abnormalities in the psychiatric population, the first and falling part of the curve being that associated, we consider, with those E.E.G. anomalies which reflect a constitutional immaturity of cerebral function. The latter part, when an increase of abnormality is witnessed, we might infer as being related to the advent in patients over 40 of the degenerative cerebral disorders. The clinical states of these prisoners over 40 years of age go some way to support the organic diagnosis. Six of 15 were found insane, only 1 was executed. Five had depression, 4 were chronic alcoholics and there were one each of disseminated sclerosis, mental deficiency with possible sleep paralysis, epilepsy with alcoholism, organic dementia, psychosis (unspecified) and doubtful dementia. Except in the depressive cases and 3 of the alcoholics, all the E.E.G.s were abnormal.

Turning now to the categories and degrees of E.E.G. abnormality, we may classify these, as was done by Stafford-Clark and Taylor (1949) into :

1. " Mild unspecific "—the anomalies found in so many neuropsychiatric patients, and probably of constitutional origin.

2. The " severe unspecific abnormalities " which may be of constitutional origin, but always raise the doubt of an acquired pathology, and lastly,

3. The focal abnormalities and the epileptic phenomena.

There is little that can be said regarding the first group, the "mild unspecific" abnormality. Between 10 and 15 per cent. of the general population show these patterns and therefore it would perhaps be more proper to call them anomalies rather than abnormalities. Nevertheless, there is a well-established relationship between this type of E.E.G. and general social and psychological insufficiency.

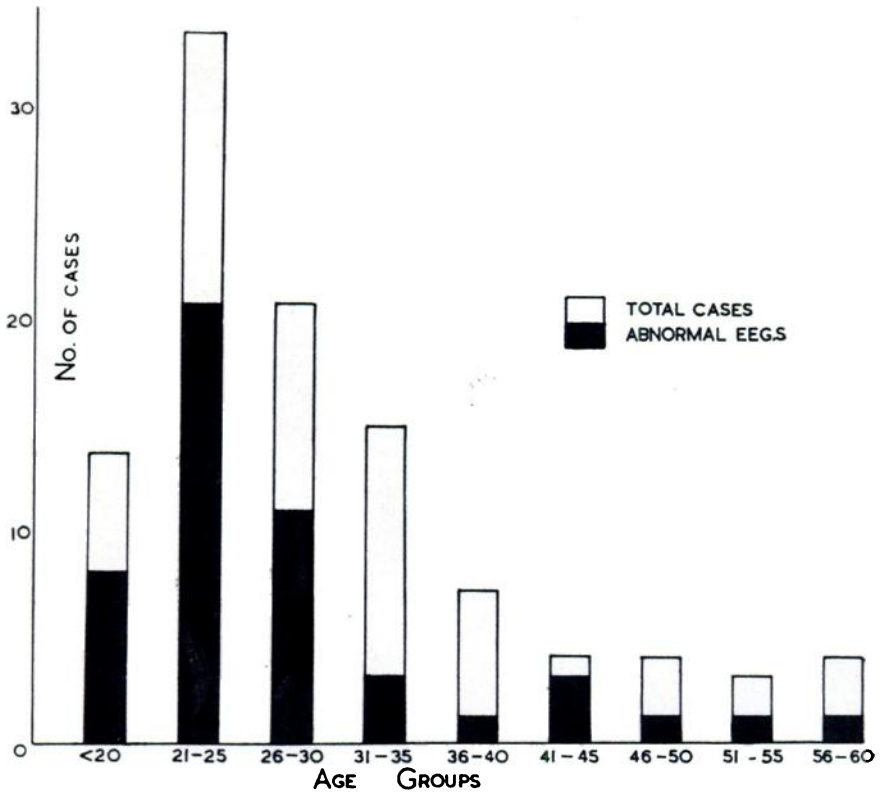

FIG. 2.—Percentage of abnormal E.E.G.s in the 105 cases divided into age groups.

It will be simplest to consider all the cases with severe E.E.G. abnormalities together but to treat the cases showing epileptic activity separately. There are 13 cases with severe E.E.G. abnormalities without any evidence of epileptic activity. These are summarized in Table I. Five of the E.E.G.s contained a focal abnormality suggesting a local pathology; in the remaining 8, the abnormalities were diffuse. Their personal histories and clinical states indicate a great loading of morbidity of all types, 4 were known to have had epileptic seizures at some time. Fig. 3, 4, 5*b* and *c* are illustrations of the type of E.E.G. abnormalities.

What possible significance may be attached to these abnormal E.E.G. findings in relation to the causation of crime? Social custom and the law have long recognized some physiological factors as mitigating the extent to which the person may be said to be personally responsible, e.g., children cannot

TABLE I.—*Severe E.E.G. Abnormality—Diffuse or Focal (Excluding Epileptic E.E.G.s).*

Case No.	Age.	Crime Category.	History.	Crime.	E.E.G.	Result.
12	23	3	Near M.D. Attempted suicide. G.F. suicide	Shot cook in Army with little motive	D	G.Rep.
15	27	3	Alcoholic. Abnormal personality — aggressive, quick tempered	Killed woman who bothered him after drinking	D	Mans.
25	16	3	"Constitutional psychopath"	Killed brother for no apparent reason	D	G.H.M.P.
27	23	3	Two brothers deaf and dumb. Psychopath with sadistic and masochistic perversions	Charged with shooting N.C.O. in his billet	F	N.G.
35	?	5	Epileptic colony 8 years. Acute depression	Strangled wife in bed	D	I.A.
47	22	1	Gross physical disabilities from osteomyelitis. "Immature adolescent"	Killed "accidentally" while committing a robbery	D	Mans.
53	34	2	Two head injuries. Thirteen previous convictions. Two epileptic fits	Murder while committing a robbery	F	G.Ex.
56	29 ♀	3	Head injury and fits as a child. *Petit mal* seen in prison. Father epileptic	Murdered own child aged 6 and kept body in suitcase for three months	D	?
60	26	5	Schizophrenia. F. insane, M. unstable	Murdered two people without obvious cause	D	G.I.
72	40	5	Organic dementia, ?cause	Murdered girl who was pregnant by him	F	G.I.
82	17	1	Fugues, ? epileptic	Accused of murdering infant	F	N.G.
94	21	3	? Schizophrenia. ? Cerebral disease	Killed his fiancée with very little motive	F	G.Ex.
100	22	3	Two M.D.'s and suicide in family. ? Psychopath	Murdered schoolboy without known motive	D	Mans.

Crime Category.—1 = "Accidental." 2 = Motivated. 3 = Apparently motiveless. 5 = Insane.
E.E.G.—D = Diffuse. F = Focal abnormality.
Result.—G.Rep. = Guilty, reprieved. G.Ex. = Guilty, executed. I.A. = Insane on arraignment. G.H.M.P. = Guilty, detained at His Majesty's pleasure. G.I. = Guilty, insane. N.G. = Not guilty. Mans. = Manslaughter.

commit murder or rape, and certifiable mental defect may affect the disposal under certain conditions. Similarly, acts committed in states of physical illness causing confusional states are not held to be liable to the severest penalties.

