The Scientific Validity of the Decision in R. v. Phillips

by
J.G. Wigmore and D.M. Lucas

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In this article, the authors, two scientists with a particular expertise in toxicology and the breathalyzer, comment from a scientific viewpoint on R. v. Phillips, *wherein the constitutional validity of the presumption in section 258(1)(c) of the* Criminal Code[1] *was upheld. The article specifically deals with the criticisms of* Phillips *made by A.C.R. Whitten in a previous article in the Journal.*[2] *The authors conclude that Mr. Whitten's criticisms of* R. v. Phillips *are not well founded having regard to a more detailed analysis of the relevant scientific studies in question.*

Dans le présent article, les auteurs, deux spécialistes de la toxicologie et de l'éthylomètre, commentent du point de vue scientifique la décision R. c. Phillips *dans laquelle a été confirmée la validité constitutionnelle de la présomption mentionnée à l'alinéa 258(1)c) du* Code criminel *[anc. 241(1)c)]. Ils examinent en particulier les critiques à l'encontre de l'arrêt* Phillips *formulées par A.C.R. Whitten dans un article paru dans notre revue : voir (1989) 1 J.M.V.L. 25. Les auteurs concluent qu'une analyse plus approfondie des études scientifiques pertinentes en question révèle que les remarques de M. Whitten sur* R. c.Phillips *ne sont pas bien fondées.*

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* (1988), 64 C.R. (3d) 154, 4 M.V.R. (2d) 239, 42 C.C.C. (3d) 150 (Ont. C.A.).

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1 R.S.C. 1985, c. C-46, s. 258(1)(c) [formerly R.S.C. 1970, c. C-34, s. 241(1)(c)] as re-en. R.S.C. 1985, c. 27 (1st Supp.), s. 36.

2 See A.C.R. Whitten, "Presumption of Blood/Alcohol Level At Time of Driving: *R. v. Phillips*" (1989) 1 J.M.V.L. 25.

1. INTRODUCTION

An article in this Journal by A.C.R. Whitten[3] is critical of the Court's decision in *R. v. Phillips* principally because it was based largely on an inadequate agreed statement of facts regarding the scientific validity of the presumption contained in section 258(1)(c) of the *Criminal Code*. As Whitten stated:

> The quality of the "scientific" decision determines the quality of this legal decision in its entirety.[4]

There are two main areas of concern to Whitten:

1. The duration of the alcohol absorption phase, which may be long and variable. As a result many drinking drivers may be in the absorption phase and the breathalyzer results may be higher than they would have been at the time of driving.

2. The blood/breath alcohol ratio which may vary greatly from person to person and therefore, in a proportion of drinking drivers, the breathalyzer results may be higher than the actual blood alcohol concentration (BAC).

Whitten stated of the attack on the presumption:

> Because of the lack of a broad ranged analysis of the scientific data pertinent to the absorption phase and the blood-breath alcohol concentration ratio, coupled with a major concession as to "agreed facts" in these areas, the attack on the constitutionality of the presumption never really got off the ground. Granted, as originally conceded, this appeal was a formidable task for the Court to confront. It would not be easy for a court to wade through statistical data in which no consensus exists in such issues as the problem of drinking drivers generally. However, the limited scientific analysis haunts this decision and until the issue is reviewed again with a more detailed scientific base, the constitutionality of the presumption is still vulnerable to attack.[5]

In this article, a more detailed analysis of the science in the decision and in Whitten's arguments will be presented and additional studies will be included which support the Court's decision.

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3 *Ibid.*

4 Above, note 2 at 26.

5 *Ibid.* at 33.

2. ABSORPTION

Absorption is the process by which ingested alcohol leaves the stomach and small intestines and enters the blood. As long as the concentration of alcohol in the stomach exceeds the concentration in the blood, absorption will continue. As soon as the alcohol enters the circulation, some of it will be eliminated, primarily as a result of enzymatic action in the liver. Thus absorption and elimination occur simultaneously, but for the most part at different rates.

