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SOME PRACTICAL ASPECTS OF CHEMICAL TESTS FOR INTOXICATION

R. N. Harger

(Many requests have been received from our readers for an article on chemical tests to determine intoxication—particularly an article which would explain in clear and, insofar as possible, non-technical language the behavior of alcohol in the body, the primary information furnished by chemical tests, what per cent of alcohol means “under the influence,” interpretation of three zones of blood alcohol, the qualifications required of persons conducting the tests, and so on. We thereupon asked Dr. Harger to prepare such an article. It is an expression of the many years he has devoted to the subject and is one which he is eminently qualified to discuss. He secured his Ph.D. at Yale University in 1922; was instructor in Chemistry, University of Kansas, 1915-17; was biochemist, United States Department of Agriculture, 1917-20; National Research Council Fellow in Chemistry, Yale University, 1920-22. Since then has held the position of Professor of Biochemistry and Toxicology, Indiana School of Medicine. Among his research activities is the development of the apparatus for the analysis of alcohol in breath known as the Harger “Drunkometer.”—Editor.)

The employment of chemistry to aid in diagnosing inebriation was first proposed about thirty years ago. However, nearly ten years elapsed before the idea was given a practical trial in the administration of justice. The first application of these chemical tests was in coroner's cases where it was important to know whether the deceased was intoxicated at the time of death. The tests were next used with living subjects, and by 1930 they had been accepted as evidence in courts in Sweden and some other European countries and also in one or two cities in the United States. These results naturally attracted the attention of people interested in curbing the growing menace of the drunken driver. As a result, the tests rapidly spread to all parts of the world where the automobile had gone. At the present time chemical tests for intoxication are being extensively used in almost every large city in the United States, by several state police organizations, by the medical departments of our Army and Navy, and in certain industrial establishments. Most of the courts in the United States now accept the evidence of these tests. Four states have passed laws providing for such tests and establishing limits of body alcohol for automobile drivers.

Shortcomings of the Usual Signs of Intoxication

Drunkenness is a very common sight and has been repeatedly described since man first began to write. The author of the Book of Proverbs describes the effect of too much wine as “*woe, sorrow, contentions, babbling, wounds without a cause, and redness of eyes*”. Seneca,¹ the Roman philosopher and statesman, wrote

¹Seneca's Epistle LXXXIII: On Drunkenness, From the English version of the Loeb Classical Library, *Quarterly Journal of Studies on Alcohol* 3:302 (1942).

about 50 A. D. "drunkenness is nothing but a condition of insanity purposely assumed", and "if you try to prove that the wise man can souse himself with much wine and yet keep his course straight, even though he be in his cups, you may go on to infer by syllogism that he will not die if he swallows poison".¹ Modern writers have added little to these descriptions.

Since drunkenness is such a well known disorder why should we ask a chemist to aid in proving that an individual has imbibed too freely? The answer is that, after an automobile accident and in some other situations, the common criteria of intoxications are frequently unreliable. The usually accepted signs of intoxication are: the odor of the breath, abnormal speech, clumsiness of movement, and evidence of "stimulation".

As regards the odor of liquor on the breath, this is a very unfair test. Although the breath of an inebriated person contains alcohol, the amount present produces very little odor. The breath odor one usually observes is really the flavoring matter of the liquor, and this varies enormously from beverage to beverage. I have seen people who were deeply intoxicated from drinking alcohol diluted with water whose breath fooled even a seasoned policeman, and who were rushed to the hospital by the officer because he thought they were poisoned. On the other hand, the consumption of a small amount of a very fragrant beverage may impart a strong odor to the breath of a person who is certainly not under the influence of alcohol. Impairment of speech and locomotion may be caused by many things besides alcohol. As for evidence of "stimulation" this requires a knowledge of the person's normal behavior. I do not mean to imply that we should disregard these common signs of intoxication. If an individual's breath smells like a brewery or a distillery, if he staggers, and if he cannot say "Methodist Episcopal" you probably would be correct in calling him drunk. However, when his case is later heard in court, his friends and a sharp lawyer may be able to convince the court that he is a teetotaler, and that he behaved abnormally because of shock or injury. In the absence of chemical tests even a competent physician cannot swear with certainty that the individual had a drop of alcohol in his body.

The common signs of intoxication have sometimes been used to falsely accuse a sober person. An Indianapolis case illustrates this point. A car crashed into a filling station damaging a gasoline pump. The driver was unsteady and talked incoherently. A policeman was called and arrested the driver for operating a car while under the influence of liquor. Shortly afterward a chemical analysis of the man's breath showed that he had absolutely no alcohol in his body. Investigation revealed that he was

suffering from a physical ailment, and his drivers license was suspended for that reason.

Where the person has been severely injured the common signs are certainly inadequate, and in death cases only chemical analyses will yield information.

In order to operate a car the driver obviously cannot be "dead drunk". The traffic laws of most states do not use the words *drunk* or *intoxicated*, but most of them employ the phrase "under the influence of intoxicating liquor". Many courts have held that this means any definite loss of driving ability caused by alcohol and includes effects considerably below what would constitute public intoxication. This means having to make decisions in cases not showing pronounced symptoms where the common signs are less decisive.

