TEXTILES PERVADE ALL ASPECTS OF LIFE AND HENCE TEXTILES ARE ALMOST always an innocent bystander at any crime. Thus, textiles often form part of the forensic evidence collected at the scene of a crime.

Textile yarns and cordages have been employed as bindings while fabrics have been used to wrap weapons, contain drugs and money, or wrap bodies. Some persons have torn police cell blankets into strips and attempted suicide by hanging; others have used long football socks. Fibres from the clothing of the criminal, or the criminal's home, may leave a trace on the victim, or at the crime scene and so on.

In some cases the textile forensic evidence is all that remains to assist the police, or the defence, in their investigations. For example, in the Azaria Chamberlain case, Azaria's jumpsuit was found one week after the baby's disappearance at Ayers Rock while the matinee jacket was found some five and a half years later. In a recent missing persons case in New South Wales, the victim's bra and underpants survived ten years burial whereas there were only skeletal remains of the victim. While the victim was identified from dental charts, the cuts and tears in the bra and panties provided evidence in support of the police theories as to the victim's final moments.

In arson cases, the fire may have been started by the ignition of a rag soaked in accelerant, and the propagation of the fire is often dependent on the burning characteristics of domestic textiles such as bedding, carpets and drapes.

The textile forensic scientist needs to be widely versed in all aspects of textile technology. A sound education in textile science and technology is necessary so that the scientist is fully conversant with the various processes that were used to manufacture the textile item in question. Without this education base, "non-textile" forensic scientists can make the most simple of
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errors, for example, describing a standard T-shirt as being manufactured from a woven cloth, whereas they are knitted.

The Department of Textile Technology [DTT], University of New South Wales [UNSW], has been involved in case work since the Graham Thorne kidnapping case. The Thorne family had won one of the first Opera House lotteries and their child had been kidnapped for ransom. The kidnapper murdered the child. Textile forensic work showed that fibres found on the body of the victim had their origin in the blanket found in the car boot of the accused. As a result of that case, the New South Wales Lotteries introduced the "Not For Publication" option on tickets.

Since then we have been involved in a wide variety of matters including the Azaria Chamberlain case, The Royal Commission into the conviction of Charles Edward Splatt, the judicial inquiry into the conviction of Mr Lindsay, the alleged Bowraville murders, drug-related matters, armed robbery, rapes, deaths in custody and coronial inquiries.

There is a need for active and continued research in textile forensic science, however the lack of funding generally means that techniques are developed, or research carried out, on a case-by-case basis. Once the case has been completed and the matter heard in court, the file is "closed" so to speak, but unfortunately the science involved in the case is rarely published in the scientific literature. The expertise resides only with the forensic scientist who completed the work.

Recently, efforts have been made to document the techniques and procedures employed in some aspects of textile forensic science. A number of forensic experts, including Michael Pailthorpe, have combined to publish the first comprehensive text book on textile forensic science (Robertson 1992). The book aims to inform both forensic scientists and the legal profession alike. The editor is to be congratulated on this achievement.

Education and Training

Textiles represent a very diverse and complex range of materials. Fibres vary widely in physical, mechanical and chemical properties. They can be arranged into a myriad of yarn and fabric structures, which can subsequently be enhanced by various fabric finishing routines. Eventually an end-product, such as a garment, is engineered from the textile fabric. The field of textiles is truly multi-disciplinary; and an understanding of it requires expertise in chemistry, physics and engineering, coupled with extensive knowledge of textiles as a specialist discipline in its own right.

Familiarity with current commercial practice throughout the complex textile manufacturing pipeline is also essential for many forensic investigations. For these reasons, it is not feasible for a forensic scientist to develop a broad expertise in the forensic examination of textiles, although they may be trained to conduct specific investigations such as fibre identification. Consequently, most textile exhibits are referred to textile specialists offering a private forensic service. In Australia, the forensic activities of such textile specialists represent only a small part of their activities, and they usually have no specific "forensic" training. Forensic skills
are learnt by experience "on the job", and through discussions with more experienced colleagues. For example, several staff of the Department of Textile Technology at the University of New South Wales are active in the forensic area.

