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## Alcoholism as a Medicolegal Problem

John M. Macdonald\*

CHRONIC ALCOHOLISM HAS BEEN DEFINED by Sherfey as that condition in which an individual harms himself or his family through the use of alcohol, and either cannot be made to realize it, or realizing it, no longer has the ability to overcome the habit. It has been estimated that there are five million chronic alcoholics in the United States: about four and one quarter million men and three quarter million women.<sup>1</sup> The reliability of these figures may be questioned, but there can be no doubt that alcoholism is a serious social problem. Alcoholism is not confined to any special segment of the population. It occurs in all economic or social levels, the professional, white collar, and skilled worker classes as well as the skid row derelict.

Medico-legal aspects of alcoholism include determination of criminal responsibility, medical evaluation of drunken drivers, interpretation of chemical tests of intoxication and the involuntary commitment of alcoholics to mental hospitals. The policy making functions of attorneys, both in public positions such as membership in the legislature, and in private practice demand knowledge of the origins, course and social consequences of the disease.

The economic costs of chronic alcoholism include medical and hospital treatment for alcoholics, losses resulting from accident and property damage, maintenance of courts and jails, support of the dependents of alcoholics, and potential wage losses. Estimates of these costs range from one to seventeen billion dollars a year. The loss in human suffering cannot be expressed in figures.

It is claimed that alcoholics are responsible each year for 1500 fatal accidents at work, 2850 at home and in public places (which is an accident rate twice that of the non-alcoholic) and sustain 390,000 personal injuries through accidents. The Yale group alleges that the life span of the chronic alcoholic is re-

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<sup>1</sup> Keller and Efron, *The Rate of Alcoholism in the U. S. A.*, 19 Quart. J. Stud. Alcohol 316 (1958).

duced approximately twelve years compared to that of the non-drinker or the ordinary drinker.<sup>2</sup>

Alcoholism among parents probably affects the incidence of juvenile delinquency. It is alleged that some criminals take alcohol to enable them to commit crimes. There can be no doubt that alcoholism is frequently associated with criminal offenses. A study of the urine alcohol concentration found in 822 persons arrested during or immediately after the commission of a felony showed that sixty-four per cent were under the influence of alcohol to such an extent that their inhibitions were reduced.<sup>3</sup> Homicide is frequently committed by persons who have taken alcohol prior to the crime. A recent study in Philadelphia showed that sixty-four per cent of 588 criminal homicides involved the use of alcohol.<sup>4</sup> The reported incidence of drunkenness in crimes of violence ranges from thirty to seventy-three per cent. It should be noted that many offenses are assumed to be due to alcohol on insufficient grounds. Thus an offense might have been committed even in the absence of alcohol. Furthermore, excessive consumption of alcohol and criminal behavior may both have the same root cause in personality maladjustment.

### Origins

The reasons for excessive drinking are not easy to define. Samuel Johnson once said, "In the bottle, discontent seeks for comfort, cowardice for courage and bashfulness for confidence." The common explanation that alcohol provides an escape from the problems of one's existence does not explain why some people resort to it while others do not. Nor does it explain why some people resort to alcohol in times of stress and do so with impunity while others become chronic alcoholics. Sociologists stress the importance of various sociological factors and there can be no doubt that social and cultural factors influence the incidence of alcoholism. These factors have been held responsible for the different rates of alcoholism between men and women and also among ethnic groups in the United States. For example, the incidence is high in the Irish and Scandinavian groups and notably low in Jewish groups. The idea that alcoholism can

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<sup>2</sup> Hirsh, *Public Health and Social Aspects of Alcoholism*, in Thompson, *Alcoholism* (1956).

<sup>3</sup> Shupe, *Alcohol and Crime*, 44 *J. Crim. L., C. & P. S.* 661 (1954).

<sup>4</sup> Wolfgang, *Patterns in Criminal Homicide* (1958).

be inherited as a unitary trait is no longer seriously considered. Metabolic, hormonal and allergic theories of causation are not supported by adequate clinical or experimental evidence.