Behavior of Alcohol in the Body

Alcohol is the only intoxicating substance in most alcoholic beverages. Within the body, a given amount of alcohol has about the same effect regardless of the beverage which was consumed. Other substances in common alcoholic beverages have practically no effect in changing the results due to alcohol.

When a beverage containing alcohol is swallowed the alcohol is partly absorbed from the stomach, but most of it is absorbed from the small intestine just beyond the stomach. In this small gut the absorption of alcohol is very rapid. Experiments in our laboratory, using dogs which were given rather large doses of alcohol diluted with water, showed that if given when the stomach was empty, over half of the alcohol was absorbed in 15 minutes and practically all of it in one or two hours. Food in the stomach somewhat delays absorption, largely because this food causes the stomach contents to become much less fluid, and this hinders the alcohol in the interior from coming in contact with the stomach and intestinal walls. If the stomach empties slowly, this would retard alcohol absorption. The alcohol from the stomach and gut is taken up by the blood in the vessels located in the walls of these organs. The flow of blood then carries the alcohol to all parts of the body, where it is stored. The various parts of the body take up alcohol about in proportion to their water content. Since brain, liver, blood, etc. have about the same fraction of water they will have about the same per cent of stored alcohol. Urine, saliva, and spinal fluid contain some more water than brain, etc., and the per cent of alcohol in these fluids is regularly about 20 per cent higher than that found in the brain, etc. The intoxicating effect is produced by the alcohol stored in the brain, and the degree of this effect is fairly proportional to the per cent of alcohol in the brain.

The stored alcohol is gradually destroyed or "burned" by the body. The average 150 pound person can "burn" about one-third fluid ounce of pure alcohol per hour, which would mean the "burning" of two fluid ounces of 100 proof whiskey in three hours or one pint (16 fl. oz.) of whiskey in 24 hours. Some people "burn" alcohol faster, and some slower, than the average rate. For a given person the rate of destruction of alcohol is practically constant regardless of the per cent of alcohol in his body. Recent investigations have shown that most of the alcohol "burning" takes place in the liver. As the liver uses up alcohol it receives more from other parts of the body, so that the per cent of alcohol all over the body decreases at practically the same rate.

It is, therefore, possible at all times, to predict quite closely the per cent of alcohol in the brain by determining the per cent of alcohol in other parts of the body. For this purpose one may use blood, urine, spinal fluid, or saliva. Breath may also be employed because it comes into intimate contact with the blood in the lungs, and the concentration of alcohol in the breath is controlled by the per cent of alcohol in the blood. In fatal cases the brain itself may be analyzed, but with living subjects this procedure would not be very popular. When death occurs alcohol "burning" immediately stops, so that brain or blood taken several hours after death will show the alcohol level at the time of death.

Primary Information Furnished by Chemical Tests

These tests are all *chemical analyses for alcohol*. They show first the per cent of alcohol in the body substance analyzed. What we wish to learn is the per cent of alcohol in the person's brain, but since brain tissue is not available in living subjects we must use other body materials. The body substances which may be used are: blood, urine, spinal fluid, saliva, or breath. We have already mentioned that the per cent of alcohol in the brain may be calculated from the per cent of alcohol in these body fluids. In the case of breath, 2000 cubic inches of *true breath*² contain practically the same weight of alcohol as one cubic inch of blood.

Since blood was the first body substance to be used, the results of analyzing any of the above body fluids or breath are usually expressed in terms of blood. Thus we say that the individual has a certain per cent of alcohol in his blood, as calculated from the urine, breath, etc.

It should be emphasized that the tests show the per cent of alcohol in the person's body *at the time the material was taken from the body*. The tests do not show when the drinking was

²This is what physiologists call "alveolar air" and is the last portion of a deep expiration.

done nor the total quantity of alcohol swallowed, but only the person's load of stored alcohol at the time he was tested. This is precisely the information desired for it represents his condition *at that moment*.

Having determined the per cent of alcohol in the person's blood we can calculate the approximate quantity of alcohol stored in his entire body. For a person weighing 150 pounds a blood alcohol of 0.1 per cent would mean that his entire body contained about two fluid ounces of alcohol which had been absorbed and stored. This is the amount of alcohol in four ounces of 100 proof whiskey or four twelve-ounce bottles of 4 per cent beer. For a blood alcohol of 0.2 per cent these numbers would be doubled. This way of stating the load of alcohol the person was carrying is usually more easily understood by judges and juries than the bare percentage figures. If the person tested weighed more, or less, than 150 pounds the calculated figure for total stored alcohol would of course be changed to correspond to his weight. However, the per cent of alcohol should be given too, because the degree of intoxication is controlled by the per cent of alcohol regardless of the person's size.

What Per Cent of Blood Alcohol Means "Under the Influence"?

The concentration of alcohol in the blood of living subjects may vary anywhere between a trace to one-half (0.5) per cent. With 0.5 per cent practically all subjects will be "dead drunk", a condition about the same as surgical anesthesia. Few intoxicated drivers will have above 0.35 per cent of alcohol in the blood, since with higher concentrations they could not remain at the wheel.

