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BIOCHEMISTRY AS A DEFENSE

JESS SPIRER *

It is now a commonly accepted fact that extensive psychiatric and psychological studies should be made of criminal offenders, so that a complete understanding of the motivations and origins of criminality be made available to the court. This need is well-stated in a recent dictum:

. . . the time has come when the judiciary must recognize psychiatry as a science, and not stand by in effect, as it once did not too long ago, allowing men who were, before and at the time of commission of crimes, helplessly controlled and obsessed by insane ideas and impulses, to be tried, convicted and punished for committing them.

When a well-trained, broad-experienced psychiatrist, reputable in his profession, makes a careful examination and gives persuasive and scientifically approved reasons for his conclusions in a given case, the judiciary should give respectful attention and consideration to such deductions and, while they may not be controlling, they should prompt additional thoughtful care in the consideration of surrounding facts.¹

The role of the psychiatrist is an easy one in those cases where the defendant is obviously and frankly psychotic, with clear and readily observable hallucinations and delusions. Difficulties arise, however, when the defendant appears to be entirely rational and well-oriented at the *time of trial* and the defense attempts to demonstrate that the defendant was "insane" at the *time of the offense*.

Often, the defendant in these instances attempts to prove that his conduct was governed by an "irresistible impulse" or urge, that he should not be found guilty because he could not control his acts and is therefore not responsible for the consequences of such acts.

In a previous article,² the author presented a general discussion of some of the psychological and legal problems associated with the concept of irresistible impulse. It was there pointed out that usually the irresistible impulse is conceived as underlying those forms of neurotic behavior known as compulsions, in which the patient finds himself impelled to behave in specific ways: in kleptomania he has an irresistible desire to steal; in pyromania, an irresistible desire to set fires; in nymphomania, an irresistible impulse toward

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1. United States v. Parelus, 83 F. Supp. 617 (Hawaii 1949).

2. J. Spirer, *The Psychology of Irresistible Impulse*, 33 JOURNAL OF CRIMINAL LAW AND CRIMINOLOGY, 457-462 (1943).

sexual activity; in dromomania, an irresistible impulse to wander; in homicidal mania, an irresistible impulse to kill. The customary explanation of such behavior is that the subject or patient *must* kill or steal or burn for any one of a number of reasons, each of which is the product of some obscure psychological cause.

In recent years, studies in physiology and neurology have suggested the possibility that compulsive behavior of the kind described above may also be associated with disturbances of the organic system of the body, and in some instances at least, a purely psychological explanation of such behavior will not suffice.³ It is our purpose to review briefly some of these findings, for clearly they are relevant to any discussion of irresistible impulse and criminal responsibility.

CRIME AND EPILEPSY

Of particular interest in this connection are the research findings in epilepsy. It was Lombroso, the Italian criminologist, who said that the born criminal was characterized by epilepsy, and that the epilepsy need not be accompanied by overt seizures or convulsions. "If fully developed fits are often lacking in the case of the born criminal, this is because they remain latent, and only show themselves later under the influence of causes assigned (anger, alcoholism), which bring them to the surface."⁴ The born criminal, said Lombroso, is unpredictable, for he is unable effectively to repress his instinctual drives; these drives burst forth "without apparent cause," thereby producing anti-social or criminal conduct.

For many years subsequent to the writings of Lombroso, it was assumed that his point of view was entirely without merit; in fact, the usual statement one encounters in the literature is that ". . . his theories are not held today."⁵ Consequently, in most of the contemporary criminology textbooks one finds little or nothing said about epilepsy.

Recent researches, however, have again raised the problem of whether there is a relationship between epilepsy and crime and delinquency. This relatively recent trend is primarily the result of studies made by means of a new diagnostic instrument, the *electroencephalograph*, which graphically portrays the electrical potentials of the brain just as the electrocardiograph does for the heart.