Alcoholism is not a single entity or disease, but a symptom of mental illness or personality disorder. Thus it may occur in the background of neurosis, as for example anxiety state, psychosis, such as paranoid schizophrenia, or character disorder. Although many psychiatrists believe that there is no one typical pre-alcoholic personality, this viewpoint is disputed. There may be some truth in the statement that many a person is an alcoholic even before he has consumed a single drop of alcohol. The term "oral character" has been used to describe certain persons who are particularly vulnerable to alcoholism. This form of personality disorder has been attributed by the psychoanalytic school to emotional deprivation or overindulgence in the very early years of childhood. The oral character is an immature, egocentric and dependent person who has a poor tolerance for frustration or tension. The dependent attitudes may be masked by an outward appearance of considerable independence.

Although he has excessive needs for reassurance and approval, his self-centered behavior deprives him of the friendship and support which he craves. Neurotic conflicts and the restrictions of conscience interfere with normal social expression of sexual and aggressive drives. Expression of these drives under the influence of alcohol leads to painful feelings of remorse which are assuaged by further ingestion of alcohol. (The conscience has been well defined as that part of the mind which is soluble in alcohol.) In his choice of wife the alcoholic tends to select a motherly controlling woman, but all too often marital conflict and divorce are the outcome.

### Course and Prognosis

Lemere<sup>5</sup> in a study of the drinking history of 500 untreated alcoholics found that: 28 per cent drank increasing amounts until death resulted directly or indirectly from the alcoholism; 29 per cent continued to have a problem of drinking throughout their lifetime; 22 per cent abstained only during their terminal illness; 10 per cent drank more moderately and 11 per cent abstained permanently. Although the illness may be interrupted at any time by a return to sobriety, it tends to run a downward course,

<sup>5</sup> Lemere, *What Happens to Alcoholics*, 109 *Am. J. Psychiat.* 674 (1953).

reflected in the work record by progressive failure and in the personality by increasing irritability, forgetfulness and disregard for the social conventions. Baseless accusation of marital infidelity are not uncommon, particularly in the presence of impotence or latent homosexual tendencies. Some alcoholics become drug addicts and resort to morphine, barbiturates or other drugs.

In the more severe cases the illness is punctuated by episodes of delirium and may terminate in suicide, dementia or Korsakoff's psychosis. Delirium (acute brain syndrome) is characterized by poorly sustained attention, variable difficulty in grasping the statements of others, and in formulating replies, disorientation, hallucinations especially visual, paranoid tendencies and anxiety, depression or other changes in mood. Dementia (chronic brain syndrome) refers to intellectual deterioration with emotional lability and defects in orientation, memory and judgment. Korsakoff's psychosis is characterized by very severe defects in memory, confabulation and intellectual impairment. The use of the term alcoholic hallucinosis indicates failure to distinguish between delirium and a brief schizophrenic illness precipitated by alcohol or other factors.

The results of continued energetic treatment of alcoholism, despite frequent relapses, justifies a more optimistic attitude than is generally held by the public. The need for adequate treatment and the futility of repeated brief jail sentences cannot be over-emphasized. Statistical studies on the outcome of treatment of alcoholics vary greatly in their findings and reports can be found to support both optimism and pessimism. This variation is related to the nature of the treatment, the selection of cases and other factors.

### Treatment

The kind of treatment to be adopted will depend upon evaluation of the causes which led to the alcoholism. Treatment should be directed to the primary disorder, neurosis, psychosis or personality disorder. At the outset the patient is told that he must choose between total abstinence and chronic alcoholism. The alcoholic is unable to change from excessive to moderate drinking. The occasional reported exception to this rule does not challenge its general validity.<sup>6</sup> Much will depend upon

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<sup>6</sup> Lolli, *The Treatment of Alcohol Addiction*, 13 *Quart. J. Stud. Alcohol* 461 (1952).

adequate motivation for treatment. The patient who seeks therapy prior to trial on criminal charges, or under threat of divorce proceedings, loss of employment, or commitment to a mental hospital may have little genuine desire for help. The overly optimistic facile chronic alcoholic who boasts that he can "take it or leave it" is not, as a rule, a suitable candidate for treatment.

The patient who is committed to hospital against his will may regard treatment as punishment and fail to cooperate. It has been stated that involuntary hospitalization serves only to improve the alcoholic's physical condition so that upon release he may continue his drinking with renewed vigor. Recent studies, however, suggest a more favorable outcome following involuntary commitment to mental hospitals. The community will not usually be prepared to compel an individual to submit to treatment until his disorder has become easily recognizable and consequently far advanced. In general, therefore, it may be said that legal compulsion alone, however desirable it may be to protect society from the alcoholic, can do little to bring to light cases of alcoholism in their earliest and, therefore, therapeutically more hopeful stages.<sup>7</sup> There is a need for more out patient clinics for alcoholics in general hospitals. Patients with serious physical or mental disorders should be admitted to hospitals without delay.

