THE FORENSIC MEDICAL DEMONSTRATION
OF THE PRESENCE OF ALCOHOL
AND CLINICAL INTOXICATION IN FINLAND

by A. ALHA*

IN FINLAND forensic medical alcohol investigations are centred in the Department of Forensic Medicine, Chemical Division, University of Helsinki. The investigations performed there include determination of the alcohol content of blood samples taken in cases of drunken driving, chemical analysis of urine samples in suspected narcotics cases as well as alcohol, and other forensic chemical investigations in fatal cases. The forensic medical examination for intoxication in cases of suspected drunken driving was made official from the beginning of 1952. Table I shows the development of the incidence of these cases during the years from 1952 to 1961. It may be noted that the number of cases has considerably increased during recent years.

Also, the number of death cases investigated in regard to alcohol has increased as may be seen from Table II.

<table>
<thead>
<tr>
<th>Year</th>
<th>Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>1952</td>
<td>1,262</td>
</tr>
<tr>
<td>1953</td>
<td>1,336</td>
</tr>
<tr>
<td>1954</td>
<td>1,263</td>
</tr>
<tr>
<td>1955</td>
<td>1,140</td>
</tr>
<tr>
<td>1956</td>
<td>1,212</td>
</tr>
<tr>
<td>1957</td>
<td>1,336</td>
</tr>
<tr>
<td>1958</td>
<td>1,455</td>
</tr>
<tr>
<td>1959</td>
<td>2,065</td>
</tr>
<tr>
<td>1960</td>
<td>3,022</td>
</tr>
<tr>
<td>1961</td>
<td>3,940</td>
</tr>
</tbody>
</table>

(The population of Finland is about 4-5 millions.)

Cases of Drunken Driving

According to the Finnish law, driving any vehicle in road traffic or operating an air traffic vehicle under the influence of alcohol or some other narcotic, or in a state of exhaustion, is a punishable offence. If drunken driving is suspected, a forensic medical examination for intoxication is performed either upon the initiative of the police or at the request of the suspected person. The submission to the taking of a blood sample for determination of the blood alcohol level was decreed obligatory in 1959. Only a physician is authorized to take the sample or to perform any other examinations requiring medical training. The police have sample packs containing three Widmark capillaries for taking the blood sample, as well as the necessary forms. Packs are delivered to the doctor along with the examinee. As the doctor takes the sample he also performs a clinical examination for intoxication.

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An expert of the Forensic Chemical Division issues his report to the court where it is attempted to reconstruct the actual situation during the driving. Available to the expert are the results of blood alcohol and other investigations, the physician’s report on intoxication, and a preliminary police report. In the Finnish legislation there is no statutory limit of blood alcohol. The courts, therefore, have freedom to consider every case.

As is evident from Table I, the number of cases examined at the Division of Forensic Chemistry since 1952 amounts to over 21,000. A report is always prepared of every case.

In cases examined by us over several years, the blood alcohol levels have remained fairly constant.

### Table III

**Form of Examination for Intoxication**

<table>
<thead>
<tr>
<th>Name of the subject:</th>
<th>Place of birth:</th>
<th>Address:</th>
<th>Profession:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examination requested by:</td>
<td>Report to be sent to:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**I. Blood sample**

- Taken from _ _ to o’clock with dry instruments
- From the tip of a finger
- Without water
- From a vein

**The skin was cleaned**

- With mercuric chloride 1 per 1000
- With water
- And dried before taking the sample

**Blood was taken into**

- A WK tube

**II. Clinical Examination**

- Performed from _ _ to _ _ o’clock
- Weight: _____ kg.
- Body weight:
  - Weighed
  - Undressed
- Stature: _ cm.
- Colour of face:
  - Pale
  - Ordinary
  - Slightly flushed
  - Intensely flushed
- Smell of alcohol:
  - Yes
  - No
- Pulse:
  - (a) Rate (standing) /min.
  - (b) Symptoms of shock: the size of the pulse, cold sweat (blood pressure)