Where in this range of blood alcohol should a driver be called "under the influence"? The only way to properly answer this question would be to try out chemical tests on several hundred drinking individuals having various per cents of blood alcohol and to determine the relationship of blood alcohol per cent and impairment from alcohol. Fortunately this has been done by several investigators in various countries and the number of drinking people studied has been, not several hundred, but several thousand. These studies have been reviewed by two competent committees in this country. These groups are the American Medical Association's Committee on Street and Highway Accidents,³ and the National Safety Council's Committee on Tests for Driver Intoxication.⁴ The conclusions and recommendations of these two committees are identical. A number of the members

³J. Am. Med. Assn., 112: 2164, 2175 (1939) & 117: 653 (1942).

⁴National Safety Council, Committee on Tests for Intoxication, 1938 Report, pp. 7-12, & 1939 Report, p. 5.

of these committees have conducted research in this field for many years.

In proposing a reasonable and just plan for interpreting body alcohol figures the committees followed three general principles:

1. In using chemical tests one should strive to protect not only the non-drinker, but also the mild drinker who has not imbibed sufficiently to lower his driving ability.

2. Errors of interpretation, if any, should favor the person being tested.

3. While, with most people, the degree of intoxication is closely proportional to the per cent of body alcohol, provision should be made for the fact that some people do "carry their liquor" better than others. This means that one cannot arbitrarily choose a certain point in the blood alcohol range and say that above this all drivers are *under the influence*, and that below it all are not affected. Recognition of this principle was the reason for providing the middle zone in the classification of drinking drivers.

With these principles in mind the above-mentioned committees agreed upon two limiting figures of blood alcohol concentration, one a low level, below which practically no one would be affected, and a second level, considerably higher than the first, above which *all* drivers are *under the influence*.⁵ These two blood alcohol figures are 0.05 (1/20)% and 0.15 (3/20)%. Note that the second is three times the amount of the first. This arrangement divides drinking drivers into three groups as regards blood alcohol concentration. The three zones and the interpretations recommended by these committees are now described and are shown graphically in Fig. 1.

ZONE I. Blood Alcohol from 0.0 to 0.05 (1/20)%

As shown by numerous experiments almost no one in this zone will be affected by alcohol. The highest point in this zone represents the accumulation of alcohol corresponding to two ounces of whiskey for a 150 pound person. It is recommended that a blood alcohol in this zone shall be considered *prima facie* evidence that the driver was *not under the influence*.

ZONE II. Blood Alcohol from 0.05 (1/20) to 0.15 (3/20) %.

In this zone some drivers will be under the influence, but not all. Of those with blood alcohols slightly above 0.05% only a few will be affected, and the fraction affected will rise with increasing blood alcohol, so that all will be affected before the blood

⁵*Interpretation of Chemical Tests for Intoxication as Recommended by the American Medical Association and the National Safety Council.* Laws embodying this interpretation have been passed by Indiana, Maine, Oregon, and New York.

alcohol reaches 0.15%. In this zone the evidence of chemical tests should be considered relevant, but not *prima facie*, evidence that the driver was *under the influence*. If the usual physical signs are present, the driver should be prosecuted, and then chemical tests will furnish valuable corroboration.

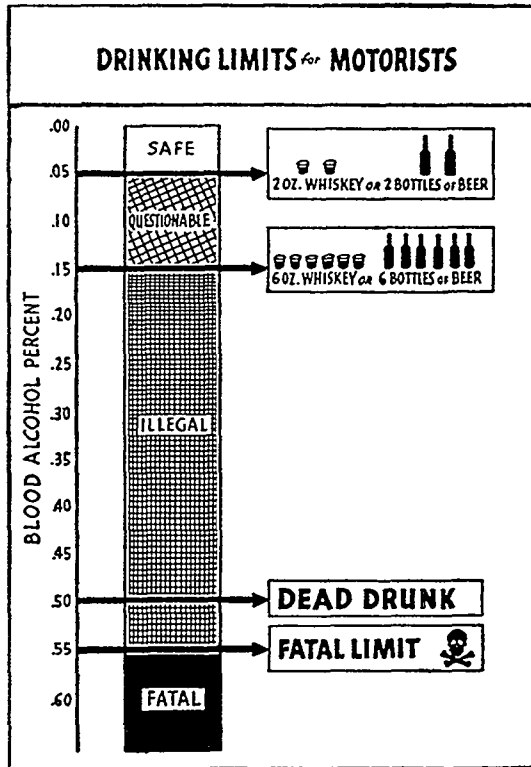


FIGURE 1

ZONE III. Blood Alcohol above 0.15 (3/20) %.

The above-mentioned committees recommended that a blood alcohol in this zone should be considered a *prima facie* evidence that the driver was *under the influence*. The lowest blood alcohol in this zone means that for a 150 pound person a total quantity of absorbed body alcohol represented by 6 ounces of 100 proof whiskey. To reach this alcohol level the person would need to drink more than 6 ounces of whiskey, because some of the alcohol would be "burned" during the period of absorption. Even heavy drinkers agree that six ounces of whiskey taken on an empty stomach is no mere "eye-opener". Studies carried out by the Northwestern University Traffic Institute show that a driver whose blood alcohol is in ZONE III has increased his chance of having an accident 55 times, which is an increase of 5500%.