However, there is no need to discuss here these well-recognized developmental defects and acquired disturbances of the physical basis of mental function. On surveying the 110 capital charge cases, few can be included under this heading. Also crimes committed in episodes of schizophrenic or manic-depressive psychoses will not be discussed, since the mechanisms leading to the crime are in these cases more usefully discussed in psychopathological terms. Exclusion of these groups still leaves some 45 cases where there are abnormal E.E.G. findings or a definite history of epilepsy, whose relationship

to the crime and the criminal remain to be investigated. Of this number 18 are epileptics and the rest show the non-specific "constitutional" E.E.G. anomaly.

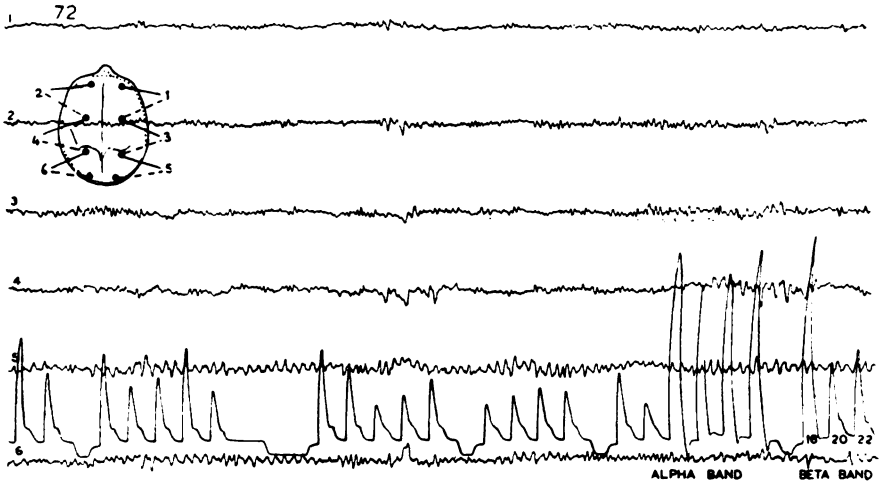

FIG. 3 (Case 72).—A 40-year-old man suffering from an early organic dementia of undetermined cause. Note the presence of irregular sharp and slow waves, especially in the left temporal region (Channel 4).

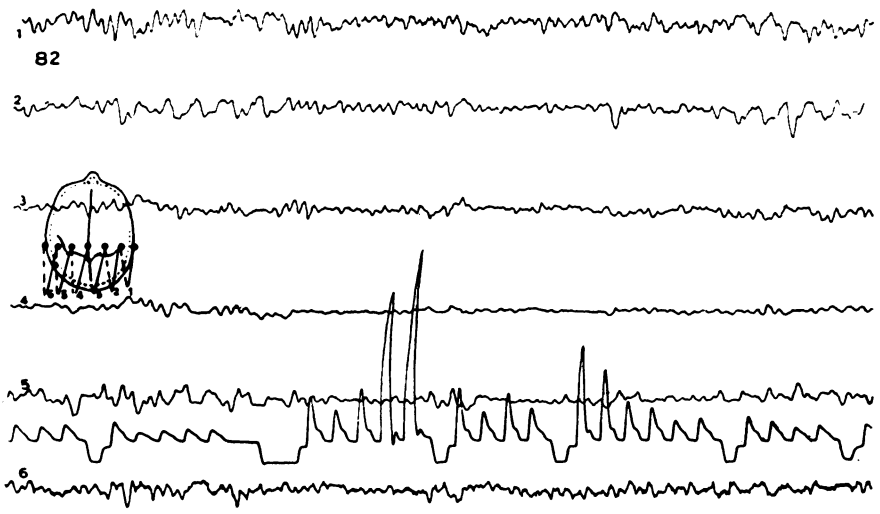

FIG. 4 (Case 82).—A 19-year-old boy with a history of fugue states, possibly post-ictal. Note the focus of 3½ c./sec. activity in the right posterior temporal region.

EPILEPSY.

The relationship to epileptic phenomena is one which is of course of the greatest immediate medico-legal importance. It often happens, as everyone knows, that the defence of epileptic automatism in a hopeless case is offered by Counsel. It is a common happening to find psychiatrists supporting such

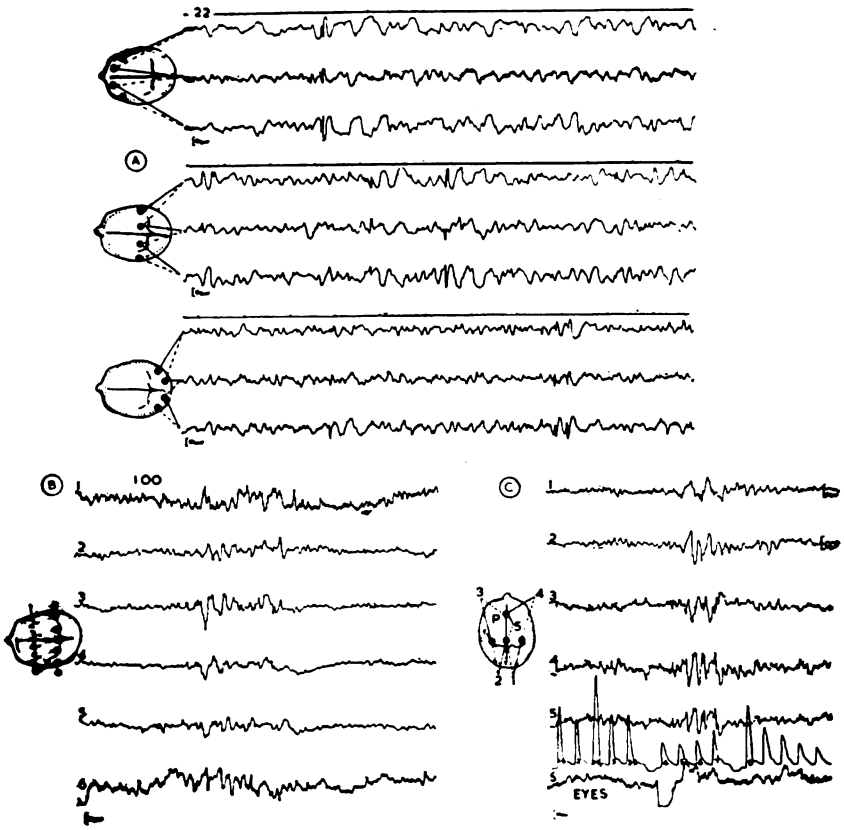

FIG. 5 (*a*) (Case 22).—A 29-year-old woman who suffered from major seizures for years and showed considerable mental deterioration. Note the bilaterally synchronous spike and wave in all areas and the excess of general slow activity. (Note the paper-speed in this record is slower than in all the others.) (*b*) and (*c*) Case 100).—A 22-year-old man with a psychopathic history, who murdered a schoolboy. The records show excess of slow activity which appears to be bilaterally synchronous. (*c*) is a record taken with a pharyngeal lead (d). (The time scale in this record is as in the other figures.)