**Walking test:**

- (a) The eyes open: Steady, Slight instabil., Definite, Quite unstable
- (b) The eyes closed: Steady, Slight instabil., Definite, Quite unstable

**Romberg’s test:**

- (a) The eyes open: Steady, Slight instabil., Definite, Quite unstable
- (b) The eyes closed: Steady, Slight instabil., Definite, Quite unstable

**Finger-finger test:**

- Steady, Slight instabil., Definite, Quite unstable

**Collecting small objects (matches) from the floor:**

- Steady, Slight instabil., Definite, Quite unstable

**Orientation as to place and time:**

- Correct, Erroneous, Confused

**Movement or counting backwards:**

- Correct, Erroneous, Confused

**Speech:**

- Distinct, Indistinct, Stumbling, Like porridge, Etc.

**Pulling himself (or herself) together:**

- Yes
- No

**Report to be sent to:**

- Address:...............................................
- Profession: ..............
- Date of birth: ............................................
- Place of birth: ..............
- Name of the subject: ...............................................
- Report to be sent to:............................................

**III. Short case history**

- Cause of examination:
  - According to the subject
  - The police
  - Other observations made at the clinical examination:

**The statement of the physician**

- Name of the subject: ...............................................
- Shows no signs of an ingestion of alcohol
- Signs of an ingestion of alcohol, but no clinically observable functional disturbances
- The intoxication is slight
  - Moderate
  - Severe
  - A deep intoxication

**Instructions for the taking of the blood samples**

- Quality and amount:
  - Other drinks ingested during the last 24 hrs. (time of consumption, quality and amount):

**IV. Some other facts**

- Does the subject suffer from any disease? If so, from what?
- Has the subject taken any medicine during the last days? When and what?
- Symptoms of:
  - (a) Disease or injury.
  - What?
- Metabolic diseases. Symptoms of diabetes. Urine tests:
  - Nol.
  - Lange
  - Gerh.

- (b) Fatigue, overwork
- (c) The use of narcotics
- (d) Nominating or traces of it

- To what extent the symptoms observed in this connection affect the assessment of the condition of the subject:

**Form of Examination for Intoxication**

- I hereby certify the foregoing

- Place and date: Signature and office of the physician
- Address of the physician: ...............................................

1 Delete lines not applicable.

(a) in 4-5% of cases no alcohol (blood alcohol less than 0.15 promille) was found,

(b) in about 16-20% of cases alcohol has been present but in an amount of less than 1.2 promille,

(c) in about 75-80% of cases the blood alcohol level has exceeded 1.2 promille.

I will now present certain aspects of cases we have investigated which may be of interest from the point of view of a forensic report.

### Determination of the Blood Alcohol

The blood alcohol determination is routinely performed by using the Widmark
method. Since 1958 the ADH method has also been employed to a limited extent.

A reliable result of alcohol determinations must, naturally, constitute the basis of a report. After the technical sources of error including, amongst others, taking of the samples are eliminated, the eventual methodical errors must be taken into account. As far as ethyl-alcohol results are concerned a methodical error may occur in the presence, in the organism, of other volatile reducing substances such as methyl-alcohol, higher alcohols, acetone, amyl-acetate, ether, gasoline, etc. These substances are found in many technical alcohols and thinners which may be ingested by alcohol misusers. In Finland the selling of liquors is a state monopoly, but higher alcohols are sold freely. Misuse of these, particularly of isopropyl alcohol (which is an ingredient in certain mouth lotions), has occurred. The intoxicating effect of higher alcohols is about three to six times greater than that of ethyl-alcohol. Ether, on the other hand, gains access to the organism in anaesthesia and gasoline, amongst others, in accidents—both substances entering the body through the respiratory tract. Table IV gives certain values obtained by the Widmark and ADH methods in cases of other volatile reducing substances, and calculated as ethyl-alcohol.

