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**EXPERT COMMITTEE ON
ALCOHOL**

First Report

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EXPERT COMMITTEE ON ALCOHOL

First Session

Geneva, 5-10 October 1953

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EXPERT COMMITTEE ON ALCOHOL

First Report *

The first session of the Expert Committee on Alcohol was held in Geneva from 5 to 10 October 1953.

Dr. H. S. Gear, Assistant Director-General, welcomed the members of the committee on behalf of the Director-General, Dr. M. G. Candau, who was away from Headquarters. He expressed the appreciation of the World Health Organization for their readiness to provide technical guidance on the important subject to be discussed, and also outlined the general principles established by the World Health Assembly and the Executive Board defining the status of and procedures for expert committees.

1. Definitions Formulated by the Expert Committee on Drugs Liable to Produce Addiction and by the Alcoholism Subcommittee of the Expert Committee on Mental Health

The committee noted the various definitions formulated by the Expert Committee on Drugs Liable to Produce Addiction and by the Alcoholism Subcommittee of the Expert Committee on Mental Health.

The Secretary explained the difference between the Alcoholism Subcommittee and the Expert Committee on Alcohol—namely, that the former was concerned with psychiatric clinical and social aspects of the question, while the latter was concerned with the physiological, pharmacological, and biochemical properties of alcohol.

2. Concepts Pertaining to the Pharmacological Position of Alcohol

2.1 Tolerance to alcohol

The committee recognized the existing state of confusion arising out of the indiscriminate use of the term "tolerance". It was felt necessary

* The Executive Board, at its thirteenth session, adopted the following resolution :
The Executive Board

1. NOTES the first report of the Expert Committee on Alcohol ;
2. THANKS the members of the committee for their work ; and
3. AUTHORIZES publication of the report.

(Resolution EB13.R14, *Off. Rec. Wld Hlth Org.* 52, 6)

to make a distinction between the use of the term tolerance in connexion with addiction-producing drugs of the morphine type, and that required for consideration of the problems which arise in connexion with the use of alcoholic beverages.

In the case of alcohol, which, in the form of alcoholic beverages, is consumed by many people as a social custom, a concept of tolerance is needed which describes differences in the inherent susceptibility of individuals to the effect of the substance on the function of the nervous system. It was therefore agreed to regard tolerance to alcohol as the capacity of the organism to function with alcohol in the blood without measurable deterioration in nervous function.

That considerable individual differences in tolerance to alcohol in this sense exist has been demonstrated in experimental work upon animals and man. Various functions of the nervous system have been tested by suitable procedures, such as fusion frequency determination, the use of the pursuit meter, electro-encephalography, quantitative measurement of standing steadiness, and many others. By administering different amounts of alcohol, and following by serial determinations both test performance and blood alcohol concentration, it has been possible to correlate the response of the organism, as measured by these tests, to blood alcohol concentration.

Such experiments have demonstrated that there is a critical level or threshold of alcohol concentration in the blood at which performance begins to show deterioration. This threshold is characteristic of the individual tested and of the particular test employed. Tolerance to alcohol can thus be measured by that concentration of alcohol in the blood at which a demonstrable effect on the performance of a given test of nervous function first becomes apparent.

Since this precise method of measuring tolerance to alcohol exists, it was considered that the term tolerance should not be used in other senses such as, for example, the following :

- (a) the amount of alcohol required by an individual to produce euphoria ;
- (b) the amount of alcoholic beverages ingested by an individual without the appearance of signs of intoxication ;
- (c) the mere ability to ingest large quantities of alcohol irrespective of whether such quantities result in intoxication or not.

The main reason for the rejection of the above forms of usage was because they relate the effects of alcohol to dosage. This is undesirable since variation in the rate of absorption and other aspects of the metabolism

of alcohol, as well as the period over which ingestion takes place, may change the relation between dosage and blood alcohol levels.