a defence with medical evidence, and yet when the accused's statement about his activities at the time of the crime is produced and when all the facts are known, only very rarely is this defence accepted. In the light of these facts and opinions, it is astonishing what a great number among these 110 prisoners either show epileptic activity in their E.E.G.s, or, and this in the present state of knowledge is more important, were known to have had epileptic seizures at some time in their lives. Those cases showing possible epileptic activity have been divided into three groups :

1. Those with specific epileptic E.E.G.s (Table II).
2. Those with no epileptic activity in the E.E.G. but a proven previous history of epileptic seizures (Table III).
3. A history of possible, but not proven, previous epilepsy (Table IV).

https://doi.org/10.1192/bjp.98.410.23 Published online by Cambridge University Press

There were 9 cases in each of these 3 groups, making 27 in all, of whom 18 could be regarded either on clinical or E.E.G. evidence as being definitely epileptic (Tables II and III).

Five of the first group were chronic epileptics and 3 were known to have personality changes, psychoses or mental deterioration. Two had been in mental hospitals, one as a certified patient (Case 2). Three were not known to have epilepsy, though 1 had a family history of epilepsy and psychoses (Case 22, Fig. 5*a*). Only 2 were executed.

TABLE II.—*Specific E.E.G. Epileptic Group.*

Case No.	Age.	History.	Crime and Category.	Result.
2	25	Chronic epilepsy with personality disorder. Previously certified patient	Quarrelled with wife over her friends and strangled her. (Cat. 5)	G.I.
5	26	Family state "epileptic fits." Low intelligence. Alcoholic. H.I.	Rape and murder of 69-year-old woman. (Cat. 4)	G.Ex.
11	28	Traumatic epilepsy with psychosis. In M.H.	Deluded about uncle and felled him with flat iron. (Cat. 5)	G.I.
22	29 ♀	Chronic epilepsy. Major seizures for years	Killed her defective child aged 2. (Cat. 3)	Mans.
46	23	Traumatic epilepsy with mental deterioration	Murder and robbery of old man. (Cat. 2)	G.Rep.
48	24	Dull; head injury. F.H. of epilepsy and psychosis	Shot girl-friend's father. (Cat. 5)	G.I.
77	52	Chronic epileptic, low intelligence, alcohol	Strangled mistress after quarrel. (Cat. 3)	G.Rep.
90	23	No known epilepsy. "Blackouts"	Killed both in-laws after birth of his own child. (Cat. 2)	G.Ex.
101	30	No known epilepsy	Stabbed wife. Provocation. Evidence of premeditation. (Cat. ?)	G.Rep.

TABLE III.—*Other Known Cases of Epilepsy.*

Case No.	Age.	History.	E.E.G.	Crime and Category	Result.
13	16	Convulsions in prison. C.P. 1947 as moral defective. Psychopath with perversion	+	Murdered and raped 5-year-old child. (Cat. 4)	G.Rep.
23	32 ♀	Nocturnal epileptic 10 years. Delusions with depression	+	Murdered own children. (Cat. 5)	G.I.
28	27	Neuropathy. Minor epileptic fits. Three members of F. epileptic	+	Murdered sister's child, aged 2. (Cat. 5)	G.I.
35	?	Had been in epileptic colony. Acute depression	+ +	Killed wife in bed without obvious motive. (Cat. 5)	I.A.
42	34	Fits in Army and in childhood. Aggressive psychopath	−	Killed old man and robbed him. (Cat. 2)	Mans.
45	27	Minor epilepsy. Had a ? fit in prison	−	Murdered doctor. Motive. (Cat. 2)	G.Ex.
54	60	Epilepsy in Army 1915. Discharged. None since 1920. Alcoholism	−	Murdered wife after alcohol. (Cat. 1)	Mans.
56	29	*Petit mal*. Convulsions before age of 14. *Petit mal* in prison	+ +	Killed own child aged 6 after alcohol. (Cat. 3)	? N.G.
82	17	Traumatic epilepsy	+ +	Murdered infant child. (Cat. 1)	N.G.

https://doi.org/10.1192/bjp.98.410.23 Published online by Cambridge University Press

TABLE IV.—*"Blackouts" and Alleged Epilepsy.*

Case No.	Age.	History.	E.E.G.	Crime and Category.	Result.
4	40	"Fits" and temper. "Collapses." Hysteria	−	Stabbed wife in street. (Cat. 2)	G.Ex.
26	35	Defence of epilepsy not accepted. Negative history	−	Rescued children from fire but wife later found dead with wound. (Cat. 1)	Mans.
36	39	"Blackouts"	−	Strangled wife and child after quarrel. (Cat. 3)	G.Ex.
37	24	H.I. aged 10. Violence in attacks after. C.P. 1925. Sex perversion. "Man with glaring eyes"	−	Ran down women with lorry, finally killing one. (Cat. 4)	G.Rep.
49	24	Blackouts in Army	+	Murdered baby aged 7 months. (Cat. 3)	G.Rep.
55	31	Defence of epilepsy not accepted. H.I., alcohol	−	Murdered mistress, her son and daughter. (Sexual character + +.) (Cat. 4)	G.Ex.
67	39	Low intelligence. Alleged fits	−	Murdered elderly woman and set fire to her house. (Cat. 1)	G.Ex.
98	19	Maniacal attacks with amnesia in prison, ? epilepsy. Long history of temper and violence. M. schizophrenic	+	Murdered another youth he disliked. (Cat. 3)	..
108	41	Attacks of nocturnal ? sleep paralysis. Attacks of violence in prison	+	Murdered and attempted to rape young girl. (Cat. 4)	Cert. M.D.

− E.E.G. normal. + E.E.G. abnormal. ++ E.E.G. very abnormal.

In the second group (Table III) 6 of the E.E.G.s were abnormal though not definitely epileptic. It is of interest that 5 of them murdered children and only 1 of the 9 was executed.

In the third group (Table IV), only 3 had abnormal E.E.G.s and 4 were executed (Fig. 6).

The type of epileptic activity in the E.E.G. is worthy of comment. Half of them showed generalized epileptic discharges, all of the "atypical spike and wave" variety and in these cases the prisoners often showed severe depressive or other psychotic symptoms. Five were focal in the inferior part of the temporal lobe and only one focal elsewhere. The types of fits these prisoners had, if they had any, were frequently unusual and not typically epileptic. In only one case was 3 c./sec. spike and wave observed—the age factor may be partly responsible for this.