About seventy-five years ago, an English scientist, Caton, discovered the fact that electrical activity was one of the phenomena of the brains of living animals; subsequent to this important finding, a number of researches

3. For example, see SHIELDON GLUECK AND ELEANOR T. GLUECK, *CRIMINAL CAREERS IN RETROSPECT* (1943).

4. C. LOMBROSO, *CRIME, ITS CAUSES AND REMEDIES*, 371 (1918).

5. A. E. WOOD AND J. B. WAITE, *CRIME AND ITS TREATMENT*, 274 (1941).

appeared in the scientific literature extending our knowledge of the character of this activity. By 1934, the psychiatrist, Hans Berger, ". . . demonstrated that the brain of man has an electrical beat; that this beat comes from neurones, not from blood vessels or connective tissue; that it changes with age, with sensory stimulation, and with various changes in the physiochemical state of the body. He showed that normally this beat appears as a mixture of more or less sinusoidal fluctuations in voltage with a frequency of from one to sixty per second, that the most easily discernible rhythm has a frequency of ten per second in normal adults."⁶

Many students of electroencephalography have since shown that abnormalities sometime exist in the rhythm or frequency of the waves recorded by the electroencephalograph, and that these wave abnormalities are associated with clinically demonstrable abnormalities in their patients.

In the standard literature on the subject of epilepsy, three fairly distinct categories of epilepsy have been delineated.⁷ There are, first, *cerebral seizures* which are associated with a widespread cortical disturbance, either metabolic or traumatic in origin. Second, a classification of the epilepsies should include those seizures which are the result of damage to a specific locus within the brain. Such seizures may arise from birth injuries, brain tumors, or other forms of brain damage. The third group of epilepsies is known as *idiopathic* or *essential epilepsy*, and here the cause of the disturbance is either entirely unknown or only vaguely suspected. When the layman speaks of epilepsy, he is usually referring to a form of idiopathic epilepsy. As a general rule, seizures of the idiopathic type first occur during childhood or adolescence, and infrequently have their inception after the age of twenty years.⁸

Idiopathic epilepsy, itself, is further subdivided into three clinical types, known respectively as *petit mal*, *grand mal* and *psychomotor* or *psychic equivalent epilepsy*.

In *petit mal epilepsy*, there is a "transient lapse of consciousness" lasting, usually, from five to twenty seconds, without any tonic spasm of the muscles of the body.⁹ Convulsive movements, if present, usually consist of rhythmic jerkings of eyelids, head or arms, approximately at the rate of three per second. In this form of epilepsy, there is no prolonged unconsciousness, and it has been reported that persons have suffered *petit mal* attacks while riding a bicycle or while walking, and yet have not lost their equilibrium. *Petit mal epilepsy* can be diagnosed by means of the electroencephalograph, for this

6. F. A. GIBBS AND E. L. GIBBS, *ATLAS OF ELECTROENCEPHALOGRAPHY*, 7, 8 (1941).

7. W. PENFIELD, *Classification of the Epilepsies*, 60 *ARCHIVES OF NEUROLOGY AND PSYCHIATRY*, 109 (1948).

8. PENFIELD, *op. cit.*, 110-111.

9. F. Gibbs, E. Gibbs, W. Lennox, *Electroencephalographic Classification of Epileptic Patients and Control Subjects*, 50 *ARCHIVES OF NEUROLOGY AND PSYCHIATRY*, 113 (1943).

form of epilepsy is associated with a distinctive brain wave pattern of alternate waves and spikes which appear rhythmically at the rate of approximately three per second.

Grand mal epilepsy is by far the most dramatic of the three types of idiopathic epilepsy, for here there is unconsciousness, tonic and clonic convulsions, accompanied by cries, frothing at the mouth, biting of the tongue and, sometimes, incontinence. The electroencephalographic wave pattern accompanying the grand mal seizure is characterized by a fast discharge of high amplitude waves.