Antabuse is a valuable adjunct in the treatment of chronic alcoholism. The drug is taken orally and has no ill effects so long as the patient refrains from alcohol. If alcohol is taken there is a rapid appearance of alarming and extremely unpleasant bodily reactions which have been aptly described as a premature severe hangover. As serious symptoms may follow ingestion of large amounts of alcohol, the treatment cannot be used in persons with serious physical disease. Another drug, temposil, which causes a less severe reaction following ingestion of alcohol may be substituted. It should be remembered that these drugs require the cooperation of the patient and that they are an aid and not a substitute for psychotherapy. The crutch provided by these drugs may have to be continued for many months or even years. All too often patients become overconfident once they have been abstinent for two to three months, and it is important to warn them of the danger of a relapse when

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<sup>7</sup> World Health Organization, 42 Tech. Rep. Ser. (1951).

the drug is discontinued prematurely. The conditioned-reflex treatment is less popular than formerly. A drug which induces nausea and vomiting is given together with alcohol for the purpose of developing an aversion to alcohol.

Alcoholism is a disease in social relations and modern treatment takes advantage of community resources such as social welfare agencies, the public health nurse, probation officer, minister of religion and Alcoholics Anonymous. The latter organization, whose members are former alcoholics, offers the alcoholic an opportunity to escape from his isolation, from the feeling that no one really understands or cares about him. The attitude of acceptance without condemnation is so strikingly in contrast with the attitude of the public, that the alcoholic is more able to accept their help. Treatment of the marital partner of the alcoholic is sometimes desirable.

The aim of psychotherapy is to resolve the emotional problems which underlie the patient's flight into alcoholism. The process of rehabilitation is not based primarily on logical or intellectual argument. Alcoholics know they should not drink. They realize better than anyone else that they are jeopardizing their personal well-being and the welfare of those near them by continuing to drink. Threats, recriminations, separations, jail sentences, promises, have little effect, and that only temporarily. Unless there is a significant change in the alcoholic's feeling about himself and his environment, he will not remain sober for long. He must learn that life in sobriety can be satisfying once the emotional conflicts are lessened, and that he can organize his personal assets into a constructive program of living.<sup>8</sup> There is a need for understanding and a spirit of optimism on the part of all those who contribute to the process of rehabilitation.

### **Criminal Responsibility**

Many crimes are committed under the influence of alcohol, but drunkenness in itself does not relieve the suspect of legal responsibility for his criminal act. According to Weihofen, involuntary intoxication is a defense, where by reason of such intoxication, the defendant was unable to understand the nature and consequences of his act. Intoxication is involuntary only if the intoxicant has imbibed as a result of duress, fraud or mis-

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<sup>8</sup> McCarthy, and Douglas, *Alcohol and Social Responsibility* (1949).

take. It is not sufficient that one was persuaded or advised to drink.<sup>9</sup>

In many crimes the intention to perform the criminal act is an essential element of the crime. As chemical tests for intoxication are performed more commonly than medical examination following arrest to the suspect, the chemical test results may become a focal point of argument in the trial. The relationship of criminal responsibility to test results is further considered in the section on these tests.

Alcoholism resulting in delirium tremens, alcoholic hallucinosis, dementia or Korsakoff's psychosis may relieve a defendant of criminal responsibility. In support of an insanity plea it is sometimes claimed that the defendant suffered from pathological intoxication. This term has been used to describe the appearance of extreme behavioral reactions with subsequent amnesia following the drinking of small amounts of alcohol. Critical study of the various descriptions of pathological intoxication tends to create the suspicion that a naive and credulous belief in the magic powers of alcohol and the diagnostic value of amnesia has resulted in a blending of the symptoms and characteristics of different reaction types to create an entity that bears more relation to legendary composite figures, such as the minotaur and the centaur, than to clinical reality<sup>10</sup>

Pathological intoxication is defined in the *Diagnostic and Statistical Manual* of the American Psychiatric Association as follows:

When without apparent pre-existing mental disorder, there is a marked behavioral or psychotic reaction with an acute brain syndrome after minimal alcoholic intake, the case will be classified here. When a pre-existing psychotic, psychoneurotic, or personality disorder is made more manifest after minimal alcoholic intake, the case will be classified under the diagnosis of the underlying condition.