It appeared to the committee particularly undesirable to introduce the concept of tolerance in connexion with the phenomenon known as "loss of control" as defined by the Alcoholism Subcommittee.¹

2.2 *Acquired increase of tolerance to alcohol*

It has been shown that to produce the same effects, as measured by objective tests, a higher blood alcohol level is required in habitual heavy drinkers than in moderate drinkers and abstainers. That this increase of tolerance is acquired is shown by its disappearance after a period of abstinence. There is, furthermore, experimental evidence that in animals subjected to prolonged administration of large doses of alcohol the blood alcohol level required to produce the same symptoms must be increased.

Since the term tolerance had been reserved to denote the inherent susceptibility of the individual to alcohol, another term was needed to describe the change in resistance to the drug brought about by habitual intake. It was recommended that this be referred to as "acquired increase of tolerance". This usage would correspond roughly to the term "acquired tolerance" as employed in the case of addiction-producing drugs of the morphine type.

In view of the variation in the acquired increase of tolerance to alcohol, even among heavy drinkers, the committee suggested that research on the determining factors should be undertaken. Such research might be greatly facilitated if it were found possible to adopt a standard set of tests in order to permit of comparison between the results obtained by different workers.

Prolonged heavy intake of alcohol does not decrease the rate of absorption nor does it increase the rate of oxidation or excretion of alcohol. There is no evidence to show that the permeability of the haemato-encephalic barrier to alcohol is lowered. Two other possible explanations have been put forward for the increase in resistance to alcohol.

Conditions may arise that make the nervous system more resistant to alcohol, or the individual may compensate for the effects of intoxication through the process of learning. Frequently, these two possibilities are regarded as though mutually exclusive, but it does not appear necessary to make this assumption. No doubt continued experience with the effects of alcohol can enable an individual to offset them to a limited degree. However, in view of the results of experiments with objective tests both in man and in animals it is the opinion of the committee that, although

¹ See *Wld Hlth Org. techn. Rep. Ser.* 1952, **48**, 33.

the biological mechanism of the change is not fully understood, the total phenomenon cannot be accounted for solely by compensation based on learning, and in addition requires for its explanation a changed physiological response of the organism to alcohol.

The committee felt that special emphasis should be laid on the fact that acquired increase of tolerance to alcohol was of a lower order of magnitude than the corresponding phenomenon known to occur with addiction-producing drugs of the morphine type. The morphine addict may develop (an increase of) tolerance enabling him to withstand several times the lethal dose. An increase of this degree has not been observed with alcohol.

While knowledge is beginning to accumulate on the action of alcohol in the unaccustomed organism, as judged by the application of a number of physiological, pharmacological, and other methods in animals and man, very little is known about the underlying mechanism of acquired increase of tolerance in the habituated organism. The committee believed that basic research in this field was very desirable.

2.3 *Withdrawal symptoms*

The existence of withdrawal symptoms in alcoholism is a controversial question. As far as animal experimentation is concerned, no evidence has come forth as yet of the existence of specific symptoms following abrupt withdrawal of alcohol. Thus, the question can be discussed only on the basis of clinical observations.

Upon interruption of an acute alcoholic episode certain symptoms are not infrequently observed. The symptoms are largely in the category of psychomotor excitement, but convulsions of the "grand mal" type are also seen.

The committee feels that a sharp distinction must be made between these symptoms and those which are produced by the withdrawal of morphine-type drugs. The symptoms after sudden withdrawal of alcohol are of short duration and, in the absence of serious organic disease, do not usually have grave consequences. Such symptoms may be tentatively regarded as involving a process of physiological readaptation, requiring a comparatively short time for its accomplishment.

The symptoms occur only on abrupt withdrawal and are not observed during either voluntary or enforced abstinence. This latter point distinguishes markedly the effects of withdrawal of alcohol from those following withdrawal of drugs of the morphine type. For this reason, the committee recommends, in connexion with alcohol, the use of the term "withdrawal symptoms" alone; the term "abstinence syndrome" is justified in the case of drug addiction of the morphine type.