In *psychomotor* or *psychic equivalent epilepsy*, the third type of idiopathic epilepsy, the patient "... becomes confused, and, as a rule, amnesic, but does not usually lose consciousness. His movements appear purposeful but are poorly coordinated, and his manner is frequently negativistic. In general, his behavior is that of a person acting out a bad dream. Often, during the seizure, there are manifestations of fear or rage with screaming or shouting. In most seizures the movements are simple, repetitive and more or less automatic. . . ." ¹⁰ The customary psychomotor attack lasts for only a few minutes, but it has been reported that they may "... go on for hours or even days. In the latter event the patient on regaining consciousness may find himself in a different city." ¹¹

In this form of epilepsy, it is important to remember that there need be no convulsion at the time of the attack, although it is not uncommon for a person suffering from psychomotor epilepsy to have a history of overt convulsions. In the extreme cases of psychic equivalent or psychomotor epilepsy, the patient sometimes acts wildly and with tremendous aggression. The older psychiatric literature reserved the term *furor epilepticus* for this state. It has been said that "Any criminotic behavior in such a state cannot have any real plan except of the most rudimentary unconscious nature; that is, there cannot be the conscious content of what is meant by a crime. It is the most primitive criminotic behavior imaginable, if it is imaginable at all." ¹² When the violent attacks are at an end, they are "... usually followed by severe headaches or deep sleep, with a complete amnesia for what has happened during these intervals." ¹³

It is almost impossible to diagnose psychomotor epilepsy with any degree of certainty without electroencephalographic study. An English murder case is reported in the *Journal of Criminal Law and Criminology* in which the defense of epilepsy was raised. Lay witnesses testified to the fact that the

10. E. Gibbs, F. Gibbs, B. Fuster, "Psychomotor Epilepsy," 60 ARCHIVES OF NEUROLOGY AND PSYCHIATRY, 334 (1948).

11. W. LENNOX, SCIENCE AND SEIZURES, 30, 31 (1946).

12. A. FOXE, *The Antisocial Aspects of Epilepsy*, in EPILEPSY, PSYCHIATRIC ASPECTS OF CONVULSIVE DISORDERS, 79, 80 (Hoch and Knight, eds., 1947).

13. J. WILSON AND M. PESCOR, PROBLEMS IN PRISON PSYCHIATRY, 176-177 (1939).

defendant had had epileptic seizures, but the prison doctor stated that prolonged clinical observation in the prison hospital revealed no evidences of epilepsy. The results of electroencephalographic study, thereupon introduced into the case, indicated that the defendant's electroencephalographic pattern was diagnostic of epilepsy. The resulting verdict was "Guilty but Insane."¹⁴

Although the psychomotor patient is confused and irresponsible, nevertheless his disorder usually goes unrecognized or is misdiagnosed. Often, "the physician classifies a case of psychomotor epilepsy under whatever heading seems to him the approximately appropriate one—for example, hysteria, psychopathic personality, or schizoid psychosis."¹⁵

Psychomotor epilepsy may be identified by means of the electroencephalograph, for ". . . the basic unit of the psychomotor discharge is a positive spike, which may be short in duration, and therefore definitely spikelike in appearance . . . , or long in duration, for example, one-fourth second, so that it looks like a wide, blunt or saw-toothed wave. . . . Usually, when the spikes occur between seizures, they are from five seconds to five minutes apart. However, when a seizure is impending, they tend to come closer together, and sometimes occur in bursts. . . ." ¹⁶

One of the interesting findings in electroencephalography is that many children who are classified as delinquents because of destructiveness, untruthfulness, disobedience and other causes are actually victims of psychomotor epilepsy. "Such episodes are usually called 'behavior problems' or 'temper tantrums' in children, and in adults may be labeled 'psychopathic personality,' 'schizophrenia,' or 'criminality.' These behavior disorders have not been thought of as possibly related to epilepsy until recently."¹⁷