*Fairness of the Interpretation of the Three Zones
of Blood Alcohol*

The upper limit of ZONE I is 0.05 (1/20) % of blood alcohol. This limit is admittedly somewhat liberal, because there are a few people for whom two ounces of whiskey on an empty stomach would produce a transitory decrease of driving ability. At present, however, the public will be more inclined to accept the test results, if the interpretation is not too strict. Furthermore, it is generally agreed that in this zone the increase of accident hazard is very mild compared with the results observed in the other two zones, particularly ZONE III.

ZONE II extends from the upper limit of zone one to a blood alcohol 300% higher. This is, therefore, a broad zone and its upper limit can be reached only after quite heavy drinking. Since the test results in this zone are used merely to confirm the usual sign of intoxication, it is difficult to see how anyone could object to the use as recommended. Many authorities believe that the upper limit of this zone should be 0.1% of blood alcohol, so it is evident that the upper limit of 0.15%, which is 50% more than 0.1%, is amply conservative.

As regards ZONE III, the only vital question here is whether there are some individuals who are so little affected by alcohol that it requires more than 0.15% of blood alcohol to lower their driving ability. The answer is that this point has been repeatedly investigated, and no such person has been found. A few people do not stagger or exhibit thick speech until the blood alcohol reaches perhaps 0.25%, but all of the hardy drinkers tested have shown a definite lowering of driving skill when the blood alcohol reached 0.15%. In fact, all were somewhat adversely affected when the blood alcohol was above 0.1%. Judgment is the first body faculty to be affected by alcohol. Judgment warped by alcohol is a far greater cause of highway crashes, than is simple clumsiness of muscular action. The alcoholic driver generally takes chances, which he would normally avoid.

A few writers in this field have objected to the recommended interpretation for ZONE III on the ground that it is unfair to expert drivers. They agree that all drivers are impaired by blood alcohol above 0.15%, but they argue that a very skillful driver may drink to the point where he loses half or more of his driving skill and yet operates a car better than certain very clumsy drivers who never indulge in liquor. They propose to call a driver *under the influence* only if he has lowered his operating skill below that of the poorest driver permitted on the highway! If we accept this strange philosophy of the administration of justice, then we should exempt our more skillful drivers from obeying speed laws and stop signs. The reason we require *all* drivers to

obey speed laws and stop signs is *to prevent each driver from increasing his individual chances of a collision*. Furthermore, this theory ignores the matter of judgment, and faulty judgment produces more crashes than does lack of skill.

Some people have insisted that the *prima facie* feature for ZONE III would be illegal in those states which define *under the influence* as not driving in the manner of a "reasonable and prudent man." *Prudence* is just another name for *judgment*, and drivers in ZONE III have pretty well cast prudence to the wind.

It has been argued that the term *prima facie* as used in this legislation is too rigid as regards interpretation. Perhaps the meaning of this term has been misunderstood. Competent attorneys tell me that *prima facie* does not mean *certain* or *absolute*, but that in law it means about the same as *presumptive*, or *unless proved to the contrary*. If this is correct the term is certainly not a rigid one. Where the judge feels that the evidence against intoxication is strong enough, he is not compelled to make a finding of guilty, even though the evidence shows that the blood alcohol was above 0.15%. However, experience indicates that this exception should be made very rarely.

It is true that the shock of an accident or the sight of a policeman may cause some inebriated people to sufficiently "pull themselves together" so as to temporarily conceal their real condition, even though they were driving with reckless abandon shortly before the collision. This point is too frequently overlooked by our courts.

Can the Tests Be Used in the Absence of Specific Legislation?

This point is frequently raised by officials who would like to employ these tests but fear that laws must be passed to make the evidence admissible in court. Only four states have passed this type of law. They are Indiana, Maine, Oregon, and New York, and in each state the law contains practically the exact features proposed by the National Safety Council and the American Medical Association. However, in many states having no such laws, chemical tests for intoxication are being routinely used, and the evidence is accepted by the courts. Cases involving chemical tests for intoxication have gone to the supreme courts of Iowa, Ohio, Wisconsin, Massachusetts, and Indiana, and in no instance has the high court questioned the reliability of such tests or the admissibility of this evidence, if legally obtained. After all, these chemical tests for alcohol are in the same class as all scientific information relating to a court case. For example, all of our courts admit the testimony of a competent chemist in cases of

alleged poisoning. Yet, I know of no state which has specified the particular method of analysis which the chemist must use, or which by law has defined the fatal concentration of arsenic or other poison in the body. Expert testimony is employed to show whether the death was caused by a given poison.

The advantage of laws defining the limits of body alcohol for automobile drivers is that in this way much time is saved by eliminating arguments over interpretation of the results, and the state avoids the trouble and expense of calling an expert witness for each drunken driving trial. In other words, legislation is desirable but not indispensable.

