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## Continuity and Contamination

One of the highest profile trials of recent times resolved primarily on the issue of contamination;

“I am not in the least satisfied in relation to any one of the items upon which reliance is sought to be placed for the results of their LCN DNA examinations that the integrity of any of those items prior to its examination for that purpose has been established by the evidence. Accordingly I find that that DNA evidence, the third and final strand remaining in the prosecution case, cannot satisfy me either beyond a reasonable doubt or to any other acceptable standard.”<sup>1</sup>

DNA is transferred from a person to other surfaces (including other people) inside skin cells and in other cells contained in body fluids such as blood, saliva, urine, and semen. Each of us has about  $10^{14}$  cells in our body (100,000,000,000,000), each with a full DNA profile packed inside them. We lose a number of these cells every minute of every day. Everywhere you go you probably leave your DNA. This is one of the main differences between DNA and fingerprints; DNA can be transferred from you to someone else and from that someone to somewhere else where you may have never been. Most contacts between people and objects are expected to result in the transfer of cells, and hence DNA, from one to the other and vice versa.

Current technologies, even the ‘standard’ profiling method, are capable of detecting picograms ( $\text{pg} = 10^{-12} = 0.000000000001\text{g}$ ) of DNA; that’s about the equivalent of a millionth of a grain of salt. It is hardly surprising to learn that, once it is established that the most likely source of DNA is from a particular person, the next step in crime investigation is to try to establish how it got there.

The difficulties in establishing that at these very low levels was recognized by the Caddy Review<sup>2</sup> which stated,

*“It is our opinion that when DNA profiles match as a result of LCN DNA profiling, the significance of the match should be reported on the probability that the two DNA profiles match only [6]. As the results were obtained from LCN it is inappropriate to*

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<sup>1</sup> Hoey, R. v [2007] NICC 49 (20 December 2007)

<sup>2</sup> [http://police.homeoffice.gov.uk/publications/operational-policing/Review\\_of\\_Low\\_Template\\_DNA\\_1.pdf?view=Binary](http://police.homeoffice.gov.uk/publications/operational-policing/Review_of_Low_Template_DNA_1.pdf?view=Binary)



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*comment upon the cellular material from which the DNA arose or the activity by which the DNA was transferred.”*

Although the FSS used to put a caveat in their LCN reports which stated that they could not comment on how or when the DNA came to be on an item which had no visible body fluid (and remember we see this a lot in standard profiling too), this did not, and has not, stopped some scientists from doing so. I am involved in at least one appeal where not only did the scientist decide that it was the accused’s DNA on the item, but that it got there during the commission of the crime. We shall see. The amount of DNA transferred, and the ability for subsequent transfer to other people and objects, has been the subject of scientific research. The vast majority of this limited research has been conducted using only small numbers of individuals (about 4 – 10) and in a very limited range of scenarios. In summary, no clear picture has emerged that could enable a confident interpretation of the finding DNA that is not associated with any particular body fluid on an object.

This discussion will simply highlight some of the comments and conclusions that feature in the published work. Operational scientists may attempt to make reference to their casework and experience as a source of informed data on these points, but it should be obvious that no matter how many profiles are observed or objects examined, without knowledge of what *actually* caused the DNA to be present it is impossible to use this as a substitute for controlled experiments or to draw any confident conclusion at all. Within this limited context, it can be reported simply how many objects submitted for such testing can yield profiles; even then, this is a very biased sample of objects.

The presence of DNA with a profile matching that found on an item does not necessarily show that the person ever had direct contact with the item. *“It has also been shown that a full profile can be recovered from secondary transfer of epithelial cells (from one individual to another and subsequently to an object) at 28 cycles [the standard method].”*<sup>3</sup>

*“The full DNA profile of one individual was recovered from an item that they had not touched while the profile of the person having contact with that item was not observed. This profile was also detected using standard 28-cycle amplification.”*<sup>Error!</sup>

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<sup>3</sup> Peel, C. and Gill, P., International Congress Series, 1261 (2004) 53-55



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These statements were reporting experimental results performed in controlled conditions and so the extrapolation to casework is difficult other than to establish that such transfer is possible.