In 1938, Jasper, Solomon and Bradley conducted a study of seventy-one children who had been admitted to the Emma Pendleton Bradley Home with the primary diagnosis of "behavior problem." They summarized their findings in this way: "Abnormalities in brain potentials were found in 71 per cent of this group with very marked abnormalities appearing in 59 per cent. Epileptiform electrical activity was observed in 39 per cent of the cases. These latter patients showed characteristic mental and emotional disturbances analogous to those associated with epileptic personality. In only two of these cases was epilepsy suspected previous to the electroencephalographic findings and none were having convulsions at the time of the examination. It is concluded that abnormal brain function as revealed by the electroencephalogram is an important component in the aetiological picture of the majority of a

14. 35 JOURNAL OF CRIMINAL LAW AND CRIMINOLOGY, pp. 176-177 (1944).

15. GIBBS, GIBBS, FUSTER, *op. cit. supra* note 10 at 332.

16. GIBBS, GIBBS, FUSTER, *op. cit. supra* note 10 at 333.

17. LENNON, *op. cit. supra* note 11 at 44-45.

group of problem children whose disorders had been considered as psychogenic previous to using this method of diagnosis."¹⁸

Lindsley and Cutts reported that behavior problem children when compared with normals show a higher percentage of abnormal slow wave activity in the electroencephalograms. These authors believe that the slow waves suggest "... a disturbance of cortical function which may be an important factor in the inability to adjust to environmental conditions, particularly if such conditions are adverse."¹⁹

Secunda and Finley conducted electroencephalographic studies on 143 behavior problem children and 76 normal control subjects, and found that in the 143 problem children, the electroencephalograms in 26 per cent were normal, borderline in 23 per cent and abnormal in 51 per cent. In the control subjects, 68 per cent were normal, 17 per cent borderline and 15 per cent abnormal. Here, again, slow wave activity was the most common abnormality in the wave pattern.²⁰

In a study published in 1945, Gottlieb and his associates reported on the electroencephalograms of 67 children who had been diagnosed as "primary behavior disorders," none of whom presented signs of organic disease or in whose condition an organic etiologic factor was suspected. The authors found that 49 per cent of these cases "had electrical brain potentials which were clearly abnormal."²¹ In a later study, these authors examined 100 behavior problem children whose age was 15 years or below and 100 psychopathic adults who were 16 years of age or more. Fifty-six per cent of the former group and 58 per cent of the latter had abnormal electroencephalograms, considerably higher than the percentage reported for presumably neurologically normal children and adults.²²

18. H. Jasper, P. Solomon, C. Bradley, *Electroencephalographic Analyses of Behavior Problem Children*, 95 AMERICAN JOURNAL OF PSYCHIATRY, 641-658 (1938).

19. D. Lindsley, and K. Cutts, *Electroencephalograms of 'Constitutionally Inferior' and Behavior Problem Children*, 44 ARCHIVES OF NEUROLOGY AND PSYCHIATRY, 1199-1212 (1940).

20. L. Secunda, and K. Finley, *Electroencephalographic Studies on Children Presenting Behavior Disorders*, 47 ARCHIVES OF NEUROLOGY AND PSYCHIATRY, 1076-1077 (1942).

21. J. Gottlieb, J. Knott, M. Ashby, *Electroencephalographic Evaluation of Primary Behavior Disorders in Children*, 33 ARCHIVES OF NEUROLOGY AND PSYCHIATRY, 138-143 (1945).