Compulsory Tests

Can a driver be compelled to submit to a test against his will? On this point the legal profession has shown considerable divergence of opinion. In two states the attorney generals have approved the use of force, while in at least two other states these officials have emphatically denied the admissibility of the results of body alcohol tests obtained without the consent of the driver under investigation.

In this connection an important point is the amount of force required to obtain the sample of body material which is to be analyzed. On this score the tests may be divided into three groups:

1. *Materials secured by invading the body.* This would include blood, spinal fluid, and urine obtained by means of a catheter. To secure blood or spinal fluid it is necessary to puncture the body; and passing a rubber tube into the bladder would be an *invasion* of the person's body.

2. *Specimen which the suspected person may easily produce.* Examples would be urine, saliva, or breath collected in a suitable container. Compulsion here would be to require the suspected person to produce the specimen.

3. *Collection of discarded body materials.* Here the suspected person is not required to perform any voluntary act, although he may be subjected to temporary restraint. To obtain a sample of urine the person is placed in a cell with a dry urinal opening to the outside. Eventually nature will require him to empty his bladder and the urine sample is secured. As regards breath, the writer's "drunkometer" test may be run on breath as it leaves the nose or mouth, by drawing this exhaled air through the apparatus. The results are just as reliable as when the subject blows into a rubber bag. The person being tested is not required to move a muscle, but he will eventually have to breathe, and the test can be run.

This type of compulsory breath test has been accepted as

evidence in a number of courts in Indiana. The following case is an example: On June 3, 1937, an Indianapolis woman drove her car through a safety zone, injuring several people and killing a baby which had been in the arms of its mother. The offending driver did not stop, but she was apprehended a few minutes later. Shortly afterwards the prosecutor telephoned me and requested that I go to the jail and run a breath test on this woman. When I reached the jail I found there a drink crazed woman who was alternately weeping and cursing. She vehemently refused to take the test. Thereupon two policemen seated her in a chair and held her there while I ran the test. I did not touch her and simply operated the apparatus to suck breath through it during each outgoing breath. It proved wise not to get too near her, because during the test, she kicked one policeman in a rather vulnerable spot. The test showed that her blood contained a little over 0.2% of alcohol, and she was arrested for manslaughter. When I testified at the trial some months later, her lawyer showed from my testimony that the test was taken against her will. He then objected to the admission of this evidence on the ground that it was a violation of his client's constitutional rights. The judge, James W. Emmert of Shelbyville, who is now Attorney General of Indiana, then questioned me closely as to the details of the test, after which the judge overruled the objection and admitted my testimony regarding the test. In his ruling the judge said, in substance, that the woman had not been compelled to perform any act, that she was not even forced to breathe, and finally that when the breath leaves the body it becomes common property anyway. The verdict was *guilty*, and the woman served a term in the Indiana Woman's Prison. We hoped and prayed that this case would be carried to the Indiana Supreme Court; but, unfortunately, it was not appealed. If finger prints or photographs may be taken without a person's consent, then it would seem legal to obtain a sample of his breath after he is through with it.

From a practical standpoint compulsory tests will probably not accomplish a great deal more than when the tests are on a voluntary basis. Our experience in Indiana, and reports from other states, indicate that only a small per cent of drivers object to being tested. As a matter of fact, most drivers under the influence of alcohol have lost all sense of caution and readily submit to these tests. In Ohio a refusal to submit to such a test may be used in evidence at the driver's trial.

We should perhaps mention two proposals for securing the driver's consent for these tests in the event they are needed. The first is to require such consent, in writing, in order to obtain a driver's license. The second is to make revocation of the driver's license mandatory, if the holder refuses to submit to a chemi-

cal test, when such a test is required and requested by the proper authorities. The result would be to place these tests on the same basis as so-called compulsory premarriage blood tests, which are required in many states. Even with these premarriage blood tests the state cannot forcibly bleed the prospective spouse, but it can withhold the license until the test is performed and the results are satisfactory.

Those interested in this phase of the subject would do well to read the excellent reviews by Inbau⁶ and Ladd and Gibson.⁷

Qualifications Required for Persons Conducting the Tests

Any chemical analysis is worthless unless it is performed with reasonable accuracy. False results regarding body alcohol may cause a serious miscarriage of justice, or be the means of discrediting a test program. Therefore, the tests should be conducted only by persons who are trained to perform them in a satisfactory manner. This does not mean, however, that a college degree in chemistry is required in order to operate all of these chemical tests. Some of the test procedures are extremely simple, others could be easily run by a high school chemistry student, while a few of these should be operated only by an experienced chemist.

In any case the prospective operator should be selected and trained by a competent chemist. The operator should not be permitted to run the test for court use until he has successfully passed his training course, which should include the running of "unknown" and many tests with human subjects to demonstrate that he is qualified to make the analysis without help. The instructor should be "hard-boiled" and refuse to O. K. any student who cannot meet the necessary requirements.