If we accept the 18 cases as the minimal hard core of epilepsy in our material, this incidence is 32 times the incidence of such phenomena in the general population. This is based on the figure of 0·5 per cent. for epileptics in the population. Even allowing for a large selection of all such cases within the present series from the murder population, the incidence is undoubtedly very great. This evidence is not based on the E.E.G.s alone, for 9 of the 18 cases did not show specific epileptic records, but the histories in these were unequivocal. In fact, only 3 cases out of the 18 were not known to have had epileptic seizures of some sort. The evidence, therefore, for some relationship existing between murder and epilepsy in some murderers is undoubted, but

https://doi.org/10.1192/bjp.98.410.23 Published online by Cambridge University Press

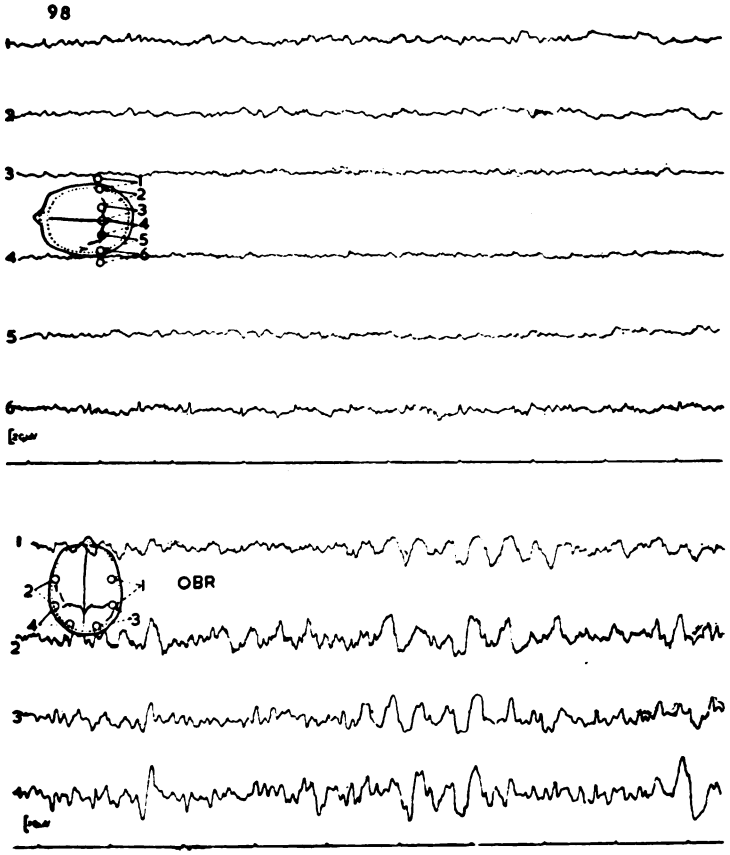

FIG. 6 (Case 98).—A 19-year-old youth who impulsively attacked another youth. Note the excess of mainly 4 c./sec. activity in the central areas (especially channels 2 and 5, which is different from the electrocardiogram best seen in Channel 6). The overbreathing response after 2 minutes when the subject was fasting, is also unstable.

this is not to say that such murders are committed in epileptic seizures or in post-epileptic automatisms.

In those cases which we have had the opportunity to follow in the courts or by a close study of all the depositions and the prisoners' statements, we have not yet observed a case in which we were not at the end satisfied personally that the chances of an epileptic seizure preceding the murder were extremely remote. In some cases, the accounts of witnesses, the time factors surrounding the murder, and the prisoner's behaviour immediately following his crime, made it as certain as it was possible to be that no seizure had occurred. This opinion, which has only been reached with difficulty, is, of course, in conformity with the established view of forensic experts and notably that of Sir Norwood East, that murders are only rarely committed in or after epileptic seizures. As a matter of fact, violent or dangerous behaviour is rarely seen during epileptic or post-epileptic automatisms in any patients. This would appear to be a generally held view based on clinical experience. It has

certainly been our own experience from an active epileptic clinic and from a ward devoted to the problems of epileptic behaviour. Dr. Denis Kennedy has assured us that at Lingfield Epileptic Colony dangerous behaviour after fits is almost unknown. Marchand and Ajuriaguerra (1948) amongst many others remark that, for example, the behaviour in a post-epileptic automatism is only occasionally violent. In support of this is the evidence from another direction that children referred to us for temper tantrums as being possible epileptic equivalents rarely show any E.E.G. changes suggestive of epilepsy, though the records are often abnormal.

Because of the forensic importance of the subject it is important to know under what conditions dangerous behaviour is witnessed in relation to epileptic fits. Such behaviour, if it is to include a spontaneous assault or murder, must be purposive, co-ordinated and sustained. Now it is obvious that no such behaviour is possible during the cortical discharge which accompanies a generalized major seizure, nor during a true *petit mal*, which is the wave and spike seizure. In the latter case full recovery of consciousness is immediate and there is no period of automatism. The major seizure is followed by a shorter or longer period of mental confusion which gradually lightens or passes into sleep. During some stage of this recovery process during which there is great disorganization of the electrical activity of the cortex, the type of behaviour in which murder could be committed is certainly possible and no doubt some murders have occurred under these circumstances. But in the 18 cases of the present series the facts surrounding the crimes excluded the occurrences of major convulsions beforehand with a high degree of probability in the majority. Nearly always the prisoners could recall events right up to the moment of the assault. The amnesia for the crime was variable but upon this in some cases, little confidence could be placed.

Post-ictal confusional states also occur after the peculiar types of seizure known as psychomotor attacks, automatism, etc. This type of seizure is one usually held to have occurred when antisocial behaviour happens in an epileptic, because in some types there is a partial hold on consciousness during the actual cerebral epileptic discharge. In the dozen or so such cases in which one of us has been able to record E.E.G.s (Hill, 1949), there was slow activity on one side. This was accompanied during the seizure by semi-purposive movements such as fumbling, chewing, etc. Never was behaviour sufficiently co-ordinated on a large enough scale to constitute an aggressive threat. On the whole, therefore, it is not possible to relate narrowly the aggressive acts of epileptics to their actual fits, but there must be instead some more general relationship.

In discussing the role of epilepsy in this connection it is advisable for the sake of clarity to adhere strictly to Hughlings Jackson's definition of the epileptic discharge as a sudden excessive discharge of the grey matter, the clinical aspect of which is the fit, and the E.E.G. equivalent the spike. It is necessary to keep this definition clearly in mind, as in any one patient suffering from such sudden excessive discharges there are often other abnormal physiological and psychological phenomena, apparently unrelated to fits, e.g., personality disorders and speech disturbances, and episodes of disturbed behaviour of

varied character such as somnambulism, fugues, maniacal outbursts, catatonic episodes, depersonalization, etc.