When the rate of absorption is greater than the rate of elimination, the BAC will increase. When absorption is slowed as when there is a large volume of food in the stomach or when the concentration differential of alcohol between stomach and blood is small, the rate of absorption will approach the rate of elimination and the BAC will not change significantly, resulting in a "plateau." Finally, when the rate of absorption is less than the rate of elimination, the BAC will decrease.

It can be seen that absorption continues to occur throughout most of the time that there is alcohol in the body. Even when the BAC is decreasing, there is still some absorption occurring. Therefore, the length of the absorption phase is meaningless, unless it is defined as the period of time during which the BAC is increasing. This will be the definition used in this article.

(a) Whitten's Criticism

Whitten is critical that the relevant agreed statement of fact was simplistic and did not take into account the "myriad factors" that affect the rate of absorption such as "age, sex, body weight, water content of the body, long term drinking habits, drinking pattern, medical condition and individual metabolism."[6]

The agreed statement of facts actually does take into account all of these factors. Agreed fact number 2 states:

> The rate of absorption is influenced by the nature of the beverage, physiological and time factors and food intake.

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6 *Ibid.* at 28.

Age, sex, body weight, water content of the body, long term drinking habits, medical condition and individual metabolism are, of course, "physiological and time factors." Whitten goes on:

> Kupferschmidt, in his article, briefly reviews eight of the experimental studies on peak blood alcohol concentrations (including the Shajani and Dunn study) in which the elapsed time from the end of alcohol intake to peak blood alcohol concentration varied from 12 to 166 minutes.[7]

Although Kupferschmidt[8] does in fact cite several studies, the one selected by Whitten is stated by Kupferschmidt to be from a Dubowski abstract from 1976.[9] Careful examination of this abstract does not reveal any "intake to peak data" at all. In fact it is a 1985 article by Dubowski in which the 12 to 166 minutes "intake to peak" results appear.[10]

Interestingly, the citation given by Dubowski himself for these data is the 1976 Dubowski abstract which does not give them. In the 1985 article, it is stated that the 12 to 166 minute range was found in an experiment using 69 male subjects who consumed 1.0g of alcohol per kg of body weight in 40 minutes. For an average male weighing about 70 kg (154 pounds) this would represent the equivalent of about five 12 ounce bottles of beer in 40 minutes. Many would not consider this a typical drinking pattern. Dubowski refers to this protocol as "slow" drinking.

Of the "eight studies" referred to by Whitten, in Kupferschmidt's article, numbers 3 and 4 do not indicate the length of the absorption phase but report only the maximum BAC obtained for a given alcohol dose.[11] Studies 2 and 3 are actually the same study and also do not give the length of the absorption phase.[12] Another two studies (numbers 5 and 6) speak vaguely of the "absorption phase" but do not define it.[13] Study number 7 does not show the

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7 *Ibid.* at 28.

8 G.J. Kupferschmidt, "Alcohol Pharmacokinetics and the Law" (1986) 42 M.V.R. 203.

9 K.M. Dubowski, "Human Pharmacokinetics of Ethanol – Further Studies" (1976) 22 Clin. Chem. 1199.

10 K.M. Dubowski, "Absorption, Distribution and Elimination of Alcohol: Highway Safety Aspects" (1985) Suppl. 10 J. Stud. Alc. at 98.

11 Above, note 8 at 208.

12 *Ibid.* at 208.

13 *Ibid.* at 208.

length of the absorption phase as indicated by Kupferschmidt but the length of the plateau.[14]

Of the "eight studies", only two actually refer to the length of the absorption phase according to the definition used in this article and one of these studies, Shajani and Dinn,[15] was referred to by the Court in *Phillips*.

The problem with the remaining study by Dubowski,[16] is that the duration of consumption and the interval of time that the breath or blood samples were collected over is not given. These can have large effect on the apparent time to the maximum BAC or the length of the absorption phase. If, for example, the samples are only collected every hour, obviously the earliest time to maximum BAC detected will be 60 minutes.