The state police of Indiana have used the writer's breath method for the last seven years. The training of their test operators is described by Superintendent Don Stiver in the February, 1944, issue of *Public Safety*. The personnel of the Indiana State Police is mostly made up of young men who rank high in intelligence, as police officers go. The prospective operators are selected because of previous training in chemistry, photography, or other technical subjects. Each summer the writer conducts an extensive course for these test operator candidates. The course includes lectures and a good deal of laboratory practice. Only those who successfully pass the course are permitted to become

⁶Fred E. Inbau, Self-Incrimination—What Can an Accused Person Be Compelled To Do? *The American Journal of Police Science*, incorporated in *The Journal of Criminal Law and Criminology*, Vol. XXVIII, No. 2, July-August 1937.

⁷Mason Ladd and Robert B. Gibson, The Medico-Legal Aspects of the Blood Test to Determine Intoxication, *The Iowa Law Review*, Vol. XXIV, No. 2, Jan., 1939.

test operators, and this means failing a good share of the candidates. Those who are certified to run the test are placed under the supervision of the chief technician at Indianapolis. The chief technician sends out occasional "unknowns" to check on these operators, and at intervals they are called to headquarters for review tests. During the past two years these men ran chemical tests resulting in about 2500 prosecutions for driving while *under the influence*, with 97% convictions. In difficult cases these technicians require the aid of a physician or other qualified person to present expert testimony regarding the interpretation of the test results and the validity of such tests.

The police departments of a few of our states and some of the larger cities are fortunate enough to have the services of men with college degrees in chemistry, but this is the exception rather than the rule. Science is rapidly replacing "hunches" and the third degree in police work, and the day is not far distant when our police laboratories will attract scientific men of high caliber with university training along this line. However, this will not happen until the authorities will make the salaries high enough to attract really good men, and the pay must be far greater than that of the average patrolman.

For the present many law enforcement agencies must get along with technicians who are trained and directed *under competent supervision*. In most communities a high school or college chemistry teacher or local industrial chemist could supervise the tests operator and check chemical solutions, etc. The present war has amply demonstrated that many people, with little or no technical background, can be trained to operate machines and instruments of precision in a satisfactory manner. Another example emphasizing this point is the widespread use of the Babcock test for determining butterfat in milk and cream. This test was devised in 1890 by Dr. Stephen Babcock of Wisconsin University. It is simple and accurate and many people who do not even have a high school education have learned to run this test properly. A number of states examine and license these Babcock test operators, and the results have been highly satisfactory. Almost none of these test operators are college graduates. The general use of the Babcock test has probably done more to improve the dairy industry than any other development in its whole history. To have restricted the operation of the Babcock test to graduate chemists would have denied the benefits of this test to many communities.

As regards drunken driving, thousands of these cases must be decided every month, and if chemical tests run by available technicians will eliminate some of the guesswork involved in settling these cases, then such tests will serve a useful purpose.

Selection of Test Method

Advice on this point is a little like trying to tell a man which insurance company to patronize or what make of car to buy. Regardless of the choice, the results achieved are about the same. A large number of test methods are available. A recent publication of the National Safety Council⁸ listed six recommended methods, and a number of others may be found in the technical literature.

The method chosen will depend upon the test operator's personal preference, his training and experience, and the facilities available in his department. As already mentioned, the results of all the test methods yield about the same final information. As regards the six test methods listed by the National Safety Council, the Council's Committee said, "The Committee is of the opinion that any one of the methods is capable of giving quite satisfactory results."

Choice of Body Material To Be Analyzed for Alcohol

We have already pointed out that with living subjects the body materials available for chemical analyses are blood, urine, saliva, spinal fluid, and breath.

Breath is probably the easiest body material to obtain. Two of the breath analytical methods available may be completed within five minutes, which makes it possible to know quickly whether to hold the driver. The results of breath analyses will probably not predict brain alcohol quite as closely as will blood analyses, but our experience with thousands of breath analyses indicate that the results are sufficiently accurate for practical purposes. In borderline cases one should perhaps also analyze one of the other body substances.

Saliva is also easy to get. Only a small amount is necessary, and any officer is capable of collecting the sample and forwarding it to a chemist. However, there is often some delay before the results of the chemist's analysis are ready. I believe that saliva should be used much more generally than it is at present.

Urine has been widely used, and the results are generally very satisfactory. As pointed out by Southgate and Carter⁹ of England, it is occasionally found that an inebriated individual will not, or cannot, urinate when requested to do so. If the bladder has not been emptied for several hours this urine may show a lag in alcohol as compared with blood. In such cases the

⁸Chemical Tests for Intoxication, Committee on Tests for Intoxication, 1938 report. Street and Highway Traffic Section, National Safety Council, Chicago, Illinois.

⁹Southgate, H. W., and Carter, G., Excretion of Alcohol in Urine, Brit. Med. Jour. 1:463, March 13, 1926.

driver should be instructed to empty his bladder and collect a second sample after about fifteen minutes.