The E.E.G. changes in the prisoners do not differ in type from the range found in the epileptic clinic, in which is seen a considerable proportion of cases with behaviour disorders. The absence of classical 3 c./sec. spike and wave is of course due in part to the age factor, but it also accords with our experience that such cases do show only mild behaviour disorders and these only when there is an obvious psychogenic element in the total situation. *Grand mal* seizures tend to be associated with abnormal mental states, e.g., the so-called "epileptic personality." Psychomotor attacks are more commonly associated with behaviour disorders than any other type of epilepsy, e.g., Gibbs, Gibbs and Fuster (1948). In these last cases one common factor between the fit and the behaviour disorder is probably the location of the epileptic focus in the temporal lobe as we have shown that even non-epileptic foci in the temporal lobe are associated with behaviour disorders (Rey, Pond and Evans, 1949). A possible reason is that this area appears to be, with the orbital frontal cortex, a centre of cortical representation of autonomic functions. Kaada and others (1949) have recorded variations in blood pressure and respiratory rate from sitmulation of the temporal pole in monkeys, and Chapman (1950) and others have made similar observations in man at operation. Post-encephalitic behaviour disorders have long been suspected to be related to interference with the lower hypothalamic vegetative centres. The temporal-orbital areas represent still higher levels of representation of autonomic function and it is possible that the temporal foci seen in some of these epileptic cases cause autonomic disturbances by discharge at this higher level.

There are still several types of episodic behaviour disorder which it is difficult to include under any of these categories. As an example may be quoted an epileptic who suffers from periods of several days' length of depersonalization and derealization. There is no gross change in his record before, during and after such episodes.

On the other hand, Figs. 7 and 8 are of a patient who suffered from recurrent catatonic episodes, followed usually by one or two major seizures. He admittedly shows cyclic E.E.G. changes but not of the sort that could be ascribed to post-ictal states or to recurrent temporal lobe discharges. Such patients tempt one to consider that there are some more general cyclic biochemical or physiological changes. An epileptic fit is not a disease but a train of physiological events which can be set in motion in "normal" brains given sufficient provocation. It is well known that the factors of blood sugar, pH, etc., alter the fit threshold and there is some evidence that the homeostatic mechanisms in epilepsy are less efficient than normal. Lennox and Cobb (1928) in their classical review of epilepsy show how variations from day to day of biochemical factors parallel the number of epileptic seizures. The numerous studies of blood chemistry in epilepsy usually show values within the normal range but a wider variation than usual from time to time in the same person.

Occasionally it is apparent that the abnormal behaviour is not related to epilepsy directly but both depend on a common factor of brain damage. For

example, the post-traumatic epileptic may have a hemiplegic disorder and a speech disorder. In such cases the behaviour can be explained without reference to epilepsy, as Barbeau (1944) points out. However, it is noteworthy that no case of traumatic deterioration without epilepsy and only one case of non-traumatic dementia without epilepsy occurs in this series.

The mechanisms described so far may act in releasing abnormal behaviour but there is no evidence that the type of behaviour released can be simply

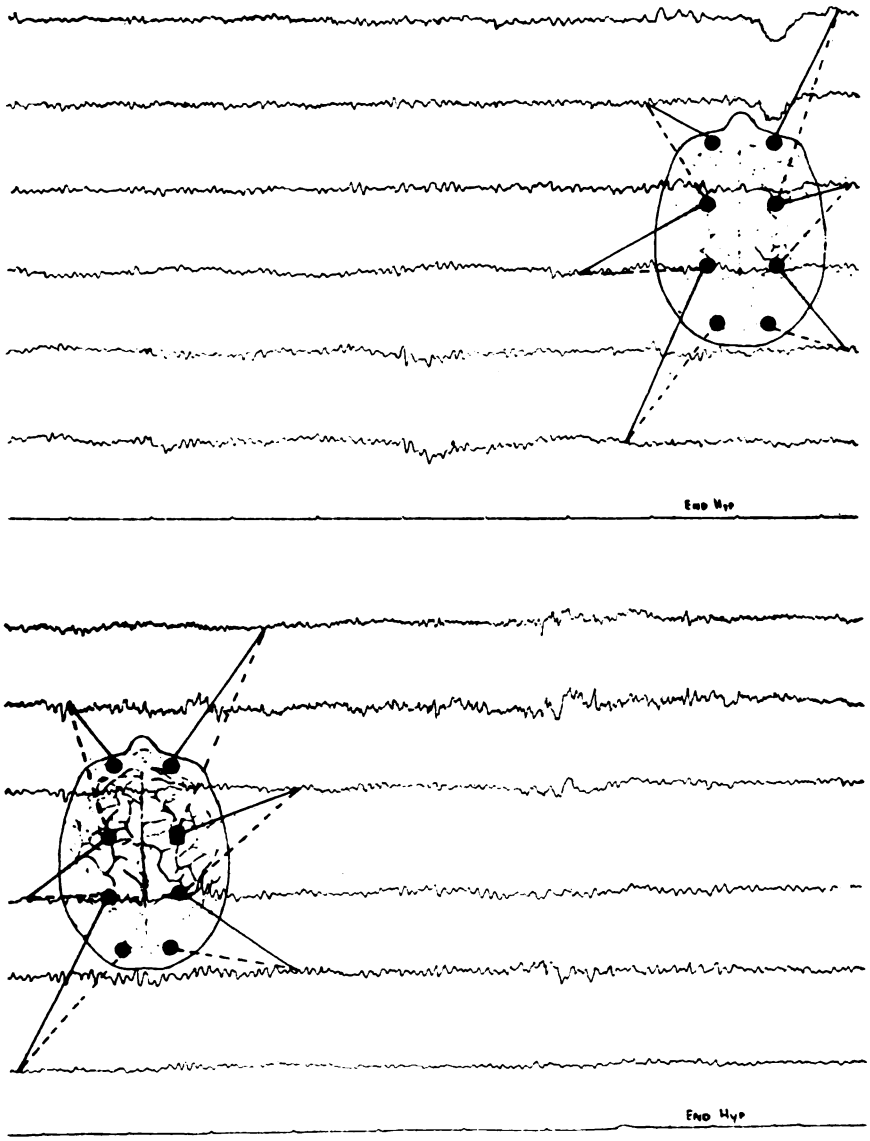

FIG. 7.—Records taken at the end of three-minute hyperventilation in a man before and during a catatonic episode. The records were taken fasting at the same time of the day. Note the greater instability in the second record while the patient was well.

explained on the basis of these release mechanisms. It has already been pointed out that there appears to be no evidence connecting epilepsy as such and aggression, so that other possible causes for this trait must be looked for. In the case of aggressive behaviour in psychopaths generally, one of us, Hill (1947) has demonstrated the improvement produced by benzedrine which they will tolerate in large doses—50 mgm. a day or more; and it was argued by analogy with the effect of benzedrine in reducing appetite and hunger that