Table IV

<p>| “Alcohol Values” given by Volatile Reducing Agents other than Ethyl-Alcohol |</p>
<table>
<thead>
<tr>
<th>Case No.</th>
<th>Blood alcohol values (promille)</th>
<th>Ingested substance</th>
</tr>
</thead>
<tbody>
<tr>
<td>2906/60</td>
<td>2.10 0.63 Mouth water (isopropanol?) spir. denat.</td>
<td></td>
</tr>
<tr>
<td>282/61</td>
<td>2.82 2.08 Mouth water (isopropanol?) spir. denat.</td>
<td></td>
</tr>
<tr>
<td>570/61</td>
<td>1.92 1.06 Mouth water (isopropanol?) spir. denat.</td>
<td></td>
</tr>
<tr>
<td>571/61</td>
<td>1.86 0.45 Mouth water (isopropanol?) spir. denat.</td>
<td></td>
</tr>
<tr>
<td>716/61</td>
<td>2.40 2.13 Sol. camphor., asthma syrup</td>
<td></td>
</tr>
<tr>
<td>859/61</td>
<td>1.66 1.39 Techn. alcohols</td>
<td></td>
</tr>
<tr>
<td>1595/61</td>
<td>2.33 2.07 Techn. alcohols</td>
<td></td>
</tr>
<tr>
<td>1078/62</td>
<td>3.09 2.16 Polishing spirits</td>
<td></td>
</tr>
</tbody>
</table>

Previously, it was widely discussed whether substances in diabetics may give rise to a significant error in blood alcohol determinations. On the basis of numerous parallel investigations with both the Widmark and ADH methods it now seems clear that such a theoretical error has no practical significance. As I mentioned before, at the Forensic Chemical Division the blood alcohol is determined routinely with the Widmark method, but the ADH method is also used if there is any reason to suspect the presence of sources of error.

From Autumn 1958 to the 15th of June 1962, parallel determinations with both the Widmark and ADH methods have been performed in a total of 176 cases. Of these:

(a) in 31 cases the ingestion of various technical alcohols, such as mouth lotions and other similar substances, was admitted. In eight cases incompatible results were obtained in parallel analyses; these results are given in Table V;

Table V

Discrepancy between the Widmark and ADH Methods in 8 Cases of Drunken Driving where the Ingestion of Technical Alcohols, Mouth Waters, etc., was Admitted

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Blood alcohol values (promille)</th>
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<td>1078/62</td>
<td>3.09 2.16 Polishing spirits</td>
<td></td>
</tr>
</tbody>
</table>

(b) 42 cases were diabetics. The results were discrepant in only one case (Table VI);

Table VI

Discrepancy between the Widmark and ADH Methods. The Only Diabetes Case, No. 1922/61, used Insulin. Clinically Severe Intoxication. Had Ingested Distilled Liquor and Beer

<table>
<thead>
<tr>
<th>Blood alcohol values (promille)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Widmark</td>
</tr>
<tr>
<td>2.22</td>
</tr>
</tbody>
</table>

(c) in 4 cases the blood sample had been taken from injured persons to whom ether anaesthesia had been administered previously (Table VII).

Table VII

Cases of Suspected Drunken Driving in which Ether Anaesthesia had been Given

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Blood alcohol values (promille)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1200/60</td>
<td>0.43 0.30</td>
</tr>
<tr>
<td>117/61</td>
<td>0.29 0</td>
</tr>
<tr>
<td>2128/61</td>
<td>1.84 1.49</td>
</tr>
<tr>
<td>409/62</td>
<td>0.20 0</td>
</tr>
</tbody>
</table>

Clinical Examination for Intoxication

It has been repeatedly demonstrated by various investigators that clinical intoxication is strongest comparatively soon after the ingestion of alcohol. This is illustrated,
amongst others, by the study of the relation of blood alcohol to clinical intoxication in voluntary subjects performed by

This has been established chemically from the urine samples sent for investigation, although this has been the case only

me (1951) and presented in Fig. 1. It will be found that as the blood alcohol level declines the symptoms disappear relatively more rapidly. The same thing is indicated by the statistics, given in Table VIII, on

TABLE VIII
Finnish Statistics on Drunken Drivers (Alha and Hjelt 1955). Over 50% were Under the Influence with Blood Alcohol Levels as follows:

(a) In the phase of increasing drunkenness, 1-0-1-2 promille (the interval between the end of the ingestion of alcohol and driving is less than 2 hours).
(b) Early in the phase of decreasing drunkenness, 1-2-1-4 promille (2 to 5 hours).
(c) Late in the phase of decreasing drunkenness, 1-4-1-6 promille (over 5 hours).
(d) In the entire material, 1-2-1-4 promille.

drunken drivers in Finland (Alha and Hjelt, 1955). This investigation also revealed that, in the majority of cases of drunken driving, less than two hours—in other words, a short time—had elapsed since the ingestion of alcohol before driving.

