Journal of Criminal Law and Criminology

Volume 31
Issue 2 *July-August*

Article 13

Summer 1940

Police Science Technical Abstracts and Notes

Blood Tests of Fingernail Scrapings

In the investigation of crimes of violence, such as murder and rape, scrapings from the fingernails of a suspect are often examined for traces of blood. In some instances there may be found definite particles of dried blood, and these can be identified by the Teichmann test and precipitin reaction if there is a sufficient amount of material available. In other cases, no apparent blood deposits may be observed, and the examination may be limited to one of the extremely sensitive preliminary tests for blood, such as the benzidine reaction. However, the significance of positive blood reactions, particularly those in the latter group, is open to question, in view of the possibility that the blood may have been deposited under the nails in some manner other than in the commission of a crime. The results of an extensive investigation of this question are reported in a recent issue of the Archiv für Kriminologie by Dr. Ferdinand Terörde of the Institute of Forensic Medicine of Heidelberg University.[1]

Fingernail scrapings were obtained from 606 persons selected at random, and all specimens of debris were tested for the presence of blood by means of the benzidine reaction. The subjects chosen for the experiment represented various occupations, including laborers, office employees, housewives, butchers, soldiers, and schoolchildren. A positive reaction was obtained in 195 of the 606 cases—165 of the 546 men and 30 of the 60 women. The author suggests that the presence of blood in such a large percentage of cases may be ascribed to such causes as care of the nails, handling of meats, cuts in the fingers, wounds from shaving, skin eruptions, bleeding nose, etc. He also points out that a few materials other than blood will give a positive benzidine reaction. In six of the positive cases the precipitin reaction could be carried out. In five of these the results were negative. As a result of the findings reported, the author is of the opinion that it is not possible to arrive at important conclusions from positive blood tests of fingernail dirt.

An Inaccuracy in the Determination of Vehicle Speeds

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In the recent case of *People* v. *Herman*, 20 N. Y. Supp. (2d) 149 (1940), the Court accepted the testimony of police officers, qualifying as experts, who, with the aid of a mathematical formula, estimated the speed of an automobile involved in an accident, from the length of the skidmarks. The formula upon which the testimony was based is as follows:

$$s = \frac{v^2}{30\,f}$$

Where s equals the distance the automobile skidded in feet,
v equals the velocity of the automobile in miles per hour,
and f equals the coefficient of friction.

The derivation of the formula has been checked by the present writer, who subscribes to its accuracy. The purpose of this note is to point out a fallacy in the manner of applying the formula in this case.

It is clear that the value of v is readily determined if the values of f and s are known. The accuracy of the value of v derived by this formula depends on the precision with which f and s can be determined. For example, if the statement of the lay witness who passed the location of the accident immediately following the occurrence and estimated the skidmarks (s) at 35 to 40 feet without actually measuring them, had been accepted, the estimated value of v would obviously have been grossly inaccurate. Fortunately, a precise value for s was available for substitution in the formula, since the police officers had carefully measured the skidmarks and, after deducting the length of the car, found that the car had actually skidded 64 feet and 1 inch.

[1] Terörde, F., "Hat ein positiver Blutbefund im Fingernagelschmutz eine praktische kriminalistische Bedeutung," Archiv f. Krim. *105*:105-114 (1939).

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The other variable to be determined was the value of f, and here is where the error was made in the application of the formula. It is stated in the opinion: "From thousands of tests made by the use of a drawbar and a dynometer, the co-efficient of friction of pavements of streets throughout New York City has been determined. The co-efficient of friction of asphalt pavements was determined to be 0.78. Others vary below and above, up to 0.95, which is the co-efficient of brushed concrete." Since the pavement in the present case was made of asphalt, the experts assumed the value of f to be 0.78. Substituting $f = 0.78$ and $s = 64$ in the formula, they found

$$64 = \frac{v^2}{30 \times 0.78} \text{ or } v = 38.6 \text{ miles per hour.}$$

The fallacy is that the value for f substituted in the formula is merely an *average* of the "thousands of tests made" experimentally. There surely must be a considerable variation from one asphalt pavement to another and from one car to another, depending on the condition of the pavement and the tires, and one could conservatively estimate a range in the value of f from at least 15% below its average value to 15% above. One can assume, therefore, that the value of f in this case might be anywhere between 0.66 and 0.90. Substituting these values for f in formula, we find that v might have any value between 35.6 and 41.6 miles per hour, instead of the exact 38.6 miles per hour.

A more exact estimate of the value of v can be made if f is more definitely known. As a matter of fact, information is available from which f can be more precisely determined. In a test made by the police officers immediately after the accident over the same stretch of roadway, the brakes were suddenly and firmly applied while the speedometer recorded 30 miles per hour, causing skidmarks 43 feet 3 inches in length.[1] Substituting this data in the formula, we have:

$$43\tfrac{1}{4} = \frac{30^2}{30 \times f}; \text{ and } f = \frac{30}{43.25} = 0.69$$

Now, taking $s = 64$, and $f = 0.69$, we have

$$64 = \frac{v^2}{30 \times 0.69}, \text{ or } v = 36 \text{ miles per hour.}$$

Though this value for v does not differ much from the one (38.6) arrived at by the police officers, it is certainly nearer the correct one, since the value of f has been determined by an actual experiment with the same car and pavement that were involved in the accident. It is obvious, however, that even this result must have a small error, depending upon the accuracy of the individual performing the test experiment and making the measurements.

Incidentally, the same result can be obtained with the aid of a simple proportion:

$$\frac{v_1{}^2}{v_2{}^2} = \frac{s_1}{s_2}$$

Where s_1 is the length of the skidmarks corresponding to velocity v_1; and s_2 that of the skidmarks corresponding to velocity v_2.

Substituting $s_1 = 64$, $s_2 = 43$, and $v_2 = 30$, we find that v_1 equals 36 miles per hour.

In the present case the improper application of a mathematical formula did not give rise to any serious consequences, since the legal speed limit was 25 miles per hour, and the velocity of the car exceeded the speed limit in any event. Moreover, the velocity of the car as estimated by the police officers was not much different from the estimate arrived at by the proper application of the formula. While here the error made did no material harm, it is possible that a similar mistake could bring about a miscarriage of justice in another case. For this reason it seemed important to indicate the proper method of using the formula.

In conclusion, it is proper to repeat the well known saying that a chain is as strong as its weakest link. A precise formula cannot compensate for errors in measuring, as such inaccuracies will be carried over to the final result. Yet, lay individuals and even physicians will often draw conclusions based on the precise mathematical analysis of data which were compiled by grossly inaccurate methods.

[1] Such test procedure was advocated in a recent article by William W. Harper entitled *A Graphical Method for Rapidly Determining Minimum Vehicle Speeds from Skid Marks*, J. Criminal L. and Crim. *30* (1):96-103 (1939).