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UNRELIABILITY OF DERMAL NITRATE TEST FOR GUNPOWER

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The San Francisco Coroner's Office for some years has routinely made paraffin glove tests for gunpowder nitrates deposited on the skin in all cases of death by gunshot, whether homicidal, accidental, or suicidal. As a result of information obtained at Coroner's inquests, when investigating officers were asked to correlate the reported findings of paraffin glove tests with the known facts, it became apparent that a re-examination of the reliability of the test was required.

The method customarily employed was examined for sources of error in technique, but none was found. The technician who performed the tests had been doing them continuously for five years at an average of two pairs of "gloves" per week. While the many tests were made from a single container, spot checks for possible contamination were made. In each case the gloves were prepared by repeated dipping of the hands of the deceased into a bucket of warm paraffin, until a suitable thickness of paraffin was applied. After cooling, the gloves were bi-valved and removed. The test reagent used was 3% diphenylamine in 95% H_2SO_4 , which was applied drop by drop over the entire glove. Each drop was observed for possible positive reaction.

With the above mentioned question of reliability in mind, several groups of cases were examined for dermal nitrates.

I

A series of 20 consecutive cases of *known self-inflicted gunshot* wounds by small arms were studied with the following result:

- 4—positive, degree suggesting gun fired by deceased
- 15—inconclusive—positive, but not to a degree excluding possibility of nitrates other than gunpowder
- 1—negative—no reaction.

II

Another series of 20 consecutive cases of persons dying of causes unrelated to gunshot with the following results:

- 0—positive
- 16—inconclusive—positive in a degree resembling the 14 inconclusive cases of gunshot deaths
- 4—negative—no reaction.

III

A series of 15 cases, 6 of known self-inflicted gunshot deaths and 9 of persons dying of causes other than gunshot. The 15 pairs of gloves were packaged, marked with identifying numbers only, and delivered to the technician. He was directed to note his findings in the usual manner, by writing out a description of the intensity of the reaction and the site and area of the hand that was involved.

A study of these written descriptions when made by each of the authors would lead them to the following opinions:

6 cases—gun fired by deceased

	H. T.	J. L.
Suggestive of gun being fired by deceased.....	3	5
Inconclusive.....	3	0
Suggestive of gun not fired by deceased.....	0	1

9 cases—gun not fired by deceased

	H. T.	J. L.
Suggestive of gun being fired by deceased.....	2	1
Inconclusive.....	5	1
Suggestive of gun not fired by deceased.....	2	7

The technician, (J.L.) by virtue of his experience, was prepared to say that despite certain cases giving positive tests, he had the "feeling" that the intensity and distribution of the positive reaction was, in his opinion, not due to gunpowder and that the test could be called negative rather than inconclusive. Unfortunately, these are opinions based not on fact but rather on assumption not easily defended. In view of the fact that the test reveals only the presence or absence of nitrates and can in no way conclusively differentiate as to the origin or source of the nitrates, it would seem safer to presume that any test showing even small amounts of nitrates should be deemed inconclusive. Any test showing large amounts can only be presumptively positive for having resulted from the firing of a gun.

INTERFERING FACTORS

Our study did not enter into the subject of specific chemicals which did interfere with the diphenylamine test. We did, quite by accident, discover that the presence of free chlorine disturbed our results although from a practical standpoint this is not a common problem. The prime consideration was that the presence, on the hands of the deceased, of certain common substances containing nitrates or nitrites did confuse the results insofar as establishing the presence of the products of combustion of gunpowder. Substances when present on the hands of the deceased which are commonly found and are known to give a positive reaction to the diphenylamine test are as follows: Tobacco or tobacco ash, fertilizer, pharmaceuticals, leguminous plants, urine, etc.

SIGNIFICANCE

It is doubtful that anyone would have sufficient trust in the dermal nitrate test to bring a criminal charge or institute criminal proceedings on the strength of the findings of this test alone. Invariably, there is a mass of other evidence already available, and the dermal nitrate test is done with the hope of corroborating or strengthening the already known facts. Although the series done is admittedly a small one, there is the suggestion that even in experienced hands the test is subject to 13% gross error. For one who might only perform the test very occasionally, the error might be even greater. Such percentage of gross error as above stated makes the test totally unsafe for use where weight is given to the test in determining guilt and a conviction would result in severe penalty.

The test itself can determine with reasonable accuracy, only whether or not nitrates were present, but this is not what we need know. We actually want to establish whether or not a gun was fired and from this viewpoint, inconclusive findings must be considered as failures. (E.g., if 100% of all these tests were inconclusive, then we would know nothing of whether or not a gun was fired, and this test was 100% a failure.) Any lesser percentage of inconclusive findings merely means a smaller proportion of failure to serve its purpose.

In the sum total of the cases studied 75% were inconclusive. Coupled with the 13% gross errors, the test becomes less than worthless. It cannot be argued that the 75% inconclusive findings merely represent non-productive or non-informative work. An inconclusive finding is a double-edged and dangerous weapon. It offers broad and fertile fields to defense attorneys as they may use this inconclusive information to negate other positive evidence. Once a test is done, the findings must be included in the protocol whether the test is inconclusive or not. They must also be included when the test is known to be erroneous. While the uncertainties of the test may be explained by the prosecution, and considerable time given to the fact that a negative test does not rule out a gun having been fired, the defense can and will make issue of the fact that if a positive test has weight in proving a gun was fired, then an inconclusive test, and certainly a negative test must be given weight to suggest that a gun was not fired. In major cases, where penalties may be extreme if conviction is obtained, it takes an overwhelming mass of positive evidence to offset any doubt in the mind of a juror, no matter how slight this doubt may be.

Any test given to as much gross error as found and at the same time producing such a large percentage of uncertainty, need be used with extreme caution, if at all, considering the small amount of positive information afforded.

The inspectors of the Homicide Detail of the San Francisco Police Department were questioned as to their recollection of cases in which paraffin glove tests served in any degree to incriminate or clear a suspect or defendant. Not one instance was recalled where it served a positive role, despite their cumulative 49 years on the detail. It was the general opinion, borne out by some with specific cases, that an inconclusive or obviously erroneous result of a glove test can give cause for acquittal, or seriously threaten to do so, in cases where witnesses to the crime and other evidence would be sufficient for conviction. Some, because of their experiences, were outspoken in their belief that the proportion of true and accurate information gained by the test was far outweighed by the harm done because of the uncertainties of the test.

CONCLUSION

The paraffin glove test for dermal nitrates is neither sufficiently certain nor subject to such scientific accuracy as to justify its routine use in establishing whether a suspect or deceased did or did not fire a gun.

This opinion is based on the evident inaccuracy, even in relatively good hands, and on the fact that the inconclusive findings noted in most of the tests done can too easily be used to offset the weight of other well documented facts of a case at trial.

The test is performed in the San Francisco Coroner's Office only if an investigating homicide inspector requests it be made despite our advice and cautioning as to its failings.

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