One author concludes, “*a detectable secondary transfer is very unlikely*”<sup>4</sup> although there is no quantitation of ‘unlikely’ nor supportive evidence from controlled trials. This paper has a number of logical and factual flaws. For example, “*case experience has found that the handled object bears the profile of the most recent handler*”; this is conclusively contradicted by other work. While the DNA of the last person to touch the item may, or may not, be on the item, the DNA of others who may or who may not have touched the item may also be present. There is no reliable way of ascribing a particular profile to a particular time.

The literature contains preliminary studies or case histories on the possibility of recovering DNA from fingerprints left on the skin or in rope, cord, wire, etc., used for strangling, gloves, knives, solid parts of cars and other objects, and on the interference of substances used to highlight fingerprints during later genetic analysis.

These works report on isolated experiments, dictated by the need to resolve definite cases, but, “*systematic studies on recovery techniques, interference by contaminants, the influence of individual and exogenous factors in the number of cells left ..., and the percentage of success in PCR analysis of the genetic impression from nuclear DNA, have not been exhaustively carried out.*”<sup>5</sup>

So, there is a lack of definitive work on the transfer of DNA, but there are nevertheless studies that show that DNA can persist for some time after contact.

The highly variable results obtained by experimenters in this area merely add to the uncertainty about *any* conclusion based on the finding of low amounts of DNA on an object.

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<sup>4</sup> Wickenheiser R.A., J.Forensic Sci., 47(3) (2002) 442-450

<sup>5</sup> M. Pesaresi et al., International Congress Series 1239 (2003) 947– 951



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So what does that mean for the defendant? Simply always check with an expert to see if there is the possibility that the defendant's DNA came to be where it is found in a way other than asserted by the prosecution.

The defendant's DNA could be on an item because;

1. they committed the crime
2. they had previous contact with the item
3. they had previous contact with someone or something that had contact with the item such as
  - a. the perpetrator
  - b. an investigator
  - c. some other object that came to be in proximity to the item

Of course, as Weir J stated,

*“They [the defence] contend, and I accept the contention, that the court must be satisfied by the prosecution witnesses and supporting documents that all dealings with each relevant exhibit have been satisfactorily accounted for from the moment of its seizure until the moment when any evidential sample relied upon by the prosecution is taken from it and that by a method and in conditions that are shown to have been reliable. This means that each person who has dealt with the item in the intervening period must be ascertainable and be able to demonstrate by reference to some proper system of bagging, labelling, and recording that the item has been preserved at every stage free from the suspicion of interference or contamination. For this purpose they must be able to demonstrate how and when and under what conditions and with what object and by what means and in whose presence he or she examined the item. Only if all these requirements have been satisfactorily vouched can a tribunal have confidence in the reliability of any forensic findings said to have been derived from any examination of the item.”*

This refers to the associated topic of continuity; can the provenance of the item be unambiguously and completely accounted by reliable *contemporary* documents. I emphasise contemporary because it is not, in my opinion, satisfactory to have someone produce a statement some time (especially years) after an event that says, “I did X”, or just as worrying, “It was the practice then to X”. I have been involved in a case where a police officer produced a statement 11 years after an event and perhaps not surprisingly got the date wrong and the exhibit label wrong, and also managed at the same time to add more information than was initially recorded. In



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the same case, an entry on the exhibit label had all the appearance of being inserted between two other dates. Life in that case got considerably worse when it was discovered that two exhibits had been swapped in their respective packages. In fairness, the scientist noted and acknowledged that in his statement. Only examination of the record, and sometimes corroboration from other records, made at the time can reliably establish what was done to an item.

The point of establishing continuity is clearly to establish that it was not possible for contamination to occur.

We recommend a thorough check of continuity and a check on the possibilities for contamination in many cases involving DNA. The same principle applies to all trace evidence such as hairs, paint and glass.

I doubt whether it makes us many friends in the laboratories that we seek the data from, but I take encouragement from Justice Weir,

*“The Defence naturally focussed a great deal of attention upon each of these areas and carried out a commendably far-reaching and thorough examination of the police and forensic laboratory records relating to exhibits and, in the process, uncovered very many unsatisfactory matters.” QED.*

Professor Allan Jamieson

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