22. J. Gottlieb, M. Ashby, J. Knott, *Primary Behavior Disorders and Psychopathic Personality*, 56 ARCHIVES OF NEUROLOGY AND PSYCHIATRY, 381-400 (1946). These findings have been confirmed by a number of investigators: D. Simons, and O. Diethelm, *Electroencephalographic Studies of Psychopathic Personalities*, 55 ARCHIVES OF NEUROLOGY AND PSYCHIATRY, 619-626 (1946). D. Silverman, *Clinical and Electroencephalographic Studies on Criminal Psychopaths*, 50 ARCHIVES OF NEUROLOGY AND PSYCHIATRY, 18-33 (1943). D. Silverman, *The Electroencephalogram of Criminals*, 52 ARCHIVES OF NEUROLOGY AND PSYCHIATRY, 38-42 (1944). J. Knott, *Electroencephalographic Evaluation of Psychopathic Personality*, 52 ARCHIVES OF NEUROLOGY AND PSYCHIATRY, 515-519 (1944). J. Knott and J. Gottlieb, *The Electroencephalogram in Psychopathic Personality*, 5 PSYCHOSOMATIC MEDICINE, 139-141 (1943). On the other hand, several studies have been reported in the literature in which no significant differences have been found to exist between delinquents and non-delinquents: F. Gibbs, B. Bagchi, W. Bloom-

It must be made clear that abnormal electroencephalograms are not found in every instance in which the diagnosis of epilepsy has been made. For example, it has been reported that in 42 per cent of patients with clinically diagnosed epilepsy, the routine electroencephalogram was of no great value.²³ The reason for this is not known at present. Where abnormal waves of certain types appear, the diagnosis of epilepsy or predisposition to epilepsy can be made unequivocally, but the absence of such waves does not preclude the existence of an epileptic process.

It seems clear, however, that a number of reputable scientists have confirmed the fact that abnormal brain wave patterns characterize a substantial proportion of children and adults who have a history of difficulty in conforming to the rules of society. Furthermore, it appears that these brain waves are of the type found in psychomotor epilepsy, a disorder in which impulsive, aggressive, negativistic behavior is one of the most important diagnostic signs. Medical science appears to accept the idea that such behavior is not willed, any more than a grand mal convulsion or a petit mal attack is willed. To this extent, psychomotor behavior is irresistible.

It therefore seems logical to suggest that when a defendant's conduct in any way seems to have a compulsive quality to it, and when the motive does not seem to be entirely rational, that an electroencephalographic tracing be made to determine whether or not an epileptic pattern is present.

CRIME AND HYPOGLYCEMIA

A second organic or biologic state which may be related to aberrant and, to some extent, compulsive behavior is that produced by hypoglycemia.

The medical profession has known for many years that a neat balance exists in the body between glucose level and insulin. Where there is a deficiency of insulin, there is an excess of blood sugar, resulting in the disorder which we know as *diabetes*. On the other hand, an overabundance of insulin produces a sugar deficiency termed *hypoglycemia*.

With the discovery of insulin in 1921, the medical profession found it possible for the first time to control the blood sugar of diabetes systematically by the administration of this drug. Physicians soon observed, however, that excessive dosages of insulin produced peculiar neuropsychiatric symptoms, and that patients who had received too much insulin were likely to react in unpredictable fashion. As a result of these observations, scientists began to investigate the role of blood sugar in behavior in an attempt to learn whether abnormalities in the sugar could be correlated with abnormalities in behavior.

berg, "Electroencephalographic Study of Criminals, 102 AMERICAN JOURNAL OF PSYCHIATRY, 294-298 (1945). B. Simon, J. O'Leary, J. Ryan, *Cerebral Dysrhythmia and Psychopathic Personalities*, 56 ARCHIVES OF NEUROLOGY AND PSYCHIATRY, 677-685 (1946).

23. Gibbs, Gibbs, Lennox, *op. cit. supra* note 9 at 125.

The subsequent findings which have appeared in the medical and psychiatric literature during the past two decades are both consistent and significant.