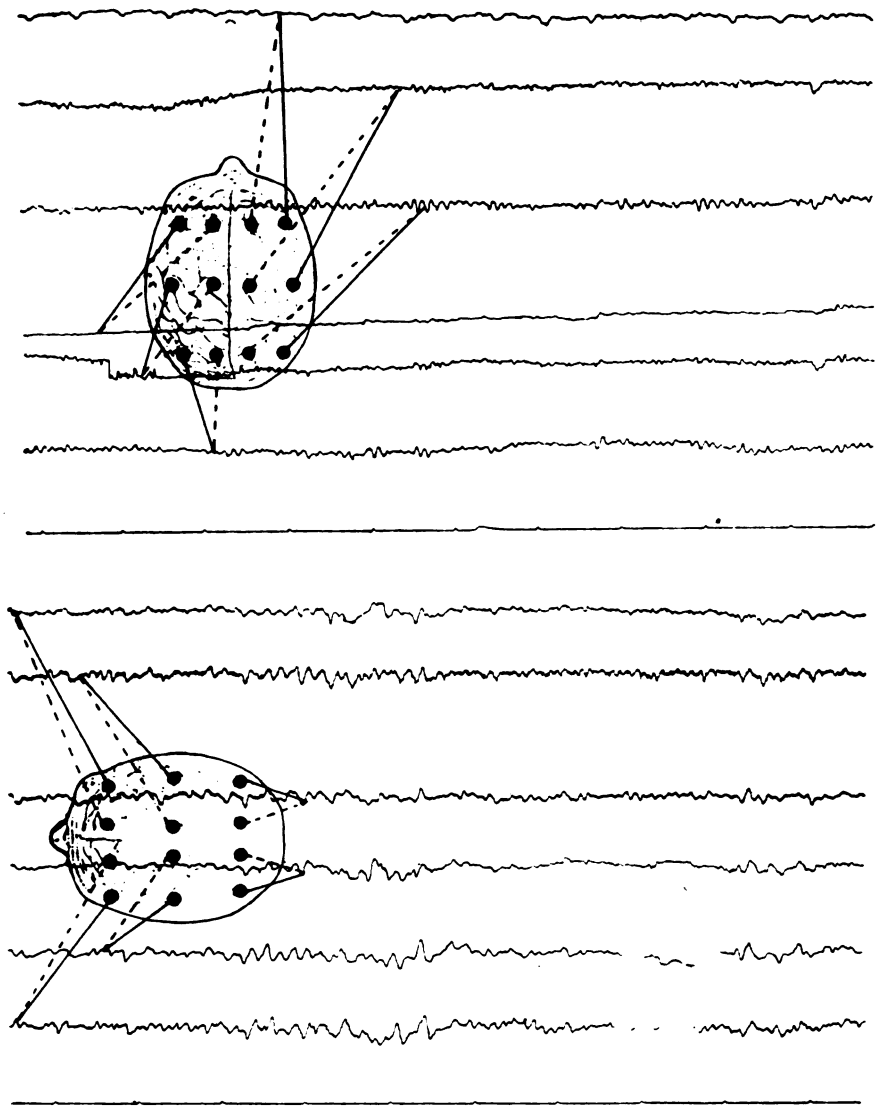

FIG. 8.—Records of the same patient as Fig. 7. Hypoglycaemia has been induced by intravenous insulin and the blood-sugar values at the time of the two sections of the record are 45 and 47 mgm. per cent. respectively. Note the much greater abnormality in the lower record taken while the patient was well, compared with the upper one done when he was in catatonic stupor.

similarly the aggressive drive is cut down to manageable limits. It is equally possible to argue that it acts by increasing cortical control of some more primitive and basal centre of impulsivity. In support of the latter is the fact that benzedrine in children often has a very marked quietening effect, even leading in some cases to sleep.

Physiological Conditions at Time of Crime.

The crimes of 16 of the cases were committed under conditions of alcoholic intoxication, severe fatigue or starvation, e.g., Cases 12 and 15 (Table I), cases 2 and 5 (Table II), Case 54 (Table III). Eleven of these had abnormal E.E.G.'s, even when taken under "normal" conditions, half of them epileptic in character. This is a significantly greater proportion of abnormal E.E.G.'s than in cases not committed under physiological stress. Further changes may often be induced if the physiological conditions at the time of the crime are simulated by, e.g., starvation, hydration, etc.

An early case of the influence of physiological factors inducing abnormal E.E.G. findings and mental changes is that reported by Hill, Sargant and Heppenstall (1943). In this case the murder was committed in a state of partial starvation and after 4 pints of mild beer. Simulating these conditions it was possible to show that the accused's previous mildly abnormal E.E.G. was grossly abnormal and that overbreathing such as would have been induced by the quarrel preceding the murder would have produced a slight but definite impairment of consciousness.

The following is the history of a patient recently under our care:

He was a young man, the only son of a professional man, whose history of maladjustment appeared to date from his Army service as a conscript. After several minor offences and a court martial for assaulting a corporal he was invalided out with a diagnosis of psychopathic personality. A few months ago he was brought up to London by his father on business, stayed behind and after a day without food he began to drink, consuming in all several cocktails and about 6 pints of beer. He then aimlessly took a tube to Hampstead and suddenly attempted to break into a doctor's house. When the police arrived he struggled violently but he has no recollection of the events until he was in the Police Station later on. Professor Cloake, to whom the case was referred, has kindly allowed us to use the E.E.G.s (Fig. 9) which were taken under standard conditions and after simulating the conditions under which the crime was committed. There is a marked difference in the dominant frequency which is slowed from the alpha to the theta range after hydration.

The type of E.E.G. changes seen cannot be ascribed to a permanent effect of the alcohol or starvation, etc., for various reasons, e.g., the type of changes are not those seen in acute or chronic intoxication but are those often found in psychopaths and epileptics without any history of alcohol. Rather it is that the abnormal E.E.G. already is a factor of disturbed cerebral functioning which is potentiated by the second factor of alcohol.

Leaving aside for the moment the cases with a history of epilepsy or with epileptic E.E.G.s we find that the E.E.G. changes found are of the type commonly seen in psychopaths. At the present these slow wave abnormalities are best regarded as evidence of constitutional immaturity of cerebral function.

There is some evidence that this relatively non-specific finding occurs in a small percentage of the general population, the percentage falling as the group tested is more and more one selected for physical and mental efficiency. It is low, for example, in Air Force pilots (Williams, 1941). Furthermore, there is evidence that persons with such unstable E.E.G.s show an increased tendency to unstable overbreathing responses, and an increased tendency to the appearance of slow rhythms with lowering of blood sugar by insulin (Heppenstall, 1944). As a group, therefore, persons with such E.E.G.s tend to be vulnerable physiologically and psychologically.