(b) Additional Studies

The laboratory studies referred to above regarding the length of the absorption phase were not the only studies provided to the Court in *Phillips*. The Court also cited studies by Loomis[17] and Gullberg.[18]

Additional studies can help answer the question about how many drinking drivers may still be in the absorption phase when tested. If a large percentage of drivers are still in the absorption phase between driving and testing then the presumption may act to their detriment.

Field studies in other countries have shown that very few drivers are in the absorption phase. A study by Lund[19] in Denmark of

14 *Ibid.* at 209.

15 J. Shajani and H.M. Dinn, "Blood Alcohol Concentration Reached in Human Subjects After Consumption of Alcoholic Beverages in a Social Setting" (1985) 18 Can. Soc. Forens. Sci. J. 38.

16 K.M. Dubowski, "Human Pharmacokinetics of Ethanol. I. Peak Blood Concentrations and Elimination in Male and Female Subjects" (1976) 5 Alc. Tech. Rep. 55.

17 T.A. Loomis, "Blood Alcohol in Automobile Drivers: Measurement and Interpretation for Medicolegal Purposes" (1974) 35 Quart. J. Stud. Alc. 458.

18 R. Gullberg, "Variation in Blood Alcohol Concentration Following the Last Drink" (1982) 10 J. Police Sci. Admin. 395.

19 A. Lund, "The Rate of Disappearance of Blood Alcohol in Drunken Drivers" (1979) 16 Blutalkohol 395.

432 drivers where double blood samples were taken one hour apart found not one case where the BAC of the drinking drivers was rising. A study of 1087 drinking drivers conducted in Britain found that only 3.8 per cent of the drivers were still in the absorptive phase.[20] A study in Sweden of urine and blood samples taken from 654 suspected drinking drivers found only 3.2 per cent had increasing BACs.[21]

Biasotti and Valentine determined using two urine samples that only 2.5 per cent of 204 suspected impaired drivers were still in the absorption phase and concluded:

> This contradicts the frequent claim of rapid consumption of numerous drinks immediately before driving.[22]

Finally, Dubowski stated:

> However, most law-enforcement related breath alcohol tests are performed in subjects in the postabsorptive state.[23]

It is also important to consider that, for the small minority of drivers whose BAC may be increasing, only the even smaller percentage near 80mg/100mL might be adversely affected by the presumption. For example, if the BAC increases from 200 to 220 mg of alcohol in 100 mL of blood from the time of driving to the time of the breathalyzer test, the presumption will be of no practical detriment to the driver.

The points raised by Whitten in his criticism of the agreed statement of facts do seem to be covered in the statement and thus presumably were considered by the Court. It may be helpful to reiterate the relevant ones here.

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20 P.G.W. Cobb and M.D.G. Dabbs, "Report on the Performance of the Lion Intoximeter 3000 and the Camic Breath Analyzer Evidential Breath Alcohol Measuring Instruments During the Period 16 April 1984 to 15 October 1984" (London: Her Majesty's Stationery Office, 1985).

21 A.W. Jones, "Concerning Accuracy and Precision of Breath-Alcohol Measurements" (1987) 33 Clin. Chem. 1701.

22 A.A. Biasotti, and T.E. Valentine, "Blood Alcohol Concentration Determined from Urine Samples as a Practical Equivalent or Alternative to Blood and Breath Alcohol Tests" (1985) 30 J. Forens. Sci. 203.

23 K.M. Dubowski, and N.A. Essary, "Breath-Alcohol Analysis on Duplicate Samples" in P.C. Noordzij and R. Rosbach, eds., *Alcohol, Drugs and Traffic Safety*, Elsemier Sci. Pubs. B.V. [Biomed. Div.] (1987) at 373.

1. These agreed facts are premised upon the case of a motorist from whom samples of breath have been demanded by a police officer and who has not consumed any alcoholic beverages between the time of the driving and the time of the Breathalyzer tests, and from whom the first breath sample is taken at least 30 minutes subsequent to the time of driving.

2. Absorption of alcohol into the blood begins immediately after initial ingestion and continues at a variable and unknown rate. It may continue for several hours. The rate of absorption is influenced by the nature of the beverage, physiological and time factors and food intake.