As awareness of the potential of textile evidence continues to increase, the demand for forensic textile technologists will increase to the point where forensic services departments may want to include this expertise in their permanent staff. We would argue that the best person for the job would be a graduate of Textile Technology. The Bachelor of Science degree program at the University of New South Wales provides a four-year honours program, covering all aspects of textiles, combined with the elements of a basic science degree. In the honours year, students gain specific research experience by undertaking their own research project. Further research skills can be developed through subsequent research training leading to the degree of Master of Science or Doctorate. In recent years, a number of our undergraduates have expressed interest in the forensic area, stimulated perhaps by contact with their teachers who are active in the forensic examination of textiles.

A possible training path for a forensic scientist with textile expertise is a degree in Textile Chemistry, followed by a graduate course (Postgraduate Diploma or Masters) in Forensic Science.

Laboratory Requirements

The textile forensic scientist requires the resources of both physical and chemical laboratory testing facilities. The University environment would seem to be ideal for this purpose. The DTT is equipped with a full range of physical testing instruments including a range of microscopes, strength testing instruments, and so on together with the usual resources of a textile chemistry laboratory.

In addition, the textile forensic scientist has access to other University facilities including electron microscopy (SEM, TEM), surface analysis, GC-Mass Spectrometry, ICP analysis, photographic services, and so on. Thus the University forensic scientist is well placed both to maintain the chain of evidence and extract as much information as is possible from the evidence.

Research and development

Many aspects of the forensic investigations of textiles are relatively new, and, as explained above, much of what has been discovered is locked away in the files of individual cases. Consequently, there is no body of research to provide a foundation for forensic examinations of textiles. For example, the extensive literature available on the pathology of stab wounds in the human body can be contrasted with the meagre preliminary investigations reported on the analysis of stab damage to clothing. Because this foundation does not exist, in confronting a particular case, the textile technologist must draw on their knowledge of textile science and technology and apply it to the particular circumstances of the case. Very often this requires extrapolation of their knowledge into areas where no valid research has been conducted. In
such cases, the investigator may have to conduct a small research program as part of the investigation, in order to support the conclusions of the investigation.

For research to be conducted, funds need to be available to pay for salaries, equipment and other operating expenses. There are a number of sources for such funds, but first there needs to be a realisation of the need for and importance of such research.

At the University of New South Wales, we have become aware of this need through our own involvement in criminal cases. Consequently, we commenced a small research effort to support our own case-by-case studies, by setting forensic topics as research projects for our undergraduate honours students (Stacey 1989; Kostantakis 1991; van Tets 1992; Browne 1992). These efforts have been supported by small allocations from our School's share of the University's Special Research Fund. As a consequence of this small start, we attracted additional funds from the Australian Federal Police in 1992, and have received a substantial grant from the National Institute of Forensic Sciences for a project to commence in 1993.

It is hoped that, from these small beginnings, forensic textile research may be established as a worthy field of scientific endeavour, encouraging textile scientists in other countries to also make significant contributions.

**Casework**

*Fibre evidence/dyes/chromatography*

Textile fibres are often left at the scene of a crime and, properly examined, can provide circumstantial evidence that links the suspect with the crime scene. An example of such a case was the conviction of Mr Splatt for the murder of Mrs Simper solely on the basis of a multitude of circumstantial evidence including paint spicules, birdseed, confectionery and textile fibres. Mr Splatt had always protested his innocence and ultimately had his case re-heard by a Royal Commission. When re-examined by a team of defence forensic scientists, much of the forensic evidence was discredited and Mr Splatt was subsequently pardoned.

*Blood/textile dynamics*

For these studies, one needs to engage both a textile expert and a blood expert. A classic example for this work was the recent judicial inquiry into the conviction of Mr Alexander Lindsay for the attempted murder of his then wife. All of the physical evidence had been destroyed by the police. We had to "recreate" blood splatter patterns visible on the remaining crime scene photographs. Our experimental results supported the defence case and Mr Lindsay was subsequently pardoned.