In Sweden and other parts of Europe, and in some places in the United States, blood is the test material used. Only a physician or a competent clinical technician should be permitted to draw blood from living subjects. This service is sometimes difficult to obtain. If there is a delay of two or more hours between the accident and the drawing of the blood sample, this will mean a considerable drop in the per cent of blood alcohol. When drawing a blood sample, alcohol must never be used to sterilize the skin or the hypodermic needle and syringe. A preservative should be added to the blood sample to prevent loss of alcohol upon standing. A good preservative is sodium fluoride, about one-half grain per drachm of blood. In death cases it is usually possible to obtain a blood sample without opening the body. One way to do this is to draw blood directly from the heart by means of a hypodermic syringe fitted with a long spinal puncture needle. With a little practice it is fairly easy to insert the needle between the ribs above the heart. This procedure is frequently carried out by the coroner's deputies in Indianapolis.

In death cases the blood sample should always be drawn *before embalming is started*. Otherwise, the sample will be contaminated with formaldehyde, wood alcohol, and sometimes grain alcohol, and will be useless. We have repeatedly encountered this trouble. If the embalming fluid used contained no grain alcohol, it is possible to do a long analysis which will yield reliable results, but the method is too complicated for general use by most laboratory technicians. We have received blood samples which were taken from the first blood which was drained from the body during embalming, but these too contained some formaldehyde, etc. The best practice is to have the coroner refuse to release the body to the undertaker until the blood sample is obtained. Embalming fluid bottles should not be used as containers for blood, even though they are well washed, as the cap linings usually contain embalming fluid. With blood samples received by us from death cases, we routinely test the blood for formaldehyde, and if it is present we reject such a sample.

*Chemical Tests for Intoxication Follow Well-Established
Principles of Medicine and Law*

In 1814 the French chemist, Orfila, pointed out that when death is caused by a poison, such as arsenic, the body organs will contain demonstrable amounts of the poison. During the 130 years since Orfila's time, many chemists have improved and extended the methods of analyzing body materials for poisons. This type of technical information is now so well accepted, that

at present practically all physicians and all courts would consider evidence of poisoning as questionable, unless it is supported by the results of a chemical analysis. The most reliable proof of poisoning is the chemist's report that he found the poison present, and in sufficient quantity to have caused death, excluding, of course, the addition of poison after death. Thus, in cases of suspected poisoning by carbon monoxide, strychnine, arsenic, lead, wood alcohol, barbiturates, etc., it is largely the chemist's analysis which settles the matter. These chemical tests are also frequently made on body materials from living persons, who are possibly suffering from the effects of poisons or strong drugs. Here, also, the chemist's report has much more weight in medicine or law, than would be given to the opinion of non-medical witnesses who simply observed the behavior of the person in question.

The victim of alcoholic intoxication is really suffering from the effect of a drug, and that drug is ethyl (grain) alcohol. It is certainly logical to apply here the same procedures for proving drug action as are used for other drugs. Chemical tests for intoxication are, therefore, just another application of the customary use of scientific tests to tell whether the person in question is suffering from the effect of a drug or poison.

It is true that most courts have held that any person may testify as to whether, in his opinion, a given individual was drunk. However, this rule was made long before the automobile appeared, and where "drunk" meant a very advanced state of inebriation. An automobile driver must be very drunk before most eyewitnesses are willing to testify in court that he was intoxicated. The other party in the collision is perhaps an exception to this rule, but his testimony often carries very little weight.

Will the Use of Chemical Tests Aid in Reducing Drunken Driving?

Drunken driving is one of the most hazardous traffic law violations. This does not mean that most of the crashes are caused by intoxication, for the reason that other traffic law violations far exceed drunken driving. Just what fraction of our total so-called automobile accidents is caused by intoxication is difficult to estimate, but the evidence is overwhelming that inebriated drivers have many times their share of the crashes.

The problem of preventing a drinking man from driving is not an easy one. With his judgment distorted by alcohol he frequently does not realize his condition, or if he does, he has ceased to be concerned over the safety of himself or others. In spite of fines, suspensions of driver's license, and even imprisonment, all communities have drivers who are repeatedly guilty of

drunken driving. With some people the urge to imbibe is very strong, and it sometimes seems a hopeless task to prevent them from fulfilling this urge just before driving.

On the other hand it has been found that where drunken driving laws are well enforced, many people who have imbibed too freely will avoid operating a car. If the certainty of punishment is great, friends and associates will restrain the more foolhardy drinkers from trying to drive. For those who are not deterred by any punishment, a long suspension of license will at least take them off the highway for a time. Repeaters should be permanently barred from driving.

Here, as with all other types of lawlessness, stricter law enforcement results in better observance of the law. If this is not true, then we are wasting a lot of money on police, prosecutors, and courts.

It is a well-accepted axiom that promptness of apprehension and certainty of punishment are the best insurance against law violations. Drunken drivers cannot be penalized unless they are apprehended and convicted, and it is here that chemical tests for intoxication are urgently needed.

In order for a chemical test program to be most effective the public must know that such tests are available and are being extensively used. When police departments will take the time to run chemical tests for intoxication after every crash, routinely testing all drivers and pedestrians involved, and if the courts will vigorously support this program, then drunken driving will decrease.

While chemical tests for intoxication will not necessarily insure honest, vigorous and continuous law enforcement, they can be of greatest assistance to officials who really desire to do their duty in curbing the menace of the drunken driver. These chemical tests should not be used to exclude the usual type of evidence of intoxication, such as the testimony of eyewitnesses, but these tests will give valuable additional information which is often sorely needed.