Although there may be no apparent pre-existing mental disorder, adequate psychiatric examination should reveal those psychodynamic factors which are responsible both for the onset of the behavioral reaction and its symptomatology. May and Ebaugh attribute failure to evaluate psychodynamic factors as accounting for the legendary effect of minute amounts of alcohol

<sup>9</sup> Weihofen, *Mental Disorder as a Criminal Defense* (1954).

<sup>10</sup> May and Ebaugh, *Pathological Intoxication, Alcoholic Hallucinosis and Other Reactions to Alcohol*, 14 *Quart. J. Stud. Alcohol* 200 (1953).



that is mentioned so frequently in discussions of pathological intoxication. A careful history supplemented by additional information from outside sources may clarify not only the particular conflict and precipitating circumstances involved, but also the correct clinical diagnosis. The term pathological intoxication should be abandoned in favor of more accurate clinical diagnosis.

Explosive outbursts of rage are not uncommon in sociopaths when their ego control has been weakened by alcohol. Dramatic histrionic outbursts may be shown by hysterics under the effects of stress and alcohol. Aggressive behaviour and amnesia may have an epileptic origin. Following severe head injury there may be greatly reduced tolerance to alcohol associated with behavioral reaction. The possibility of a short-lived delirious reaction with bizarre behavior should not be overlooked. Even small quantities of alcohol may temporarily release a schizophrenic reaction or exacerbate the symptomatology in cases of ambulatory or pseudoneurotic schizophrenia. The association of amnesia, violence and alcohol does not justify diagnosis of the dubious hypothetical syndrome, pathological intoxication.<sup>11</sup>

### Chemical Tests for Intoxication

Chemical tests for intoxication are based upon analysis of the patient's blood, breath or urine. The brain alcohol concentration is somewhat lower than the blood alcohol concentration, but equilibrium is reached quickly and there is a constant ratio between the alcohol concentration in arterial blood and that in the brain. During the first hour of drinking, the alcohol level in peripheral venous blood is frequently ten to twenty per cent below that of capillary blood. The alcohol concentration in the latter is a more accurate indication of the concentration in the brain.

There is a fairly constant ratio between the concentration of alcohol in the blood and the concentration in the urine as it is secreted. Commonly accepted figures for the urine blood alcohol ratio range from 1.2 to 1, to 1.3 to 1. A urine alcohol test does not necessarily reflect the blood alcohol concentration. A person was given 250 cc. of whisky on going to bed at ten p. m.; the urine was retained until eight a. m. At this time, the concentration in the blood as judged from the urine was 0.11 per cent, whereas direct examination of the blood showed it to

<sup>11</sup> Macdonald, *Psychiatry and the Criminal* (1957).

be alcohol free.<sup>12</sup> In order to avoid obtaining urine which has accumulated in the bladder over a long period of time, the sample should be obtained about fifteen to twenty minutes after the patient has emptied his bladder completely.

Usually the test results on urine or breath are reported in terms of the equivalent blood alcohol concentration. Blood alcohol tests may be expressed as milligrams per cubic centimeter, milligrams per 100 cubic centimeters, or grams per 100 cubic centimeters. If each expert at the trial uses a different method of reporting the blood alcohol level, this may cause considerable confusion, which is not always confined to the lay persons present. In the stress of the court room atmosphere, the expert himself may become confused. He should remember that the following figures all express the same concentration of alcohol in the blood.

150 mg. per 100 cc.	1.5 mg. per cc.
0.15 gm per 100 cc.	150 mg per cent
0.15 per cent by weight	

The concentration of alcohol in the blood reaches a maximum in about one half to one hour after ingestion. Absorption from the gastrointestinal tract is slowed by the presence of food, especially fatty food in the stomach. More rapid alcohol absorption occurs from drinks containing an alcohol concentration of from fifteen to thirty per cent than from drinks containing more concentrated or more dilute solutions. After reaching a maximum the concentration of alcohol in the blood decreases at a fairly steady rate. About ninety per cent of the alcohol is oxidized to carbon dioxide and water and the remainder is eliminated unchanged, principally in the breath and urine together with small amounts in water loss from other sources.<sup>13</sup>

The rate of disappearance of alcohol from the blood varies considerably between individuals. This is of some importance as medical or biochemical experts in court sometimes claim to be able to estimate the accused's blood alcohol concentration at the time of the crime on the assumption that the accused eliminated alcohol from his blood at a certain rate between the time of his drinking and the time of the crime. Rabinowitch quotes the Criminal Court of Appeal in Texas as accepting as a fact that normally all persons eliminate alcohol from their body at

<sup>12</sup> Haggard, Greenberg, Carrol and Miller, *The Use of the Urine in the Chemical Test for Intoxication*, 115 J. A. M. A. 1680 (1940).