Among our cases there have been many in which clinical examination had demonstrated considerable intoxication although the blood alcohol has been low, e.g. below 0-8 promille. After brain and other injuries have been eliminated there has, in the remaining cases, been an above-the-average incidence of certain special features:

(a) The age of the examinee has been under 20 or over 60 years.
(b) Ingestion of drugs has occurred.

in those few instances where the clinical examination has primarily aroused suspicion, specifically, of the use of narcotics or drugs. In 1961 at the Division of Forensic Chemistry, 21 such urine samples were investigated, various drugs being demonstrated in 20 cases. In other cases the ingestion of drugs has been established on the basis of data obtained from the course of events. In Table IX are listed those drugs which, according to the current view, may endanger the security of traffic.

TABLE IX
The Drugs Known to be Dangerous to the Safety of Traffic

1. Substances of the morphine group.
2. Hypnotics.
3. Many ataractics and tranquillizers (such as meprobamate and reserpine).
4. Antihistaminics (such as diphenhydramine = Benadryl).
5. Amphetamine and methamphetamine.
6. Many chemotherapeutical and antibiotic drugs.

A specific group amongst drug cases seems to be composed of tuberculous persons who are taking, as their treatment, PAS and isonicotinyl hydrazide. The general use of drugs, especially of antipyretics, sedatives, hypnotics, and of the modern psychopharmacological substances such as ataractics, tranquillizers, and antidepressants, as well as antihistamines, has (according to data obtained from many countries) increased during recent years.
Is the use of drugs also, as far as the safety of traffic is concerned, a more significant factor than before? I will try to present some statistical views on this complicated question. Our form for the examination for intoxication (Table III) contains sections referring to the use of drugs. In the Forensic Medical Institute of our capital Helsinki, doctors specialized in forensic medicine, on duty "round-the-clock", investigate the cases of drunken driving at the request of the police. In the following Table X I have collected those cases of drunken driving investigated at the Forensic Medical Institute of Helsinki in the years 1952, 1956 and 1961, in which the examining specialist has recorded the use of drugs.

**Table X**

A Report about the Use of Drugs in Cases of Drunken Driving Examined at the Forensic Medical Station of Helsinki in the Years 1952, 1956, and 1961

<table>
<thead>
<tr>
<th>Year</th>
<th>Cases Examined</th>
<th>Drug Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Number</td>
</tr>
<tr>
<td>1952</td>
<td>684</td>
<td>111</td>
</tr>
<tr>
<td>1956</td>
<td>461</td>
<td>110</td>
</tr>
<tr>
<td>1961</td>
<td>741</td>
<td>194</td>
</tr>
</tbody>
</table>

These statistics, although being based on accounts given by the examinees and therefore in many aspects unreliable, will nevertheless, in my opinion, lend support to the concept that in cases of drunken driving the use of drugs bears more significance than before.

Of the 194 drug cases investigated at the Forensic Medical Institute in 1961, the drug involved in 73% of the cases was a mixture of various antipyretics, sedatives and ataracts, used against general aches and pains, or for sedation, and mostly obtainable without prescription.

**Fatal Cases**

Since the discovery of the ADH method the development of forensic medicine in respect of alcohol investigations in fatal cases has greatly improved. Provided that the taking of samples from the deceased is done properly, compatible results in parallel determinations with the ADH and Widmark methods from the blood samples of the deceased will generally give a reliable basis for interpretation of the results of alcohol investigation.