3. Elimination of alcohol from the body begins shortly after absorption and continues at a relatively constant rate which ranges from approximately 10 to approximately 25 mg of alcohol in 100 mL of blood per hour.

4. When the rate of absorption is greater than the rate of elimination, the blood alcohol concentration will increase. When the rates are approximately equal it will remain relatively constant (plateau) and when the rate of elimination exceeds absorption the blood alcohol concentration will decrease.

5. If alcohol is consumed on an empty stomach, the blood concentration will usually reach, or be within 20 mg per 100 mL of, a maximum within approximately 30 minutes, have a variable plateau period, usually within a range of approximately 30 to 60 minutes, and will then decline at a rate generally of 10 to 20 mg per 100 mL of blood per hour.

6. The blood alcohol concentration determined by a Breathalyzer test at a time at least 30 minutes subsequent to, but within two hours of driving, will usually be different from the blood alcohol concentration at the time of driving, unless there is a lengthy plateau period prior to the decline in blood alcohol concentration, in which case the blood alcohol concentration would be about the same. This difference will not operate to the possible disadvantage of the accused, except as set out in paragraph 11, below.

...

9. Except where there is a very lengthy plateau period, the lower of the two blood alcohol concentrations determined by a Breathalyzer, at least 30 minutes after the time of driving and at least 15 minutes apart and within two hours of the driving, will only be the same as the concentration at the time of driving if, in the interim, the said concentration has increased, plateaued, and subsequently decreased to the concentration which existed at the time of driving. Although it is possible for this to occur, it would be unusual.

...

11. Breathalyzer results will almost always be within +/- 10 mg/100mL of the actual blood alcohol concentration of the subject at the time of testing. Furthermore, since the lower result of two separate proper breath test analyses is the one which invokes the presumption, a reading of 91mg/100mL or greater would of necessity mean that the blood alcohol concentration at the time of apprehended driving was in excess of 80 mg of alcohol in 100 mL of blood, except in relatively rare cases where there has been both a large amount of alcohol consumed within a few minutes prior to apprehended driving and

> where the Breathalyzer tests are commenced within 30 minutes of the last alcohol consumption. Readings of 90 mg/100 mL or less are also subject to the +/- 10 mg per 100 mL possible margin of error inherent in the analysis of breath samples in approved instruments.

These statements would appear to be reasonable statements of the consensus of the vast amount of published scientific data.

3. BLOOD/BREATH ALCOHOL RATIO

The blood/breath alcohol ratio (BBR) is literally the ratio of the concentration of alcohol in the blood passing through the lungs to the concentration of alcohol in the air in approximate equilibrium with the blood in the lungs. Because of the obvious difficulty in designing experiments to directly measure the BBR, it is typically inferred from the correlation of measurements of the concentration of alcohol in breath collected near the end of an expiration and in blood from a peripheral vein or capillary. Much of the variation in the scientific literature for inferred values of the BBR can be explained by variations in the details of the experimental procedures used rather than by significant actual variations in the BBR.

Indeed, a strong case can be made for eliminating reference to what can at best be described as the "apparent" BBR and dealing in practical work at least, only with the correlation between blood and breath results since that is what is actually measured and is what is of real interest.

Nevertheless, the apparent BBR is frequently referred to and, because it is discussed by Whitten and the decision in *Phillips*, it will be discussed here.

The breathalyzer in Canada is calibrated using a BBR of 2,100 to 1; that is 2,100 mL of breath contains the same amount of alcohol as 1 mL of blood. It has been known for many years that the breathalyzer calibrated using this ratio tends to read lower than the actual BAC.[24] The reason for this tendency is that the 2,100 to 1 ratio is too low and the mean apparent BBR for the general population is closer

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24 B. Coldwell, ed., *Report on Impaired Driving Tests* (Ottawa: Queen's Printer, 1957).

to 2,300 to 1.[25]

If the apparent BBR is less than 2,100 to 1, the breathalyzer result will be higher than the actual BAC. If the apparent BBR is greater than 2,100 to 1, then the breathalyzer will underestimate the BAC.