*Washed or not?*

Often it is important to know if a certain textile has been washed or not. In one recent case carried out for the police, certain aspects of the police case...
related to the laundering history of a certain garment. Full knowledge of the manufacturing sequence was of great assistance to the forensic scientist. It was found that the paraffin wax type lubricants applied to the yarn during manufacture were still fully (that is, 100 per cent) present on the garment in question. Thus the garment had not been washed.

Stabs, cuts and tears

Very often, a textile may be physically damaged in conjunction with some criminal activity. Clothing is severed as a knife is stabbed into a victim; a climbing rope may be partially cut through to precipitate a deadly fall; a strip may be torn from a prison cell blanket to effect death by hanging; garments may be torn during a violent struggle, such as a rape.

Most often, the court wants to know the cause of this physical damage. This aspect of forensic textiles leapt to public prominence during the Azaria Chamberlain trial, where the issue was initially whether the jumpsuit was damaged by dingo teeth or by scissors. This case highlighted how little previous published research was available to aid investigators in such a study. Subsequently, N.A.G. Johnson has initiated a small research effort in this field, to build up a better understanding of how to proceed with such problems. These investigations are based on a study of the physical arrangement and appearance of the fibres and yarns in the fabric at the damaged region, and so the research field has been labelled textile severance morphology.

Textile severance morphology was particularly useful in one case where a T-shirt was found on a headless skeleton. The garment was quite stiff and heavily contaminated with dried body fluids, and was still crawling with maggots and other insects. Nonetheless, it was established that the severances in the garment were consistent with having been made by stabbing actions, and an estimate of the number of stabs could be given. No other physical evidence was available to determine the cause of death.

Unfortunately, not everyone in the investigation chain is aware of the potential use of severance morphology. No doubt much textile evidence is overlooked by crime scene investigators, and the ignorance of other forensic experts can cause difficulties for the textile expert. N.A.G. Johnson took considerable care in confirming that a particular severance on a garment had been caused by very sharp scissors, and that the scissor cut had been made after the garment had been contaminated with body fluids. This seemed particularly important, until it was eventually confirmed that a pathologist had snipped at the fabric with surgical scissors, without passing this information along with the chain of evidence.

Hangings

The strength of a textile may also be of importance. In inquiries into deaths in custody by hanging, it has been necessary to know whether the strips of blanket fabric could have been torn from the prison cell blanket by the victim, using the limited resources at their disposal. The techniques of fabric severance morphology must first be used to determine whether the strip was
cut or torn; very often a tear may be initiated by cutting, or puncturing; the teeth can also be used to initiate a tear. This requires a knowledge of the tearing mechanisms of fabric, and trials on similar blankets in a similar state of degradation.

Another issue is whether the strip of fabric allegedly used to effect the hanging could have supported the weight of the victim. This is a different aspect of fabric strength and is influenced by impact effects, such as the height from which the victim fell, and whether the noose tightened quickly or gradually. The elongation and energy absorbing properties of the fabric strip are also of importance here.

**Rape**

Strength of a textile can also be important in rape cases. In one such case, a key piece of evidence was a button and attached fragment of fabric found at the scene of the alleged rape. Firstly, this fragment was matched to the damaged blouse worn by the victim. The defence alleged that the woman had willingly cooperated in the sexual intercourse, but N.A.G. Johnson found that the removal of the button and fabric fragment was associated with considerable force; this was consistent with the victim's account of the rape.

**Storage of Evidence**

One of the principal responsibilities of the private forensic scientist is for the safe storage of the evidence. When the police deliver a specimen to us for examination there is the usual paperwork to sign that establishes the chain of evidence. The police then leave and we are totally responsible for the care and storage of that police evidence, often until the day of the court appearance.

The matter of storage is further complicated by the delay that necessarily occurs between the preparation of a quotation for the work and the acceptance of that quotation by the police. In a recently highly publicised case, we held the evidence for four months pending approval to carry out the work. Eight months after completion of the work, the evidence was still in our care, in spite of many requests to have it collected.