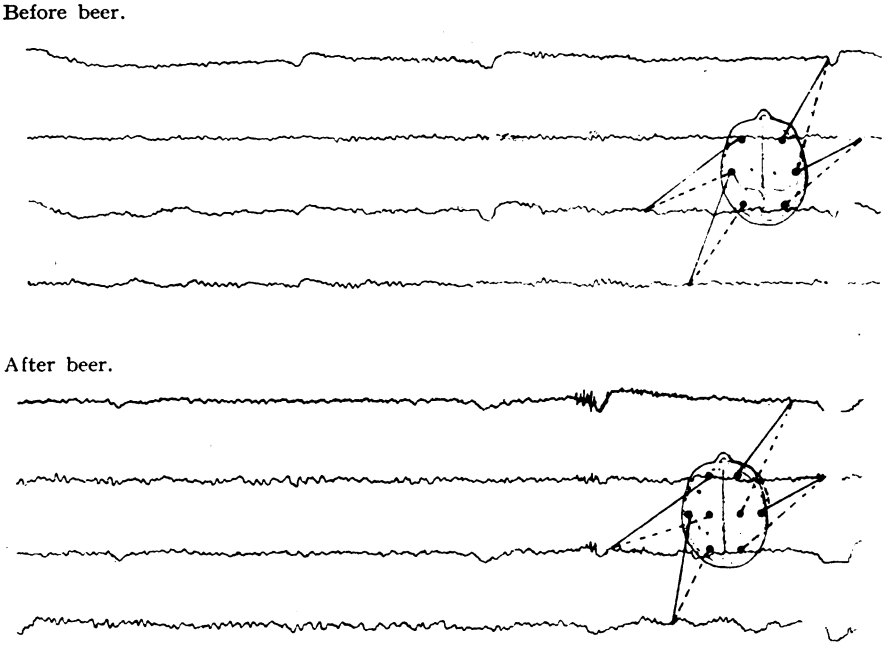

FIG. 9.—Records of a 19-year-old man under standardized conditions and after the ingestion of four pints of beer. Note the slowing of the dominant frequency after hydration. (Records taken by Professor Cloake and reproduced by his kind permission.)

Even before electroencephalography the role of temporary changes in the physiological conditions of the brain in precipitating mental abnormalities and disturbances in behaviour was well recognized. " The hungry man is an angry man " runs an old adage. The literature on peculiar disturbances in behaviour with insulin-induced hypoglycaemic reactions in diabetics has been summarized and discussed by Wilder (1947). A wide variety of actions can occur; only occasionally are they aggressive in character. During the war the mental oddities of pilots exposed to low oxygen tensions at high altitudes were well recognized. Fatigue and sleepiness have also been the subject of investigations, e.g., by Kleitman (1939). The effects of alcohol are, of course, universally recognized, and they may be for the meantime included under this heading because of the many similarities induced by the reversible intoxicating acton

of this drug and the temporary disturbances of homeostasis induced by starvation, fatigue, hypoglycaemia, etc., both in the clinical picture and in the E.E.G.

In an interesting review from a hospital for the criminal insane of Quebec, Barbeau (1944) reports that 1·6 per cent. of all admissions over a period of 20 years were epileptics—34 cases. He points out that in many of the cases the actual crime was purely nominal and that there appeared to be no particular type of crime associated with epilepsy. Within this group there was a high percentage of cases with psychological disorder or brain injury and many of the crimes committed or attempted were done under the influence of alcohol. In a study published after this paper was first given, Alström (1950) notes how many of the acts of violence committed by epileptics occur under the influence of alcohol. Four of the 18 definite epileptics in our series were under abnormal physiological stress at the time of the crime.

Psychological Factors.

From the preceding discussion it would not be too conservative to say that physiological investigations have not so far provided us with definite causes for the aggressive character of the acts committed by murderers, though they have perhaps helped to understand how it is that crude violence can be released in susceptible subjects. We must therefore consider what light may be thrown on aggression by psychological studies. As far as the prisoners are concerned, it is obvious that detailed psychological and social studies are out of the question while the prisoner is in prison awaiting trial. Nevertheless, the Prison Medical Officers have usually supplied us with much relevant information. Dr. Taylor and Dr. Stafford-Clark have kindly allowed us access to some of their notes and from these it is noteworthy that 5 out of 14 epileptics were aggressive subjects as were 8 out of 30 who had constitutional non-specific abnormalities. This proportion, high as it is, compared with epileptics as a group, would undoubtedly have been higher were more details available.

This aspect of the Borderland of Epilepsy has long been clinically recognized. Bratz (1911) for example, as is well known, started a long controversy with his attempted delineation of *Affekt Epilepsie* as a distinct group (see Guttmann, 1929). There were attempts to describe the effect of emotion or affect as due to a roundabout mechanism of overbreathing producing tetany and so a convulsion. An alternative explanation was that such patients (whose abnormal personality traits were well recognized) had labile vasomotor control —another aspect of disturbed homeostasis which predisposes to fits. These ideas have been generally discarded, since the E.E.G. suggests quite other mechanisms. From present-day knowledge of the cortical representation of autonomic function a more direct relation between emotion and autonomic discharge may be assumed which involves the interaction of cortex and basal areas directly without the mediation of any vascular or biochemical effect. Whether an epileptic fit in the sense of a sudden excessive discharge of the grey matter is then produced, depends on still further factors, which may be either local, in the sense of an epileptogenic scar, or general, as in the case of so-called

idiopathic epilepsy, where the lowered threshold to discharge is shown by, e.g., the leptazol threshold.

We have had occasion to examine carefully a number of epileptics and have obtained some idea of the relation between personality and the character of the fit and actions performed during and after it. In all cases where aggression was a prominent feature it was psychologically comprehensible. Recently we had as a patient a probationer nurse who made one attempt at suffocating a newborn baby with a deformed jaw. Later on she attempted to strangle a nurse. Both attempts seemed to be quite senseless and unpremeditated, and apparently out of keeping with her previous personality. Her E.E.G. showed a marked excess of slow activity, and spikes and waves were induced with a small dose of leptazol given in divided doses by a standardized technique. On further investigation of her psychological state she gradually revealed that beneath her apparent normal façade were a wealth of aggressive fantasies and dreams, so that the incongruous aggressive acts were shown to have a comprehensible psychological relationship with her personality.

The part played by the temporal lobe may be again relevant. It has already been mentioned that we have observed many psychological factors which appear related to temporal lobe disorders. Penfield has shown that electrical stimulation of the temporal lobe can cause past experiences and memories to be revived. Associations peculiar to the individual appear to become here part of the person's " physiological " structure.

The differences between epileptic and non-epileptic abnormalities may not therefore be as great as it appears, from two points of view. Firstly, there may be common physiological release mechanisms such as increased tendency to disturbances of homeostasis and cortical control. Secondly, there is no evidence that aggression has any peculiar relation to epilepsy.

The Victims.

Reflections upon these 110 prisoners should not omit the victims. A study of the types of victim revealed one interesting point. 66 women, 26 men and 17 children were murdered. The high incidence of women victims depends, perhaps, upon the fact that over 90 per cent. of the murderers were men. There were 27 wives, 11 mistresses, 13 girl friends, 2 mothers and 13 other women of all ages. Child murder is always an interesting psychological phenomenon. The three groups of epileptic or alleged epileptic murderers—that is, 27 individuals—killed 8 children, whereas the remaining 83 non-epileptic murderers killed only 9 children. This relationship between child murder and the epileptic disorders is statistically significant, but its meaning is quite obscure. Obviously this may be a psychopathological, not a physiological problem.