In order for a truncated breathalyzer result to be 100mg/100mL when the actual BAC is only 80mg/100mL, the apparent BBR would have to be 1,541-1,680 to 1. This is important in that agreed fact number 12 states:

> Most, but not all, police forces in this province exercise their discretion not to charge persons with "over 80" where the lowest reading is less than 100.

(a) Whitten's Criticism

Whitten refers to the "Facts" by stating:

> The most significant facts enumerated are ... and that the breathalyzer operates on the assumption that the ratio of blood alcohol concentration to breath alcohol concentration is 2100 to 1.[26]

Having set up this straw man, he proceeds to knock it down:

> The Court is left with a "fact" that is a statistical "mean", in an area of differing opinions as to the prevailing range of data.[27]

However, agreed statement of fact number 10 actually states:

> The determination of the alcohol concentration in blood by means of an analysis of the alcohol concentration in breath using the breathalyzer is based on the premise that the former is greater than the latter by a factor of 2100 to 1. This factor can vary from person to person, but since it is lower than the generally accepted average value of 2300 to 1, it tends to operate in favour of the accused except in a minority of cases. Only about 5 per cent to 10 per cent of the population may have a factor less than 2100 to 1, with a very few being as low as approximately 1900 to 1. The ratio may be determined empirically in any given case.

The agreed statement of facts thus actually did recognize the variability in the apparent BBR.

Whitten supports his argument by stating:

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25 A.W. Jones, "Precision, Accuracy and Relevance of Breath Alcohol Measurements" (1976) 11 Mod. Probl. Pharmacopysch. 68.

26 Above, note 2 at 27.

27 *Ibid.* at 29.

> In studies reviewed by Kupferschmidt, the ratio of blood alcohol concentration to breath alcohol concentration ranged from 1555:1 to 3005:1.[28]

It is of interest to trace the ancestry of this statement and to determine what exactly these "studies" were.

The Kupferschmidt article that Whitten refers to actually states:

> Dubowski and O'Neill(11) indicate the variability of this ratio in their findings *during the absorption phase* and in some individuals during the elimination phase. *In 393 subjects, the range of results was 1706-3063:1 with an average of 2280:1.* Dubowski(1) indicates that 95% of a given population would have a partition ratio between 1797:1 and 2763:1 and that 99.7 percent would have a partition ratio between 1555:1 to 3005:1.[29] [emphasis added]

The two studies by Dubowski referred to are Dubowski in 1985[30] and Dubowski and O'Neill in 1979.[31] The *range* of blood alcohol to breath alcohol ratio stated by Kupferschmidt is not, as indicated by Whitten, 1,555 to 1 to 3,005 to 1, but rather 1,706 to 1 to 3,063 to 1. The wider range mentioned by Kupferschmidt is a statistical indicator of variance and was never in fact observed in Dubowski's experiments.

The relevant statement in the study by Dubowski is:

> However, significant variations from this population mean (for the blood/breath ratio) exist *during active alcohol absorption* and in some individuals even in the postabsorptive phase. The typical biological variability of human alcohol pharmacokinetic parameters is well illustrated by the data from studies of Dubowski and O'Neill (1979). These are summarized in Table 1, for the ratio of alcohol concentrations in whole blood and end-expiratory breath in healthy adult men in *the fully postabsorptive phase.* These experimentally determined ratios have a Gaussian distribution. Hence a *postabsorptive* blood alcohol: breath alcohol concentration ratio range of 1797:1 to 2763:1 can be estimated for 95% and 1555:1 to 3005:1 for 99.7% of such a population.[32]

The "studies" quoted by Whitten, by Kupferschmidt and by Dubowski himself are in actual fact only one study, by Dubowski and O'Neill.[33] That "study" is not published as a peer-reviewed scientific paper but only as an "abstract." The relevant quote from that "study" actually is:

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28 *Ibid.* at 29.