While the processes behind the appearance of these withdrawal symptoms are not clear, the occurrence of convulsions accompanied by characteristic electro-encephalographic changes (patterns of diffuse slow rhythms immediately after the convulsion) strongly suggests that some symptoms at any rate have an organic basis although emotional disturbances may play a part in their appearance.

Further study of such withdrawal symptoms in the human subject appears to be necessary. Although alcohol withdrawal symptoms have not, hitherto, been observed in animals, there is a possibility that more-adequate methods of investigation will reveal them.

3. The Approach to Alcoholism by Animal Experiments

3.1 *General considerations*

The phenomenon of increased voluntary consumption of alcohol by animals under different experimental conditions has been reported by a number of workers. Among these conditions may be mentioned vitamin deficiency, toxic agents (including those producing obvious liver damage), and states of conflict induced by conditioning procedures.

This phenomenon is occasionally referred to as "experimental alcoholism", but the committee considers the use of this term to be undesirable. In the present stage of knowledge it is not possible to extend such observations upon animals subjected to vitamin deficiencies or toxic influences directly to the problem of alcoholism. The latter condition involves considerably more than a mere increase of alcohol consumption. The relief by alcohol of experimentally induced neurotic manifestations in animals represents a somewhat closer approach to alcoholism, but important features of the latter are not represented in such an experimental situation, since the preference for alcohol does not persist after resolution of the conflict. Similarly, the demonstration in rats of the genetically determined character of alcohol drinking behaviour cannot be directly applied to the human problem.

3.2 *Specific organogenic approaches*

Present knowledge of the basic mechanism of acute alcoholic intoxication is meagre. This constitutes a difficulty in the investigation of the corresponding long-term changes induced by alcohol. Various proposals have, however, been made to elucidate certain aspects of alcoholism by means of experimentation to the more recent of which brief reference may now be made.

3.2.1 *Nutritional deficiencies.* In recent years, attention has once more been focused on the possible role of dietary factors by a number of investigators, mostly using autoselection techniques applied to rats. The preference displayed in a restricted choice situation has an inherent weakness for which reason the identification of increased voluntary consumption of alcohol under such conditions with that occurring in alcoholics may not be justified. On the other hand, it might be maintained that a preference for alcohol shown in autoselection experiments could be an indication of the presence of a need which, exaggerated under pathological conditions, might gain the attributes of craving in the sense of irresistible desire. The committee feels that this point is far from settled.

3.2.2 *The approach via endocrine studies.* On the basis of clinical reports indicating reduced adrenocortical function among alcoholics and stimulation by alcohol of the pituitary-adrenal system, craving for alcohol has been interpreted as arising from the need for substances of the adrenal cortex which, according to the results of certain experiments carried out on animals, may be released following ingestion of alcohol. It has been surmised, although not as yet demonstrated, that alcoholism might result from a disturbance in the control of the pituitary affecting adrenocortical secretions. The evidence in the literature is, however, conflicting.

3.2.3 *Other concepts*

(a) According to some authors, craving has been interpreted as the need for lengthening of chronaxie by the depressant agent, alcohol. The generalization to the entire nervous system of observations on the flexor-extensor relationship in peripheral nerve seems highly dubious. In alcoholics variable effects of alcohol on chronaxie were found, and earlier ideas on the influence of acid-base equilibrium were invoked as an explanation of the chronic toxic states believed by that particular group to account for the phenomena of chronic alcoholism. Such ideas undoubtedly account for later attempts to implicate pyruvate as the toxic factor in (chronic ?) alcoholic states.

(b) Upholders of the view that alcohol possesses antigenic properties have suggested, on the basis of the treatment by intravenous administration of alcohol, that circulating antibodies require the consumption of increased amounts of alcohol.

(c) Attempts have been made to explain craving for alcohol as the result of hyperactivity of cerebral centres vis-à-vis the mid-brain or medullary centres. The resultant disequilibrium may, according to such ideas, be overcome either by the depressant action of alcohol on the cortex or by stimulation of the lower centres by apomorphine.

(d) The presence in blood of a "resentment substance" of cholinergic character, removed by alcohol, has been invoked as an explanation of desire for alcohol.