It is now generally agreed that in mild cases of hypoglycemia the patient complains of excessive hunger (although sometimes of lack of interest in food), cold extremities, perspiration, headache, dizziness, tremor of the hands, flushing of the face and other physical conditions. There is also a general slowing down of mental processes, and the patient often has difficulty in making the most simple decisions. Furthermore, we find that the patient often becomes mildly aggressive and irritable.²⁴

Where the hypoglycemic condition is more severe, one can see definite neurological signs which we need not enumerate here. On the psychological side, the patient finds it almost impossible to concentrate and there is marked loss in the realm of abstract thinking ability. Sometimes—and this is of significance from the standpoint of the problem approached in this paper—the patient becomes hyperactive and tense, almost maniacal.²⁵

The extreme cases of hypoglycemia are characterized by confusion and disorientation. These patients are frequently diagnosed as suffering from hysteria, schizophrenia, mania, melancholia, etc. One finds statements in the psychiatric literature to the effect that “. . . some cases of hypoglycemia are first regarded as psychoneurotic.”²⁶

Originally, it was believed that hypoglycemia developed only in diabetics who had been given too much insulin, but in 1924 Harris demonstrated that hypoglycemic symptoms appeared in patients who were not receiving insulin; he proposed the thesis that pathology of the pancreas could spontaneously produce an excessive amount of insulin. Subsequent studies substantiated his theory, and the term, *spontaneous hypoglycemia*, is now employed to describe a hypoglycemia which is not induced by the administering of insulin to the patient, but which occurs as the result of some pathology in the body processes. More recent investigations have shown that hypoglycemia may result from a wide variety of causes, such as disorders of the anterior pituitary gland or of the adrenal cortex, liver and kidney dysfunctions, faulty diet, overexertion, etc.

The diagnosis of spontaneous hypoglycemia is difficult to make, for the symptomatology is not uniform in all cases. In one instance, the patient may be depressed, in another, agitated, and in another, simply confused or be-

24. C. TURNER, *GENERAL ENDOCRINOLOGY* (1948).

25. M. BODANSKY and O. BODANSKY, *BIOCHEMISTRY OF DISEASE* (1940).

26. H. Strauss and I. Wechsler, *Clinical and Electroencephalographic Studies of Changes of Cerebral Function Associated with Variations in the Blood Sugar*, 102 *AMERICAN JOURNAL OF PSYCHIATRY*, 36 (1945).

wildered.²⁷ Furthermore, any of the above symptoms may be present for only a short time, and may vanish after a meal or after glucose has been administered. Proof of the hypoglycemia is extremely difficult to obtain when there are but single attacks at widespread intervals, and it is almost impossible to confirm the diagnosis when an isolated hypoglycemia arises from an external factor like starvation. Of course, the diagnosis is easy to substantiate in chronic cases by blood studies, once suspicion of hypoglycemia arises, but frequently the condition is first described as a functional disorder; it is only when laboratory studies are conducted that the condition is accurately diagnosed.

Wilder has stated that from the standpoint of hypoglycemia in crime, a suspicion of hypoglycemia "... will arise when we hear that the criminal offense does not seem psychologically well motivated, or when there is amnesia for either the whole incident or for single details, or for the time prior to the incident. We shall have it in mind if physical symptoms like striking perspiration, tremor or other symptoms of hypoglycemia accompany or follow the incident, *e.g.*, deep sleep. We shall always keep in mind this possibility if we are dealing with a diabetic, whether he receives insulin or not, or with a non-diabetic treated with insulin, or with a person known to suffer from a condition frequently accompanied by hypoglycemia, *e.g.*, a liver disease or endocrine disorder. We should also think of hypoglycemia in undernourished as well as in abnormally fat individuals, or in cases which present a history of chronic malnutrition, acute starvation, diarrhea or vomiting prior to the crime."²⁸

It has also been shown that "... excitement may, under special circumstances, cause hypoglycemia. . . . In our experience this applies to a combination of repeated excitements within a short period of time, combined with insufficient intake of carbohydrates. These repeated excitements, just like repeated injections of adrenalin and thyroxin, mobilize the glycogen stores, transforming glycogen into glucose, and deplete them. If the subsequent supply of carbohydrates does not replenish them, the ground is laid for hypoglycemia. It is, therefore, very important in the case of an impulsive criminal act to obtain the history of food intake prior to the act."²⁹