When working for the defence side of a case, matters become far more complicated. The prosecution forensic scientists will have already completed their work and, of necessity, may have partially destroyed the evidence in destructive testing. Since it can take several months, or even years, for matters to reach court the defence forensic scientist may examine the evidence months or even years after the alleged event took place. In the case of appeals that are made several years later, the police may have destroyed the evidence. For example, in the recent appeal by Mr Lindsay, all of the textile evidence had been destroyed.

If forensic evidence is still available it usually takes an order from the court to have that evidence removed to the defence team's laboratories. More often than not, a prosecution forensic scientist will be in attendance whilst the defence forensic scientist carries out their investigations. Should destructive testing be required, then further court orders are required. The evidence is
returned to the safe custody of the police when such defence investigations have been completed.

**Financial Matters**

In the past, the police have had a tendency to overlook the issue of cost when submitting evidence for examination, only to react with shock when they receive the bill. This may have occurred because the officer-in-charge of the case was not the person responsible for paying the bill. More recently, the accounting procedures appear to have improved, so that the investigation cannot proceed until the expenditure for a quoted figure has been approved. Unfortunately, it seems that again the officer-in-charge of the case may not have the authority to approve the expenditure, so that delays in gaining approval occur.

On the other hand, certain defence cases may literally have unlimited budgets, for example, Royal Commissions and some Legal Aid matters. One Aboriginal Legal Aid matter can be recalled wherein Michael Pailthorpe was engaged for three weeks (away from home) only to be in the witness box for about four hours.

**Presentation of Evidence**

Scientists have been trained to communicate their research findings in seminars, conferences and journals wherein open and free discussion takes place. Constructive criticism and open discussion are important parts of the scientific ethic.

However, the adversary system of justice does not allow for full scientific debate and it is virtually impossible for the forensic scientist to present their findings as they would like. Answering "yes" or "no" to poorly framed scientific questions does not necessarily get to the essence of the scientific results.

Often the barristers are ill-equipped in the relevant aspects of science and have to be fully briefed by their forensic scientists. Michael Pailthorpe has, on many occasions, virtually written his barrister's brief of questions.

If the opposing barrister cannot find fault with the science, or all else fails, then they will resort to a personal attack on one's credibility as a forensic scientist. Cross-examinations of that nature can be most stressful experiences and are quite unnecessary.

In many ways, the quality of the scientist's technical skills and knowledge are only as useful as their ability to present them in a credible and authoritative manner in the witness box. Creating the right image with the judge and jury members may be more important than the logic of the scientific argument, which they may not be capable of understanding.

**The Commitment**

In deciding to accept a forensic case, a private textile technologist takes on a serious commitment which may add a lot of additional stress to their normal routine. This stress comes from a number of factors. Firstly, there is the
pressure to "get it right" because of the severe consequences that the evidence can have on the lives of the victim(s) and suspect(s).

Secondly, the forensic scientist must strive for total perfection in both the experimental work and record-keeping. One must always bear in mind that all case notes may be tendered as evidence in court.

Thirdly, there is the fear of violence or other harm from criminals who might attempt to influence the course of justice before a hearing, or seek revenge afterwards. Within a rapidly changing world, the criminal element now has little or no regard for the system and may well harbour a grudge after a term of imprisonment. The private forensic scientist is seen to be part of that same system and, in many ways, runs the same risks as the police and judiciary.

In spite of taking the obvious precautions of silent telephone numbers and of not being listed in the telephone book, the private forensic scientist lacks anonymity. Unless one makes a special request of the prosecuting barrister, the second question put will be confirmation of one's home address. This statement is made in front of the accused and their family, friends and consorts. There is obviously always the risk of possible retaliation or retribution against the private forensic scientists themselves or their families.