The committee is not convinced by the evidence put forward in favour of any of these concepts.

3.3 *General comment*

It may be added that the pathophysiological approach has not as yet achieved major successes in the therapeutic field, where empirical methods remain dominant, and are often directed mainly towards assisting the application of psychotherapy.

It is suggested that, at the present time, a tentative approach is required. This visualizes an interplay of laboratory investigation and planned clinical experiments designed to check and guide the laboratory work at intermediate stages. Animal experiments might be of considerable value in studying the nature of particular processes which could be considered to play a part in the genesis of alcoholism. Although there is at present no evidence for the initiation of heavy drinking through organic disturbances, this possibility can by no means be considered to be ruled out. The increased voluntary intake of alcohol observed in animals under various experimental conditions probably signifies an organogenic "craving" or "need" for alcohol for which parallels might be found in alcoholism.

3.4 *The position of alcohol as a drug*

After the foregoing deliberations the committee turned its attention to the previously noted definitions formulated by the Expert Committee on Drugs Liable to Produce Addiction and the Alcoholism Subcommittee of the Expert Committee on Mental Health.

It was agreed that the question of whether alcohol, from a pharmacological point of view, should be classified as a drug liable to produce addiction should as far as possible be answered on the basis of the attitude of the committee to the items discussed above.

The definition of an addiction-producing drug given by the Expert Committee on Drugs Liable to Produce Addiction was accepted.² According to this definition drug addiction is characterized by:

"(1) an overpowering desire or need (compulsion) to continue taking the drug and to obtain it by any means ;

"(2) a tendency to increase the dose ;

² *Wld Hlth Org. techn. Rep. Ser.* 1950, **21**, 6

“ (3) a psychic (psychological) and sometimes a physical dependence on the effects of the drug ”.

Overpowering desire to continue taking the drug and to obtain it by any means was considered by the committee to occur only in a minority of users of alcohol ; and if it does occur, it is of a lesser degree than is the case with morphine. The acquired increase of tolerance to alcohol is of a considerably lower order of magnitude than the corresponding phenomenon known to occur with addiction-producing drugs of the morphine type. The lack of persistent abstinence symptoms after withdrawal of alcohol was held to indicate the absence of dependence in a degree comparable to that produced by morphine-like substances.

Since alcoholism does not conform with the requirements of the above definition of drug addiction, it was agreed that alcohol cannot be classified as an addiction-producing drug.

The question of whether alcohol might be listed as a habit-forming drug was then discussed, and the committee decided that this was not possible in view of certain characteristics of this substance.

In this connexion, emphasis was laid on the following features :

(a) The serious social consequences of excessive intake of alcohol must exclude alcohol from the habit-forming group of drugs.

(b) The sudden withdrawal of alcohol from heavy drinkers often causes withdrawal symptoms of short duration which imply some degree of dependence, although withdrawal of alcohol does not cause persistent abstinence symptoms as in the withdrawal of morphine and allied drugs.

(c) Although the committee hesitated to acknowledge the increased voluntary intake of alcohol observed in animals under certain experimental conditions as “ experimental alcoholism ”, these observations seem to indicate that a “ craving ” for alcohol may have a physical basis besides the psychological origin which presumably is predominant in alcoholism.

For these reasons, it was thought necessary to place alcohol in a category of its own, intermediate between addiction-producing and habit-forming drugs.

In defining an appropriate category for alcohol, the definition of an intermediate group of drugs suggested by the Expert Committee on Drugs Liable to Produce Addiction at its third session³ was chosen as basis.

The following statement was agreed on :

Alcohol must be considered a drug whose pharmacological action is intermediate in kind and degree between addiction-producing and

³ See *Wld Hlth Org. techn. Rep. Ser.* 1952, 57, 10.

habit-forming drugs, so that compulsive craving and dependence can develop in those individuals whose make-up leads them to seek and find an escape in alcohol. With this substance the personal make-up is the determining factor but the pharmacological action plays a significant role. Damage to the individual may develop, but does so in only a minority of users. The social damage that arises extends, however, beyond these individuals themselves.