The most significant methodical error in alcohol investigations in death cases is caused by putrefaction of the corpse. In traffic fatalities it is almost always possible to obtain fresh samples. I will describe, in brief, some of the viewpoints emphasized in Finland in regard to successful alcohol investigation of a corpse. A prerequisite of obtaining a fresh sample is flexible cooperation between the police and the doctor. The physician must be called at once to take the samples. The performance of a post-mortem must not be waited for. After cleaning the skin, e.g. with a 1:1,000 sublimate solution, the doctor takes the blood samples in special tubes (prepared with a conserving agent) from peripheral parts of the body, i.e. from the extremities, and a urine sample by catheterization.

The alcohol content of the blood sample is determined in parallel by the ADH and Widmark methods. Conforming results are, as was already mentioned, usually sufficient to indicate the role of alcohol. The urine sample is held in reserve and examined in case of need as, e.g. where the deceased has survived for some time after the accident, maybe in a hospital, and the alcohol has had time to get eliminated from the blood although still demonstrable in the urine. Such a case is presented in Table XI.

**Table XI**

The Significance of Alcohol Level Determination in the Urine. Case 704/61. Was Arrested Intoxicated in the Evening, Found Dead in the Morning. Autopsy: Cranial Fracture and Cerebral Haemorrhage

<table>
<thead>
<tr>
<th>Determination of alcohol (promille)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Widmark</td>
</tr>
<tr>
<td>Blood</td>
</tr>
<tr>
<td>Liver (Weinigdistill)</td>
</tr>
<tr>
<td>Urine</td>
</tr>
</tbody>
</table>

If parallel determinations from fresh samples give incompatible results, in other words if the Widmark value is considerably higher than the ADH value, the situation suggests the presence of ingested volatile reducing substances other than ethyl-alcohol, exactly as in living persons. If other volatile reducing substances are primarily suspected or the case is otherwise complicated, e.g. suspected putrefaction, a post-mortem must be performed. From the samples taken it will then be possible, when necessary, to perform extensive forensic chemical qualitative and quantitative alcohol investigations.

The authorities in Finland have begun to realize that considerable insurance and
legal significance is attached to the forensic chemical alcohol investigation of traffic fatalities. Year by year, samples have been sent for examination in increasing amounts (as was shown by Table II). Of the 801 fatalities investigated during 1961 at the Division of Forensic Chemistry in regard to alcohol, 233 were traffic fatalities. In 98 of these (42%) the blood alcohol was elevated (>0.35 promille). Some statistical data concerning traffic accidents in Finland are presented in Table XII.

**Table XII**

*Data from the Finnish Official Statistics Concerning the Traffic in 1961*

<table>
<thead>
<tr>
<th>Category</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>All traffic accidents</td>
<td>25,085</td>
</tr>
<tr>
<td>(Of them alcohol cases)</td>
<td>1,555</td>
</tr>
<tr>
<td>Traffic deaths</td>
<td>786</td>
</tr>
<tr>
<td>(Of them alcohol cases)</td>
<td>108</td>
</tr>
<tr>
<td>The number of cars and motorcycles</td>
<td>412,000</td>
</tr>
<tr>
<td>The number of mopeds</td>
<td>170,000</td>
</tr>
</tbody>
</table>

In conclusion I wish to mention that gas chromatography is a new method offering significant advances in alcohol investigations. So far it hardly comes into question as a routine method for alcohol determination. But for clearing up complicated cases it is well suited. We are expecting that the equipment needed for this method will soon be available at the Division of Forensic Chemistry.

Finally I would like to add, as a forensic scientist with over 10 years’ experience of alcohol cases, that our system in drunken driving cases gives us good opportunities to determine intoxication. The police and the medical profession can cope with this problem more efficiently than previously, with the aid of our help.

It is my experience that the police, as well as the law-courts, are satisfied with our system.

**DISCUSSION**

Mr. Bloch (France): Does the expert examine the subject himself? If not, do you not think that this reduces the expert value considerably?

Professor Alha: The expert on alcohol does not examine the subject. This is done by a medical expert—a physician.