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Conference report

Trace evidence: Here today, gone tomorrow?☆

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ABSTRACT

The recent report of the National Research Council of the US National Academies "Strengthening Forensic Science in the United States: a Path Forward" found evidence that the level of scientific development and evaluation varies substantially among the forensic science disciplines. In this paper the status of trace evidence will be reviewed from an international perspective with particular reference to case studies. The paper will argue that the trace evidence discipline needs to learn from past experience and that serious coordinated action is required at an international level if trace evidence is to continue to meet the standards expected of forensic science in the future. The paper concludes that it is vital that trace evidence remains a key component of forensic investigation due to its important role in addressing the 'what happened' question.

1. Introduction

The genesis of this short paper was a plenary presentation to the 5th meeting of the European Academy of Forensic Sciences (EAFS), examining the current state of play for trace evidence and, at which the trace evidence examiners of today were invited to consider how the value of trace evidence examination might be enhanced in the future by looking at the lessons from the past. This paper is not a comprehensive, or even a mini, review of the literature dealing with trace evidence. The reader is encouraged to go to the Interpol website at http://www.interpol.int/Public/Forensic/IFSS/Default.asp where the proceedings are published of the Interpol International Conference on the Forensic Sciences. At this tri-annual meeting selected member countries produce reports on over 20 evidence categories covering the published literature for the three year reporting period. There is no single trace report but several trace categories are included. These comprehensive reports provide an excellent capture of the research findings and technical advances and, usually, an insight into the immediate future and significant issues for each evidence area.

What is trace evidence?

For the purpose of this discussion trace will be defined at a conceptual level as:

- a very small amount of substance, often too small to be measured
- the surviving evidence of a former occurrence or action of some event or agent [1].

At a more practical level trace will be defined as:

- the analysis of materials that, because of their size or texture, transfer from one location to another and persist there for some period of time. Microscopy, either directly, or as an adjunct to another instrument, is involved [2].

There is an emerging view that trace actually defines forensic science as a discipline because it constitutes the most basic material or physical information on crime [3].

Of course, no discussion about trace would be complete without a reminder of the often quoted (or misquoted) Locard Exchange Principle of 'every contact leaves a trace'. However, this simple statement hides a more complex truth which is that the trace must first be *recognised* before it can be recorded and then recovered. We like to think of these as the three 'Rs' of evidence, recognition, recording and recovery. As this process must start at the crime scene it is worth re-stating another self evident truth, trace evidence starts at the crime scene. Because trace evidence by definition is microscopic and transitory in nature its presence will most often not be immediately visible and, hence, recognisable. Hence, the recovery of trace evidence relies heavily on understanding how such traces are transferred and persist and how best to collect what may remain from a contact event.

This paper will analyse two significant cases in which trace evidence played a key role, one ended up as a Royal Commission into a wrongful conviction [4], the other to the conviction of an offender for murder [5]. The purpose in reviewing these cases is to identify some key considerations and to see what we can learn from the past to enhance the use of trace evidence.

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2. The Splatt Royal Commission

The report of the Royal Commission concerning the conviction of Edward Charles Splatt runs to some 343 pages. It is a complex case and no attempt will be made here to provide a comprehensive discussion of the evidence and the very detailed dissection of the original trial evidence which took place during the Royal Commission. Suffice to say that the Royal Commissioner, Justice Shannon, commented that "counsel for the prisoner could slash and hack and probe at every conceivable point" [pp 342 in Ref. [4]]. A brief summary of the crime is that Rosa Simper, aged 77, was killed in her home in Adelaide, South Australia (SA), sometime between 1:00 am and 6:00 am in the morning of 3 December 1977. She had been strangled with her brassiere and had injuries to her face and head caused by blows from a blunt instrument. There was also evidence that she had had some type of metal instrument inserted in her vagina and anus. The bedroom in which she was found had been ransacked but little of value appeared to have been taken. Theories abounded as to the motivation of her killer but none emerged as single motive. At the time of the murder there was no single comprehensive forensic laboratory provider in SA but the South Australian Police had a well developed crime scene group who dealt with major crime. The practice of the time was that members of this group not only processed the crime scene but would then recover trace evidence which would be sent to a number of laboratories for 'analysis'. It is fair to say that this crime scene group had a strong belief in the importance of trace evidence. It should also be remembered that this was in the era before the emergence of DNA testing.