4. Metabolism of Alcohol

The committee felt that as a large part of its discussions had been concerned with the problems of alcoholism, it would be appropriate, in discussing the question of the metabolism of alcohol, to pay special attention to the conditions arising from excessive intake of alcohol which has occasionally been reported to occur among alcoholics. A regular daily consumption of 400 g of alcohol or even more has been claimed as an authentic observation. Intakes of such magnitude raise the problem of whether present knowledge of the metabolism of alcohol is capable of furnishing a reasonable explanation of the disposal of such an amount of alcohol.

4.1 *The disposal of alcohol following excessive intake*

The mechanisms by which alcohol is disposed of by the body are in general well known. The major portion of the alcohol undergoes oxidation, principally in the liver, while a small percentage is directly excreted via the kidneys, lungs, and sweat glands. The portion which is oxidized may undergo either complete or partial oxidation. In the latter event, the acetate formed as an intermediate product, and added to the general "metabolic pool" of acetate, is assumed to enter into synthetic reactions.

The excretion by the routes mentioned, which makes as a rule a very small contribution to the total disposal, is capable of a relatively large increase when the alcohol intake is excessive, since the total amount excreted by these routes increases roughly as the square of the amount ingested. Nevertheless, even at high levels of alcohol intake, the proportion of the ingested alcohol excreted by such means remains small.

The question therefore arises whether, in conditions of excessive intake of alcohol, it is necessary to suppose that the rate of oxidation is greatly increased. This would imply a marked dependence of the rate of alcohol disposal upon the blood alcohol concentration, since oxidation is the principal process concerned in the elimination of alcohol. Experiments carried out by different methods have, however, confirmed each other in showing

that while a certain degree of dependence of oxidation rate upon blood alcohol concentration does most probably exist, this is not very marked within the range of blood alcohol levels up to 0.2%. The dependence of alcohol oxidation rate upon blood alcohol concentration appears to be more readily demonstrable under some conditions than others, e.g., following the ingestion of beer. The committee considers that there is need for further study of the relationship between oxidation rate and blood alcohol concentration at really high levels.

The average rate of disposal of alcohol, based upon study of blood alcohol curves, is generally stated to be not much greater than 100 mg/kg/hr. This value represents the collective results of observations made, for the most part, upon younger male subjects in the fasting state following the administration of moderate amounts of alcohol (usually not more than 1 g per kg in a single dose) which would lead to blood alcohol concentrations of about 0.13% in subjects of average body-weight. There is, however, a considerable degree of variation around the mean, and disposal rates in the vicinity of 200 mg/kg/hr are found recorded in the literature. In order to account for the disposal of 400 g of alcohol per diem by a person of average body-weight, it is necessary to postulate a disposal rate of approximately 200 to 240 mg/kg/hr. Even after making due allowance for a possible increased rate of excretion, resulting from higher blood alcohol levels and the effects of diuresis, it may still be necessary to assume a rate of alcohol oxidation well above the average but still not outside the limits of variation demonstrated experimentally.

It is not, however, absolutely necessary to postulate complete oxidation of the large quantities of alcohol involved, which might raise difficulties in that the total oxidation of 400 g of alcohol or more would lead to the production of more than 2,800 kilogram-calories (Cal) in 24 hours which is in excess of the normal resting metabolism. Instead, it is possible to conceive that some of this large amount of alcohol may undergo partial oxidation, and that the acetate resulting therefrom may enter into synthetic reactions leading to the formation of depot fat. Studies carried out with the aid of ethyl alcohol labelled with radio-active carbon have shown that, following the removal of most of the alcohol by oxidation, a slow elimination of radio-active carbon dioxide continues for many hours, indicating the fixation in the tissues of some portion of the carbon originally supplied in the form of ethyl alcohol. It would be consistent with present knowledge of acetate metabolism to assume that the incorporation of the radio-active carbon into fat is the cause of this phenomenon.