This same author points out that one should consider hypoglycemia as a causative factor in crime "... when the behavior of the criminal is peculiar, not quite in the line of his usual personality. . . ." This possibility becomes

27. See for example, T. Rennie and J. Howard, *Hypoglycemia and Tension-depression*, 4 *PSYCHOSOMATIC MEDICINE*, 273 (1942); S. Portis, I. Zitman, *A Mechanism of Fatigue in Neuropsychiatric Patients*, 121 *JOURNAL OF AMERICAN MEDICAL ASSOCIATION*, 569-573 (1943).

28. J. Wilder, *Sugar Metabolism in its Relation to Criminology*, in *HANDBOOK OF CORRECTIONAL PSYCHOLOGY*, 124-125 (R. Lindner and R. Seliger, eds, 1947).

29. *Id.* at 121-122.

more likely when the patient reports a history of "spells" or black-outs, with amnesia for the event.

In one reported case, a white woman of thirty-eight years was admitted to the psychopathic ward of the Los Angeles General Hospital because on the previous day she had had a "nervous spell." Her history disclosed the fact that she had been subject to "nervous hysterical spells" during which she "became emotionally upset and was unable to control herself." It is reported that "Once while in this condition she beat her son unmercifully without rhyme or reason, another time she threw articles of furniture about."³⁰

The behavior of this patient was, during her attacks, characterized by confusion, irritability and maniacal outbursts. It is conceivable that a crime of violence could have occurred during one of her hypoglycemic attacks. Were she examined clinically during the period between attacks, she would have appeared rational and relatively well-adjusted. It is this fact which raises a difficult medico-legal problem. "Since these states may occur and disappear sporadically, and the patient . . . may be mentally normal in the interval, the diagnosis of the psychotic spell is not always easy to substantiate. We may add that the patient's own testimony may be highly misleading due to his amnesia. We feel certain that many cases of that sort remained unrecognized in the past. Even if the psychotic state of mind at the time of the crime as well as the suspicion of hypoglycemic etiology of this state were recognized it still may be difficult to prove. . . ." ³¹

Wilder has accumulated a number of cases in which patients were involved in such diverse crimes as theft, traffic violations, aggressive acts and profanity while in a hypoglycemic state.

The data presented here suggest the necessity of making careful biochemical studies of those defendants whose crimes appear to be unusual for any of the following reasons: (1) the act is out of keeping with the known character of the defendant; (2) there is a state of amnesia for events preceding, concomitant with, or subsequent to the crime; (3) the defendant's demeanor at the time could be described as "peculiar"; (4) there is a noticeable change in demeanor after ingestion of food or glucose; (5) there is a history of diabetes or treatment with insulin.

It has been our purpose to point out that biopathology may play an important role in criminal behavior. From our point of view, it is meaningless to speak of intentional or willed crime in those instances where the motivation is rooted in an organism which is disordered to such an extent that the individual cannot control his actions, and where behavior therefore is, to all in-

30. E. Ziskind and W. Bayley, *Hyperinsulinism*, 23 THE JOURNAL OF LABORATORY AND CLINICAL MEDICINE, 231-240 (1937).

31. Wilder, *op. cit. supra* note 28 at 110.

tents and purposes, automatic. We have briefly discussed but two organic or bio-chemical disturbances, epilepsy and hypoglycemia, which are capable of producing abnormal behavior. There are other organic disease states such as encephalitis, brain tumor, thyroid abnormalities, etc., which merit further analysis along the lines proposed in this paper.

If our orientation be correct, then it should be clear that there is need of bio-chemical and neurological studies of persons accused of crime; this is particularly essential in those cases in which motivations are obscure and tenuous.