The deceased was found lying on the disturbed surface of her bed in an essentially ransacked bedroom. There is no doubt this scene would have challenged any crime scene examiner in 'recognising' what was or would prove to be, significant evidence. Quite properly attention focused on the bed and trace materials were recovered from this bed. As Justice Shannon summed up, "amongst the trace material at the crime scene were particles of paint and of metal. That combination of paint and metal caused investigating police to focus considerable attention on Wilson's." Wilson's was a small industrial unit opposite the home of the deceased where metal work and spray painting operations were conducted. Initial examination of the trace recovered from the bed revealed the presence of particles and small agglomerates of what appeared to be spray paint and metal particles. These were assessed (but not counted) as being present in a ratio of about 75% paint, 25% metal. Clothing from the workers in Wilson's revealed that only one, Charles Edward Splatt, had paint and metal present on his clothing in this ratio. All other employees (there were 10 or 11) had more metal than paint on their clothing. Splatt was the spray painter in Wilson's! Remarkable as it may seem in retrospect this was the basis on which Splatt was charged in March 1978. However, by the trial in September 1978 the prosecution case had identified seventeen (17) trace materials which it would allege linked the scene of the murder with Splatt or his personal environment. In the prosecution opening address the jury was told "the Prosecution case against the accused is based exclusively and essentially on" the evidence of the trace materials. In the final address to the jury they were invited to conclude that the "the number (of trace materials) was too great to be attributed to coincidence or accident" and that "the accused must have been so closely in contact with the deceased that he must have been her attacker and indeed her slayer." [4].

These seventeen trace materials are listed in Table 1.

It is beyond the scope of this paper to look at all of these trace materials individually but that is exactly what happened during the Royal Commission — each in turn was dissected, slashed, hacked and probed until each in turn, like the proverbial green bottles on a wall, fell over to leave none. One of us (JR) worked on this Royal Commission, instructed by the Crown to review all of the evidence and particularly fibres, hairs and botanical trace. Other experts were also instructed by the Crown to review trace in which they had particular expertise. Only the botanical evidence will be considered here.

Table 1
Trace materials used to link Charles Edward Splatt to the victim.

1.	Orange paint spheres
2.	Spheres of paint — other colours
3.	Metal spheres — weld spatter
4.	Steel or iron particles — from machine or drilling operations
5.	Wool fibres
6.	Blue and white cotton fibres
7.	Orange paint particles on blue and white cotton fibres
8.	Yellow cotton and artificial fibres
9.	Foam spicules
10.	Human hair
11.	Sugar crystals
12.	Fish shaped lolly with blue and white cotton fibres attached
13.	Brown and white artificial fibres
14.	Seed endosperm
15.	Wood particles
16.	Non ferric metal similar to aluminium
17	Non ferric metal similar to zinc

In brief the botanical evidence consisted of two aspects. Fragments of wood were located on the bed as were fragments of seed endosperm. We will restrict our consideration of even this category to only the seed endosperm. The prosecution theory was that the fragments of seed had come from bird seed. Splatt had an aviary at his home and the logic followed that he would have accumulated fragments on his clothing which were then 'shed' during the murder. Notably the trousers allegedly worn by Splatt during the commission of the crime had turn ups which would act like a reservoir to trap even quite large particles of trace. The botanist Dr Kuchel, who conducted the original examination (supported in part by a colleague Dr Jenner) had worked for the Police before but was not a forensic scientist. The basis of his examination was to examine starch grains from the recovered fragments and to then compare these with a sample of birdseed taken from the Splatt aviary. Seven different types of seed were identified from the aviary, wheat, oats, sorghum, sunflower, safflower, panicum and phalaris. In evidence Dr Kuchel agreed that he "was able to match them back" meaning he had 'matched' *five* of the seven seeds. Dr Jenner stopped short of using the term match but said that "it is highly probably likely that they are in fact wheat, oats, and sorghum respectively." As further proof that the fragments were from uncooked seeds he stated that the starch granules had a characteristic optical feature seen under polarized light which disappears when starch is heated and gelatinises [6].

As pointed out earlier, there are some fundamental 'forensic' problems with this evidence. The first thing that should have been done was to isolate the fragments having the appearance of being of botanical origin and fully describe the number and appearance of the fragments. There is no evidence this was in fact done. Hence, the evidence failed on at least one of the 'Rs', recording. Even from remaining photographs of the recovered materials it is clear the fragments consisted of more than starch endosperm. Other parts of the seed such as seed coats can be very useful in assisting to identify a seed [6]. But, more importantly, the relevant forensic or criminalistics question, which should have been asked was, 'what would be the possible origin of such fragments?' As the hypothesis for their origin was the Splatt aviary the next obvious question should have been, 'are the recovered fragments different to fragments in the aviary typical of what would be available for transfer?' (*not* whole seeds). Only after these questions were satisfactorily answered would it be appropriate to then move to the question of 'identity'. Here, it is simply worth pointing out that it is not possible to absolutely identify seeds from their starch granules, although, combined with other evidence such as the microscopic structure of other seed structures it would be possible to offer strong evidence of 'identity' in a comparative sense against a closed population such as a seed mix. Another interesting question, however, would have been, 'how rare or how common the seed mix used by Splatt might be, or, even how common it is to have an aviary?'