Quite apart from the possibility that oxidation of alcohol may not proceed to completion, there is the additional possibility that the disposal rate may be somewhat increased by influences associated with the taking of food. On the basis of present knowledge, there is thus no insuperable

difficulty in accounting for disposal rates of alcohol the existence of which, since continuous accumulation of alcohol could not occur, must be inferred from the large intakes occasionally recorded. It would, however, be a matter of extreme interest to have subjects displaying such a phenomenon more thoroughly investigated with a view to finding whether an explanation on the lines suggested in the foregoing paragraphs may be considered valid. It requires to be re-emphasized that such excessively high intake of alcohol is a rare occurrence.

The observations already mentioned relating to the variation of the oxidation rate at different levels of blood alcohol raise an interesting problem. Hitherto, the assumption has been generally made that the descent of the blood alcohol concentration follows a rectilinear course. This independence between oxidation rate and concentration was perfectly consistent with the view that the first step in the oxidation of alcohol in the animal body was effected solely by a dehydrogenase. The kinetics of this reaction are well known and would lead to a rate of oxidation which would be independent of the blood alcohol concentration down to quite low levels of the latter. Since now it is necessary to recognize that the oxidation rate is to a certain extent dependent upon the blood alcohol concentration, some modification of views is required. One suggestion that has been made is to the effect that alcohol may enter into a coupled reaction with hydrogen peroxide in the presence of catalase which would lead to its oxidation. This process, the rate of which would be dependent upon the concentration of alcohol, might possibly afford an explanation of the newer observations.

4.2 Nutritional involvement of alcohol consumption

It has already been stated that oxidation of alcohol leads to formation of acetate, which is further oxidized by the same route as acetate coming from other sources. Of the total 7.1 Cal available from the total oxidation of one gram of alcohol, approximately 2.6 Cal are liberated during the first stages of oxidation to acetate. The remainder should clearly be available to the body, provided that the acetate is oxidized completely, and as present indications are that alcohol exerts no specific dynamic action, the total calories appear to be available.

Since the calories provided by alcohol are available for metabolic purposes, the committee considers that they should be included in the tabulation of energy value of diets using the value of 7.1 Cal per gram of alcohol. When the average diet of a population is evaluated it must be borne in mind that the consumption of alcohol is distributed in a very irregular fashion. While adult men drink it in sizeable amounts, children and women generally consume very little, and even in the group of adult men, the habitual intake varies widely according to the individual drinking behaviour.

The distribution is remarkably skew. In some countries, as much as 37% of the alcohol consumption is accounted for by 2% of the population.

For this reason, the committee recommends that in the analysis of the composition of diets the amount of alcohol should be placed in a special category alongside protein, carbohydrate, and fat, and that in any nutritional survey attention should be paid to the distribution of alcohol consumption throughout the population considered.

Since alcohol consumption is generally compensated by a decreased intake of calories from other sources, there is a danger that the habitual use of large amounts of alcohol may lead to deficiency diseases caused by a low intake of protective foodstuffs.

5. Alcohol and Traffic

5.1 *Statistical studies regarding alcohol and road accidents*

It is evident that with regard to the vital question as to whether or not alcohol is the cause of a road accident, a definite answer can seldom or never be given in the individual case. Official statistics regarding alcohol and road accidents in most countries probably show only minimum figures, and cannot without a number of precautions be used for determination of the role of alcohol. Official figures in most countries are based on the following :

- (1) the number of road accidents officially reported ;
- (2) the number of cases detected in which alcohol is involved.

The percentage of cases of road accidents in which alcohol has played a role, when obtained from the two items mentioned, is liable to all the uncertainty inherent in the total number of road accidents and the number of accidents in which alcohol is thought to have played some part. The actual percentages stated show a wide variation from country to country.

In recent years, endeavours have been made to frame studies upon the role of alcohol in road accidents so as to comply with stringent statistical requirements. The committee considers that such endeavours deserve encouragement.

5.2 *Clinical methods*

In the collection of statistics on the role of alcohol in road accidents, and in the enforcement of laws regarding alcohol and road traffic, methods are needed that make possible a decision as to whether the person in question can be assumed to have been under the influence of alcohol to such an extent that his driving abilities were definitely impaired.