<sup>13</sup> *Supra*, n. 11.

the same rate—a belief contrary to every known fact about the metabolism of alcohol in the human body.<sup>14</sup>

Once alcohol absorption has been completed and equilibrium has been established, the average fall in blood alcohol concentration is 15 mg. per cent per hour and the average disappearance rate of alcohol from the body of a 150 pound man is 7 gm. per hour (i.e., 9 cc. of absolute alcohol or about two-thirds of an ounce of whisky). These are average figures and the rate of disappearance of alcohol from the body varies between one person and another, and also in the same person from day to day or even hour to hour. According to Widmark, the rate of fall in blood alcohol concentration in different individuals varies between 10 and 24 mg. per cent per hour. Similarly, the disappearance rate of alcohol from the body varies between 4.3 and 11.2 gm. per hour.<sup>15</sup>

It is clear that any attempt to estimate the suspect's blood alcohol concentration at the time of the crime on the basis of deductions drawn from a knowledge of the amount of alcohol ingested over a certain period of time, or from the results of a blood alcohol test taken some hours after the crime, can yield only a very approximate answer, because of the wide variation in different persons in rates of disappearance of alcohol from the body. Yet some experts will estimate a suspect's blood alcohol level in this manner at a single definite figure, which is stated in evidence with a degree of confidence and dogmatism which ill becomes their scientific training.

There is marked individual variation in reaction to alcohol, and widely divergent blood alcohol concentrations may be required in different individuals to produce the same degree of intoxication. All other things being equal, a person accustomed to taking alcohol regularly will probably be less affected, at a given blood alcohol concentration, than will be an abstainer or occasional drinker. Brain injury, organic brain disease, or recent febrile illness may render a person more susceptible to the effects of alcohol. Barbiturate and tranquillizing drugs, such as chlorpromazine, potentiate the effects of alcohol.

Mellanby has shown that a given level of blood alcohol produces more symptoms of intoxication when the blood alcohol

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<sup>14</sup> Rabinowitch, *Chemical Tests of Alcoholic Intoxication*, 24 *Obiter Dicta* 2, 15 (1955).

<sup>15</sup> Harger and Hulpieu, *The Pharmacology of Alcohol*, in Thompson, *Alcoholism* (1956).

concentration is rising than when it is falling. *Mirsky et al.* have demonstrated that when the blood alcohol concentration is maintained for some hours, symptoms of intoxication may disappear at blood alcohol levels which are much higher than those at which symptoms of intoxication previously developed. For example, one of their patients became drunk at a blood alcohol level of 188 mg. per cent and later regained sobriety at a blood alcohol level of 291 mg. per cent.<sup>16</sup>

These findings have been subjected to question as peripheral venous blood was used in the experiment. Fifteen minutes after the first drink, the level of alcohol in arterial blood may be forty to sixty per cent higher than the level in peripheral venous blood and this lag may persist for the first hour of drinking. Therefore, during the rising level, the actual alcohol concentration in arterial blood and brain may have been much higher than the peripheral venous blood levels reported by *Mirsky*.<sup>17</sup>

Goldberg's study<sup>18</sup> cannot be subjected to this criticism as capillary blood was used for the alcohol tests. The degree of intoxication at a given blood alcohol concentration was found to be greater for motor and psychological functions, but not for sensory functions, when the blood alcohol concentration was rising than when it was falling. Thus symptoms appeared at lower blood alcohol concentrations than the concentrations at which they disappeared. More sensitive tests were employed than those used by *Mirsky et al.* The difference in blood alcohol concentrations between appearance and disappearance of symptoms varied from 1 to 32 mg. per cent depending on the particular motor, psychological or sensory function tested.