FURTHER NOTES RELATING TO CHEMICAL TESTS FOR INTOXICATION

Such is the importance of the subject of chemical tests to determine intoxication that the Editor takes this opportunity to review a number of recent developments of particular interest to readers of this Journal. Of exceptional import is the forthcoming meeting of the *National Conference on Street and Highway Safety* to be held at Washington, D. C., October 10-12, 1944. Scheduled for consideration at the meeting is a provision as to chemical tests which was prepared by the Conference's Committee on Uni-

form Traffic Laws. In brief, the provision calls for the use of chemical tests in traffic cases in which the driver is suspected of intoxication. Reference to the outcome of the meeting and the specific provision adopted will be made in a later issue of this JOURNAL. If the presented provision is approved and made a part of the Uniform Code (it is designed as prospective Section 54 of Act V), such an inclusion will exert an impressive influence in spurring much needed legislation. This can be understood in light of the organization and work of the Conference over a period of years.

The Uniform Vehicle Code was originally prepared in 1925-6 by the *National Conference on Street and Highway Safety* in cooperation with the *National Conference of Commissioners on Uniform State Laws*. Many agencies and organizations had a part in the Code's preparation—among them the Bureau of Public Roads, the American Association of Motor Vehicle Administrators, the American Automobile Association, the American Transit Association, the National Automobile Chamber of Commerce, the National Bureau of Casualty and Surety Underwriters, the National Safety Council, and many others. As need arose and as changing conditions warranted, the Code has been rewritten and revised. And as time went on other agencies, as for example, the Safety Division of the International Association of Chiefs of Police, joined in reviewing and revising the Code and in contributing their influence toward legislative acceptance of Code provisions. Thus, inclusion of a sound provision relating to chemical testing in the field of motor vehicle traffic will go far to assist in the passing of much needed legislative programs.

Of significant interest, also, is the recent action taken by the *Junior Bar Conference* of the American Bar Association at their annual convention held in Chicago September 12, 1944. The resolution adopted read as follows: "Resolved: That the Junior Bar Conference of the American Bar Association approves the use of chemical tests for intoxication in the trial of traffic violations and other criminal violations." And in the 1944 report of the American Medical Association's committee assigned to study problems of motor vehicle accidents, the following recommendation is found: "The physician can aid enforcement officers in the control of drinking drivers by examining such drivers suspected of being under the influence and seeing that these cases are prosecuted in a scientific manner." Then the report urges that physicians fully acquaint themselves with the standard procedures for making examinations and for avoiding legal pitfalls in taking specimens, making the chemical analyses and presenting testimony in court. These indications of interest on the part of the Junior Bar and of the American Medical Association are hearten-

ing signs and forecast things to come.

And now, what of the police? To what extent are police departments employing chemical tests for intoxication? The September, 26, 1944 *Summary* issued by the National Safety Council's *Committee on Tests for Intoxication* describes the situation for the year 1943. The *Summary* is based upon information supplied by the 317 cities and the many states which participated in the National Traffic Safety Contest. Of the cities, 55, or about 18% reported use of such tests in suspected "under the influence" cases. These 55 cities are scattered among 20 states. Of particular interest is the fact that state police departments in 16 states advised use of chemical tests. Thus, as the *Summary* points out, chemical tests are in use in at least 26 of the 48 states—over half. But as yet, the use of chemical tests in traffic cases is negligible when considered in terms of the large number of driver and pedestrian intoxication cases which come to the attention of the police over the nation. Tabulated in the *Summary* are incomplete reports showing a total of only 4,640 tests taken during the year by the departments reporting in the Contest. Nevertheless, the facts are an indication that the beginnings of a broad and effective program of scientific chemical testing are already here and it is within the realm of probability that in the coming years use of chemical tests will make as great strides forward toward the goal of professionalized policing as has the science of fingerprint identification. As respects the nature of tests given by the reporting departments, 551 of the 4,640 were blood tests, 1,680 were breath tests, 1,951 were urine tests, and in the remaining 458 cases, two or more tests were given. For further information relating to the *Summary* and for Public Safety Memo No. 30, dated September, 1944, entitled "Setting up Chemical Tests for Intoxication," write to Mr. Harvey D. Booth, Secretary, *Committee on Tests for Intoxication*, National Safety Council, 20 North Wacker Driver, Chicago, Illinois.

There has long been need for a training handbook which would describe in clear and concise language the principles and procedures of chemical testing. The Indiana State Police should take a bow for their recently published Training Manual No. 1 entitled, "Chemical Tests for Intoxication." Within the 52 pages of the manual is packed a wealth of information copiously aided by more than a hundred illustrations. Materials included are from the pens of Superintendent Don S. Stiver of the Indiana State Police and Dr. R. N. Harger of the Indiana School of Medicine and have been selected and edited by R. F. Borkenstein, Chief Laboratory Technician of the Indiana State Police. Further information can be secured by writing to Mr. Borkenstein, Indiana State Police, Indianapolis, Indiana.—D. G. Monroe.