Taking into consideration (1) the investigations performed in recent years on the effect of alcohol on different functions in laboratory experiments, (2) the results of statistically designed practical tests on drivers, air pilots, etc., and (3) the statistical evidence from the few adequate studies existing on alcohol and road accidents, the inference cannot be avoided that, at a blood alcohol concentration of about 0.05%, a statistically significant impairment of performance is observed in more than half the cases examined.

The blood alcohol concentration at which departure from the normal performance can be demonstrated is of course dependent on the sensitivity of the test employed, and in a specified test on the tolerance of the person in question (see sections 2.1 and 2.2, pages 3 and 5).

The ordinary clinical tests used in forensic practice must, when compared with the tests used in the experimental work referred to, be classified as rather crude. They may thus lead to faulty conclusions as to the condition of the person examined, so that an individual with a high concentration of alcohol in the blood may be adjudged sober, while an individual with little or no alcohol in the blood may be considered under its influence. For this reason, clinical methods cannot be relied on as the only means of deciding whether a person is under the influence of alcohol. Clinical examination is, however, of importance in ruling out injury or disease as the cause of the behaviour.

5.3 *Chemical methods*

A number of methods for the determination of blood alcohol have been in use for many years, and have proved useful and reliable. Among those for the micro-determination of alcohol in samples as small as 0.1 ml, the method of Widmark has perhaps been the most widely used, the total experience comprising hundreds of thousands of tests. Its reliability in living persons, including diabetics, has recently been established by comparison with other methods, among them the specific alcohol dehydrogenase method.

Determination of alcohol in the breath must be considered a less reliable index of alcohol concentration in the organism than the direct determination of alcohol in the blood, so that small differences in alcohol concentration cannot be reliably ascertained in this manner. However, when for some reason blood alcohol determinations cannot be made, determination of alcohol in the breath, when carried out with appropriate precautions, provides an acceptable substitute. The ratio of concentrations of alcohol in the blood and urine is so influenced by factors of absorption and elimination that urine alcohol determination has a limited value, and should be used only as a supplement to blood alcohol determination. Alcohol

determination in saliva has recently been introduced in forensic practice. Experience, however, is so far too limited to permit its value to be assessed.

5.4 *General remarks*

Legal views on alcohol and road traffic vary in different countries and States. These differences in attitude probably originate from a difference in point of view on the question as to which of the following acts shall be considered to be liable to penalty; either the intake of a certain amount of alcohol possibly leading to impairment of driving ability, or the driving of a motor-car in a state of impaired driving ability caused by the intake of alcohol. In the first instance, the objective of the legislation is generally preventive, and more stress will naturally be laid on the blood alcohol concentration. In the second case, proof of actual impairment of driving ability in the particular individual is paramount, and more stress must be laid on the result of a thorough examination of function.

Owing to the widespread consumption of alcoholic beverages and the increasing complexity of traffic, the necessity for an acceptable solution of the important problem of alcohol and traffic is obvious. Differences in attitudes toward alcohol, in the intensity of road traffic, and in the general concept of justice in different countries, make it apparent that a single solution will not fit all cases. Thus, the problem must, for the present, be attacked on a national level.

6. The Need for Further Discussion

Many of the problems upon which the committee has touched need for their satisfactory resolution the combined efforts of experimental workers and clinicians. There are certain subjects which can only be adequately dealt with at a meeting attended by both groups. The decision to place alcohol in a position between that of the addiction-producing drugs on the one hand, and habit-forming drugs on the other, exemplifies the difficulty which arises from the attempt to draw a sharp dividing line between the presence and absence of addiction-producing properties in a substance. Variations in the degree to which a drug shows each of many different properties must be taken into consideration and some of these properties are indicated more by clinical, psychological, and social effects than by experimental evidence from the natural sciences. Further exploration of this matter would necessitate a joint meeting of experimental workers and clinicians, and the committee recommends that the WHO should consider convening such a meeting.