A recent experience at the University of New South Wales serves to show just how vulnerable one can be. Michael Pailthorpe had completed certain work for the police that matched certain fibres found on the balaclava discarded by an armed robber at the scene of the crime with fibres from certain clothing found at the home of the suspect. Following the then normal reporting procedures, a report was issued to the officer-in-charge of the case. As for all of our Unisearch reports, the report contained a statement relating to our policy on retaining samples. In this case the statement read "All remaining samples in this case have been retained for possible court action".

Because of normal legal requirements, the police prosecutor supplied the defence with a copy of the report. Within one month of issuing that report, a person or persons broke into our building, found their way to Michael Pailthorpe's laboratories and offices (located on the second floor) and smashed their way into every office. The only items stolen were the balaclava and jacket in question. Valuable items such as money, a gold watch, computers, dictating machines, and so on were left untouched.

Apart from recovering the physical evidence, it was obvious to the author that the intruder(s) had also attempted to obtain the original laboratory case notes and the "slides" referred to in that report, being microscope slides. In their ignorance the intruder(s) went through the staff's photographic slides. Fortunately it was a fingerprint taken from a colleague's slide box that identified one of the intruders who is currently serving 6 months for the crime. It is understood that soon after the intruder was arrested, the armed robber changed his plea to guilty. Obviously, all of our procedures relating to the storage of exhibits have been reviewed and improved since this experience.

A further aspect of commitment is time. In addition to the time of conducting the actual investigation and preparing a report, the investigator must allow time for briefings by Counsel and court appearances.
Unfortunately, the latter can be particularly time-consuming because of the uncertain scheduling of court proceedings. As often as not, the stand-by, travelling and waiting times can greatly exceed the time actually spent in the witness box or, for that matter, the time spent in the laboratory. Depending upon contractual agreements, there may be no fee involved for such time-wasting activities.

While those who live with this system seem to accept it, those of us whose activities lie outside the legal sphere are constantly dismayed by the inefficiencies of the legal system, particularly the costly misuse of people’s time.

Another issue related to the time commitment concerns the use of an assistant to conduct certain elements of the investigation. In many laboratories, technicians develop skills in particular experimental techniques and may be able to conduct aspects of the investigation on behalf of the principal investigator. This may also help to reduce the fee for the investigation. The courts, however, usually prefer the witness to have conducted all the experiments themselves.

When a forensic scientist chooses to claim the work of others as their own, serious consequences may follow. For example, Justice Morling (1987) was highly critical of a certain professor who gave evidence in court as if he had actually performed the laboratory work himself. Newspaper reporters at the time nicknamed him "The Armchair Professor".

However, it is our view that, provided the activities of an assistant are closely supervised by the investigator, the court should be willing to accept the results of "routine tests" performed by the investigator's assistants.

Impartiality

One advantage of the private forensic scientist is the perceived impartiality. Even though they may have been contracted by the defence or the prosecution, they are seeking the same "truth", often in spite of defence or police "pressure" to come to a particular conclusion. They must resist pressure from the various parties to bias their findings, or to seek only what will help one side of the case.

This appearance of impartiality is of great value in court, adding weight to the scientist's evidence; it also greatly reduces the chance of attack from a barrister, since such attacks are often aimed at a perceived bias in the findings, or an emotional commitment to the client. For example, a forensic scientist was once involved in a case between an Australian paraplegic and a Japanese car manufacturer. Although his evidence was discredited in court in favour of the other side's expert, he was heard to say, that "at least he was acting for the right side". We believe that such thoughts of being on a particular side should not enter the mind of the private forensic scientist, for fear of such thoughts, even in the subconscious, introducing a bias to their findings and interpretations.
Conclusions

There must be some compensations for undertaking this work otherwise no-one would do it. One of the compensations is financial, but not all of the effort is adequately rewarded, especially if some under-funded government department is footing the bill. There is also the sense of providing a community service, and the need for someone to provide answers to the court. The authors enjoy the challenge of tackling intriguing problems, using one's scientific and problem-solving skills to reconstruct parts of a crime from the available textile evidence. Another challenge that some may actually enjoy is the confrontation with the Queen's Counsel.

All matters considered, the private forensic scientist has a very important role to play in the criminal justice system.

References