29 Above, note 8 at 210.

30 Above, note 10.

31 K.M. Dubowski, and B. O'Neill, "The Blood/Breath Ratio of Alcohol" (1979) 25 Clin. Chem. 1144.

32 Above, note 10 at 102.

33 Above, note 31.

> *We therefore determined this important ratio, in-vivo in 149 experiments on healthy adult human males.*
>
> Paired specimens of end-expiratory breath and antecubital venous blood samples were obtained simultaneously (or nearly so) during the *proven postabsorptive phase* of alcohol intake/distribution/elimination . . . The data were analyzed by statistical regression analysis for *397 paired specimens and 142 corresponding blank values.*
>
> *We conclude that the mean BAC/BrAC under these conditions is about 2280:1,* and that in the post-absorptive state, a conversion factor of 2280 for alcohol analysis instruments employing end-expiratory breath should yield the best estimate of the co-existent BAC for a healthy adult male population with normal body temperature.[34]

In Kupferschmidt's review of Dubowski's work, there are several mistakes. All the subjects were in the post-absorptive phase and not the absorptive phase as stated. There were 149 experiments on an unstated number of subjects, not 393 subjects as stated by Kupferschmidt. The original makes no mention of the range of the blood/breath ratios, only the mean of 2,280 to 1.

The major problem with the Dubowski and O'Neill reference is that it is only an abstract. It is not a full scientific peer reviewed paper where all the experimental conditions would be stated. For example, the type of breath alcohol testing device and the dose of alcohol given over what period of time are not known.

The statement by Whitten quoted would have been more accurate if it had been:

> In one study by Dubowski and O'Neill in 1979, under experimental conditions which are not fully known, the mean blood/breath alcohol ratio was found to be 2280 to 1.

Unfortunately, Whitten, Kupferschmidt and even Dubowski himself misquoted from an abstract by Dubowski and O'Neill.

An additional complication is that the "studies" quoted by Whitten regarding the BBR do not indicate the subjects' BAC. At low BACs, small variations in the measured breath or blood alcohol concentrations will cause a large variation in the apparent BBR. This is illustrated in Table 1. A +/- 10mg/100mL variation or "possible margin of error" in the breathalyzer result will cause the apparent

34 *Ibid.*

BBR to vary widely at low BACs. It is not appropriate however, to use an apparent BBR obtained at a low BAC to cast doubt on the range of breathalyzer readings typically involved in court cases.

One study often quoted in court to show a wide variation in apparent BBR illustrates this point. In this study of 6 subjects, the apparent BBR was found to vary from 1123 to 1 to 3133 to 1.[35] This is a wider range even than that quoted by Whitten. However a closer look at the data reveals that the 1123 to 1 ratio was for a subject with a BAC of 9.29 mg/100mL and a breath alcohol concentration of 17.4mg/100mL. This is within the generally accepted +/- 10mg/100mL variation of breath tests.

There is only *one* result in this study that was above 80 mg/100mL and for that subject the BAC was 81.70mg/100mL and the breath alcohol concentration was 86.8mg/100mL. It is interesting to note that, in an actual case, due to the truncation of the breathalyzer results, the breath alcohol concentration would be reported as 80mg/100mL.

The "studies" reported by Whitten do not indicate the subject's BACs and are therefore of limited scientific value.

Whitten goes on to refer to Kupferschmidt as the source for:

> In one study by Mason and Dibowski, the authors recommended the abandonment of a conversion of breath alcohol concentration to blood alcohol concentrations because of the variations amongst individuals.[36]

Kupferschmidt actually wrote:

> Based upon their findings, Mason and Dubowski(9) proposed that conversion of breath alcohol concentrations to blood alcohol concentrations be abandoned. Instead, they suggested that impaired driving legislation be redefined in terms of the alcohol content of both the breath and the blood.[37]

Mason and Dubowski actually stated:

> During 1974 the proposal to report breath-ethanol concentration as such evidently gained considerable acceptance. In February 1975, the Executive Board of the Committee on Alcohol and Drugs of the NSC adopted a resolution recommending revision of the Uniform Vehicle Code so that blood and breath analyses for alcohol are dealt with separately but in parallel(127). Thus for breath, in a given jurisdiction, the quantity of ethanol present in 210 liters of substantially alveolar air (0.10g in the case of states using a limit of

35 T.A.A. Alobaidi, D.W. Hill and J.P. Payne, "Significance of Variation in Blood:Breath Partition Coefficient of Alcohol" (1976) 2 Br. Med. J. 1479.