Some persons may show clinical evidence of intoxication with a blood alcohol concentration of less than 50 mg. per cent, while others, usually chronic alcoholics, may not be intoxicated, by clinical tests, despite a blood alcohol level of over 300 mg. per cent. Several chronic drinkers in *Jetter's* study<sup>19</sup> were

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<sup>16</sup> *Mirsky, Piker, Rosenbaum and Lederer, Adaptation of the Central Nervous System to Varying Concentrations of Alcohol in the Blood, 2 Quart. J. Stud. Alcohol 23 (1941).*

<sup>17</sup> *Harger, Comments on the Article "Medico-Legal Aspects of Chemical Tests of Alcoholic Intoxication" by Dr. I. M. Rabinowitch, 12 Canad. Serv. M. J. 808 (1956).*

<sup>18</sup> *Goldberg, Quantitative Studies on Alcohol Tolerance in Man, 5 Acta Physiol. Scandinav. 1 (1943).*

<sup>19</sup> *Jetter, The Chemical and Clinical Diagnosis of Acute Alcoholism, 221 New Eng. J. Med. 1019 (1939).*

found to be relatively sober by clinical tests, yet the blood alcohol concentration ranged from 350 to 450 mg. per cent. This latter concentration is close to the lethal point and is one at which severe intoxication or even coma is the common finding.

The findings of six investigators regarding blood level and the appearance of frank intoxication have been reported by Harger and Hulpieu.<sup>20</sup> The usual criteria for frank intoxication in these studies were weaving gait, slurred speech and other signs of muscular incoordination. These criteria of intoxication represent a greater degree of impairment than the beginning levels of impairment included in the definition of "under the influence" accepted by most courts with respect to automobile driving.

Certain conclusions may be drawn from these findings. A very few persons become drunk with a blood alcohol concentration below 50 mg. per cent. Almost ninety per cent of persons with a blood alcohol level between 150 and 200 mg. per cent are drunk. Very few persons with a blood alcohol concentration of over 200 mg. per cent will escape a diagnosis of drunkenness. The higher the alcoholic content of the blood, the greater is the probability that the person was intoxicated, but this is a statistical conclusion, it therefore may or may not, and need not necessarily apply to the individual.<sup>21</sup> The blood alcohol level should always be interpreted in the light of the clinical findings.

It should be emphasized again that a person may become incapable of driving a car safely before he becomes clinically drunk.

### Reliability of Chemical Tests For Intoxication

As with any laboratory test there is always the possibility of error. The wrong blood may be tested, the chemical solutions may contain impurities, or mistake may be made in obtaining or reporting the results of the test. Contamination by rubber connections causes minimal errors.<sup>22</sup> A manslaughter case where the sample of blood for the test had been allowed to clot and the chemist had used the serum only for the test, prompted the comment by Rabinowitch that such a procedure could lead to

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<sup>20</sup> *Supra*, n. 15.

<sup>21</sup> *Supra*, n. 14.

<sup>22</sup> Jetter, A Critical Survey of Various Chemical Methods for Determining the Alcohol Content of Body Fluids and Tissues With Their Physiological and Medico-Legal Significance, 2 Quart. J. Stud. Alcohol 512 (1941).

an error of twenty to twenty-five per cent.<sup>23</sup> This contention has been contradicted by Harger<sup>24</sup> and Muehlberger.<sup>25</sup>

The use of alcohol for sterilizing the skin surface prior to the taking of the blood specimen does not introduce any appreciable error into the results of the blood analysis. In Muehlberger's extensive experience, the error is usually less than 0.01 per cent alcohol in the blood and never has been known to be above 0.02 per cent.<sup>26</sup> When only small amounts of blood are available, as with capillary tests, there is greater potential chance for chemical errors. Providing a careful technique is used, blood alcohol tests should not have an error exceeding plus or minus three per cent in alcohol concentrations of 0.1 per cent and over.<sup>27</sup>

A breath test will only give an accurate measure of the concentration of alcohol in the circulating blood if there has been a lapse of at least fifteen minutes between either the taking of the last drink or the time of regurgitation of alcohol from the stomach and the taking of breath for analysis. During this fifteen-minute interval any alcoholic liquor remaining in the mouth and throat or under a dental plate will have been washed down by saliva.<sup>28</sup>

Those breath tests (Drunkometer and Intoximeter) which calculate the content of alveolar air in an ordinary breath by analyzing the carbon dioxide content, are based on the assumption that the carbon dioxide content of alveolar air is always close to 5.5 per cent by volume. This assumption is not true in the presence of severe acidosis or alkalosis which will affect the test results. These conditions may be controlled or eliminated by proper precautionary methods. Practically all types of acidosis can be detected (with the possible exception of uremia) by the presence of acetone in the breath.<sup>29</sup>

The severe acidosis in starvation, uncontrolled diabetes and uremia may cause falsely high results in a breath test as com-

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<sup>23</sup> *Supra*, n. 14.