Legal Fate of the Prisoners.

In conclusion, brief reference should be made to Society's attitude to these prisoners. This attitude, which is very properly expressed by the Judges, juries and by the firmness with which prosecution prosecutes its case, determines to a much greater extent than the wording of the McNaghten Rules, what in

the end is the fate of any given man accused of the most serious of all crimes. It is a familiar experience to see the McNaghten Rules ignored, or their meaning stretched suitably to accommodate this attitude towards the accused. How is this contemporary attitude expressed by the figures in the present series? Age and the type of crime are the most important general factors. Stafford-Clark and Taylor's paper shows that Society's attitude to murders involving sexual offences such as rape, is quite clear. Six out of 9 of these prisoners were executed, by far the highest percentage executed in any group. In contrast, the group of prisoners whose crimes were apparently motiveless called out a different attitude towards them. It will be recalled that these prisoners showed a remarkably high incidence of unexplained E.E.G. abnormality. Of 18 cases only 2 were executed. In 5 cases the prosecution reduced the charges during the trials to manslaughter. In 4 cases the prisoners were reprieved after being condemned to death. One man only was found insane at trial. Two were found "not guilty." Society is very unwilling to hang such persons.

As far as age is concerned, Fig. 10 tempts a speculation and perhaps a pious hope which has been fostered by a psychiatric attitude to crime, but

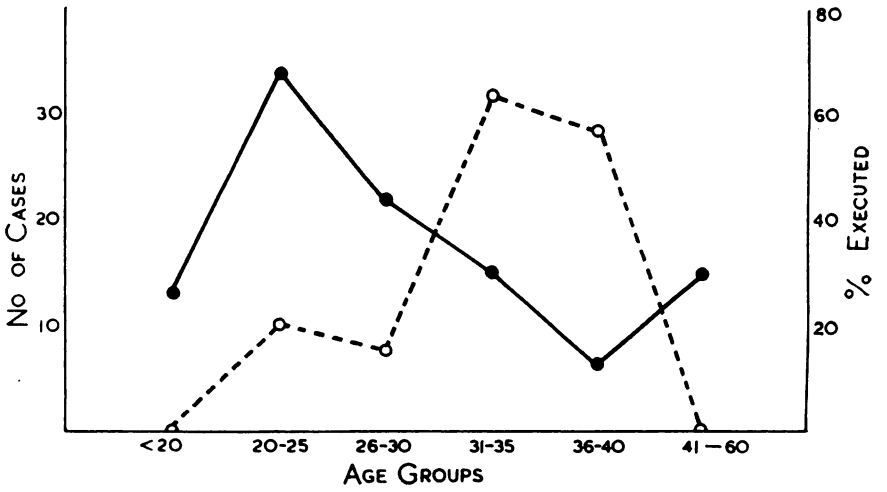

Fig. 10.—Distribution by age of total number of prisoners (black line) and of the percentages that were executed (dotted line).

one which is perhaps not generally held by psychiatrists. The majority of murders in this series are committed by young men under 30 years of age. Not many of these are executed. By law, no murderer under the age of 18 at the time of the offence is executed, and in fact none of this series under the age of 20 years was executed and only 20 per cent. of those aged between 20 and 30. Over 30 the percentage rises sharply to 60 per cent., to fall again over the age of 40 years. These figures contrast strongly with the analysis by age of all males convicted of murder which was presented as evidence by the Prison Commissioners to the Royal Commission on Capital Punishment. According to this series, which covers the period 1900–48, the percentage

executed has been between 50 and 60 per cent. over the age range 20 to 60 years. The discrepancy between the total number and our series, may be because there is in fact a tacit recognition, not openly expressed, of immaturity factors in our series which diminish culpability of the prisoners and of which the abnormal E.E.G. may be one expression. Similarly, so few murderers over 40 in this series are executed, perhaps because there is again a tacit recognition of factors causing deterioration of personality and thereby of culpability. If this be so, we may perhaps look forward with confidence to the time when knowledge of those factors, psychological and physical, will surely extend the range of our understanding of immaturity on the one hand and degeneration on the other and the gap will close.

Summary.

One hundred and five capital cases submitted to electro-encephalography before trial are reviewed in the light of what was known of their past histories, personalities and the circumstances of the crime. Only 6 were women. Eighteen cases were definitely epileptics. Thirty-eight had abnormal personalities and 37 a family history of mental disorder. Just over half showed abnormal E.E.G.s, the percentage falling with age up to the age of 40. In 16 the crime was committed under the influence of alcohol or other physiological stress.

As indicated in the text, we are much indebted to the medical staff of Brixton and other prisons, and particularly to Dr. J. C. Matheson. It is also a pleasure to record our gratitude to the Prison Commissioners who have granted permission to publish this work although it does not necessarily represent their views, and to Professor Cloake for kindly allowing us to see his records. Fig. 1 has already been published in evidence given before the Royal Commission on Capital Punishment.

References.

Alström, C. H., *Acta Psychiat. et Neurol. Supplem.*, 1950, 63.
Barbeau, A., *Union med. du Canada*, 1944, **73**, 1147.
Bratz, E., *Monat. f. Psychiat. u. Neurol.*, 1911, **29**, 45 and 162.
Chapman, W. P., Livingston, R. B., and Livingston, K. E., *J. Neurophysiol.*, 1950, **13**, 65.
Gibbs, E. L., Gibbs, F. A., and Fuster, B., *Arch. Neurol. Psychiat.*, 1948, **60**, 331.
Guttmann, E., *Zeit. f.d.g. N.u.P.*, 1929, **119**, 377.
Heppenstall, M. E., *J. Neurol., Neurosurg., Psychiat.*, 1944, **7**, 112.
Hill, D., *Br. J. of Addiction*, 1947, **44**, 50.
Idem, *IVth Inter. Neurol. Congress*, 1949, **1**, 27.
Idem, Sargant, W., and Heppenstall, M. E., *Lancet*, 1943, i, 526.
Kaada, B. R., Pribram, K., and Epstein, J. A., *J. Neurophysiol.*, 1949, **12**, 347.
Kleitman, N., *Sleep and Wakefulness*, 1939, Univ. of Chicago Press.
Lennox, W. G., and Cobb, S., *Medicine*, 1928, **7**, 105.
Marchand, L., and Ajuriaguerra, J. de, *Les Epilepsies*, 1948 (Paris: Desclee de Brouwer & Co.,)
Rey, J. H., Pond, D. A., and Evans, C. C., *Proc. Roy. Soc. Med.*, 1949, **42**, 891.
Stafford-Clark, D., and Taylor, F. H., *J. Neurol. Neurosurg. Psychiat.*, 1949, **12**, 325.
Wilder, J., in *Handbook of Correctional Psychology*, edited by R. M. Lindner and R. V. Seliger, 1947. (New York: Philosophical Library.)
Williams, D., *J. Neurol. Psychiat.* (new series), 1941, **4**, 257.