36 Above, note 2 at 29.

37 Above, note 8 at 210.

> 0.10%w/v for blood and 0.08 g/210 l for states using the 0.08%w/v standard for blood), could define by statute the alcohol-related element of the offense of driving while under the influence of alcohol. It is hoped that the NHTSA will give sympathetic consideration to including the recommendation in the forthcoming revision of the Highway Safety Program Manual. If such were the case it is likely that application in actual traffic law enforcement could begin within about two years.
>
> This would be a significant step forward.[38]

(b) Additional Studies

One of the most extensive studies of the apparent BBR in drinking drivers showed that in 815 cases where the blood and breath samples were taken within 10 minutes of each other, only 3.3 per cent had an apparent BBR of less than 2100 to 1.[39] The lowest apparent BBR detected in 0.5 per cent of the drivers was in the range 1900-1999 to 1.

Another field study of 134 drinking drivers where blood and breath samples were taken within a mean time difference of 36 seconds, found that when the breath alcohol concentration was above 100mg/100mL, the corresponding blood alcohol concentration was always above 100mg/100mL.[40]

Another study comparing the apparent BBR under laboratory conditions and in 991 drinking drivers in the field, found that there was a tendency for the apparent BBR to be higher in the field than under laboratory conditions which means that breath alcohol testing instruments in the field were more likely to underestimate the subject's BAC.[41]

Finally, Jones states in regard to the BBR:

> Some of the extremely low or high values reported in the literature are unrealistic with reference to the physicochemical properties of ethanol and the composition of whole blood and breath. The abnormally high or low

38 M.F. Mason, and K.M. Dubowski, "Breath-Alcohol Analysis: Uses, Methods and Some Forensic Problems – Review and Opinion" (1976) 21 J. Forens. Sci. 9.

39 Above, note 20 at 55.

40 H.C. Pribor, C.R. Campbell, J.H. Hebb and D.C. Trost, "Ethanol and Vehicular Safety: The Nashville Experience: Part II. Breath-/Blood Alcohol Correlation" (1985) 23 Lab. Man. 21.

41 V.J. Emerson, *et al.*, "The Measurement of Breath Alcohol" (1980) 20 J. Forens. Sci. Soc. 1.

> blood/breath ratios often cited in court proceedings at DUI trials are probably caused by gross errors in the sampling and/or analysis.... At low BACs, even small variations in the measured concentrations of alcohol will tend to cause large variations in the apparent blood-breath ratio.[42]

4. CONCLUSION

Whitten's criticism of the scientific aspects of the Ontario Court of Appeal decision in the case of *R. v. Phillips* may not be well founded in light of a more detailed analysis of the relevant studies.

This matter illustrates the problem that occurs when professionals attempt to go beyond their area of expertise. We sympathize with the non-scientist who tries to properly judge a complex scientific issue. We would be in the same situation if we as scientists were writing about law and were building our case exclusively on selected court decisions.

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42 A.W. Jones, "Enforcement of Drunk-Driving Laws by Use of "Per Se" Legal Alcohol Limits: Blood and/or Breath Concentration as Evidence of Impairment" (1988) 4 Alcohol, Drugs and Driving 102.

TABLE 1

The Effect of a 10mg/100mL Variation in the Breathalyzer Result on the Apparent Blood:Breath Ratio

"Actual" BAC(mg/100mL)	Breathalyzer Result (mg/100mL)	Apparent Blood:Breath Alcohol Ratio
20	10-30	1400-4200
50	40-60	1759-2625
100	90-110	1909-2333
150	140-160	1969-2250
200	190-210	2000-2211