<sup>24</sup> Harger, *Medicolegal Aspects of Chemical Tests of Alcoholic Intoxication*, 39 *J. Crim. L., C & P. S.* 402 (1948).

<sup>25</sup> Muehlberger, *Medicolegal Aspects of Chemical Tests of Alcoholic Intoxication*, 39 *J. Crim. L., C & P. S.* 411 (1948).

<sup>26</sup> *Ibid.*

<sup>27</sup> *Supra*, n. 22.

<sup>28</sup> Bogen, *Drunkenness*, 176 *Am. J. M. Sc.* 153 (1928).

<sup>29</sup> Jetter and Forrester, *The Perchlorate Method for Determining Concentration of Alcohol in Expired Air as a Medicolegal Test*, 32 *Arch. Path.* 828 (1941).

pared with a blood alcohol test. Several persons addicted to alcohol who were admitted to the hospital in a state of severe starvation showed a breath alcohol figure much higher than the blood alcohol figure.<sup>30</sup> Hyperventilation, to the point of imminent syncope, may result in a breath alcohol determination which is fifty to one hundred per cent higher than the true level present in the blood sample.<sup>31</sup> Hyperventilation is to be avoided; at least ten minutes should elapse from the time of hyperventilation to the time the apparatus is used. The drastic unnatural type of hyperventilation used in the above study by Jetter and Forrester does not occur in subjects being given breath tests, and a few deep breaths just prior to the test do not alter the results.<sup>32</sup>

Alkalosis resulting from emesis or severe muscular exercise may give falsely low results in a breath test. The subject should be at rest for at least ten minutes if there has been previous severe muscular exercise; a waiting period of twenty to thirty minutes becomes necessary if emesis has occurred.<sup>33</sup>

The National Safety Council studied three methods of blood alcohol determination by analysis of the breath. It was found that when the Drunkometer, Intoximeter and Alcometer were used in the manner recommended by the authors, the results obtained were in close agreement (plus or minus .015 per cent) with results obtained by direct analysis of the blood. The maximum disagreement was 0.28 per cent and this error (along with two others over .02 per cent) was probably due to faulty technique.<sup>34</sup>

If the victim and the accused had been drinking equal amounts of liquor together prior to the homicide, it may be claimed that a post-mortem blood alcohol test on the victim gives a good indication of the blood alcohol concentration of the accused at the time of the crime. Such an assertion is open to question as the rate of alcohol elimination from the body may vary considerably between the two persons. There are four important sources of error in the estimation of the blood alcohol concentration in a dead body. (1) Alcohol may be produced in the body

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<sup>30</sup> *Ibid.*

<sup>31</sup> *Ibid.*

<sup>32</sup> *Supra*, n. 17.

<sup>33</sup> *Supra*, n. 22.

<sup>34</sup> *Chemical Tests for Intoxication*, National Safety Council Committee on Tests for Intoxication (1953).

after death by alcohol producing bacteria.<sup>35</sup> (2) Putrefaction may cause the production of volatile reducing agents which, unless special precautions are taken, may interfere with the determination of alcohol content of the blood or tissue. (3) Diffusion of alcohol through the stomach wall after death may cause an increased alcohol concentration in blood in the thoracic cavity. Gifford and Turkel<sup>36</sup> demonstrated that instillation of whiskey into the *in situ* stomach of cadavers may result in sufficient diffusion of the alcohol to result in a thoracic blood alcohol level as high as 312 mg. per cent. Blood from the femoral veins of the same cadavers contained no alcohol or only a slight trace. (4) The fluid used to embalm the body may contain alcohol.

The results of chemical tests for intoxication are so highly regarded by some courts that any technical error in the performance of the test may cause grave injustice.

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<sup>35</sup> Bonnichsen, Halstrom, Moller and Thedrell, Development of Ethanol in Blood Samples and Human Organs During Forensic Clinical Practice, 9 *Acta Pharmacol. et Toxicol.* 352 (1954).

<sup>36</sup> Gifford and Turkel, Diffusion of Alcohol Through Stomach Wall After Death: A Cause of Erroneous Blood Alcohol Levels, 161 *J. A. M. A.* 866 (1956).