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Fiber Examination in Forensic Science

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It is a well known fact for the most forensic scientists that the fibers may be used to provide crucial evidence in criminal cases. In the current era where much attention has been directed towards DNA analysis, fibers examiners must find new ways in which their service to the criminal justice system can be improved and extended. These changes can be focused on three major areas-finding new applications where fiber evidence may be useful to improve case management and analytical procedures; accumulating new information on fiber frequencies to facilitate the assessment of evidential value of case findings and striving to increase fibers intelligence work. Many forensic scientists have appreciated the uses of transferred fibers to provide evidence in criminal cases. The most frequent use is to provide evidence of possible contact between persons in crimes like murder, rape and sexual assault or aggravated assault. The next is in demonstrating contact between persons and other textile surfaces e.g. car seats or furnishings and usually concerns cases of armed robbery or terrorism. Fibers may be recovered from a point of illegal entry, or from weapons, knives, firearms, which may provide links to a suspect or victim. They can also be used to corroborate hit and run accidents, or to help in providing proof of having driven a stolen vehicle or having been driving whilst drunk. In the current era use of DNA has increased and leading to a real or perceived reduction in the importance of trace evidence, because of disadvantages associated with it which are: slow case speed, recovery and matching analysis. These disadvantages lead the case towards inconclusiveness. So, the success lies in overcoming these hurdles and giving marvelous contribution towards the crime reduction in the world.

Classification of Evidence

Evidence can be classified as shown in Figure 1. Direct evidence includes firsthand observations such as eyewitness accounts or police dashboard video cameras. Circumstantial evidence is indirect evidence that can be used to imply a fact but that does not directly prove it. No one, other than the suspect and victim, actually sees when circumstantial evidence is left at the crime scene. But circumstantial evidence found at a crime scene may provide a link between a crime scene and a suspect. For example, finding a suspect's gun at the site of a shooting is circumstantial evidence of the suspect's presence there. Circumstantial evidence can be either physical or biological in nature. Physical evidence includes impressions such as fingerprints, footprints, shoe prints, tire impressions, and tool marks. Physical evidence also includes fibers, weapons, bullets, and shell casings. Biological evidence includes body fluids, hair, plant parts, and natural fibers. Most physical evidence, with the exception of fingerprints, reduces the number of suspects to a specific, smaller group of individuals. Biological evidence may make the group of suspects very small, or reduce it to a likely individual, which is more persuasive in court. Trace evidence is a type of circumstantial evidence, examples of which include hair found on a brush, fingerprints on a glass, soil tracked into a house from shoes, and others. Fibers come under physical circumstantial evidence; more precisely it is trace evidence.

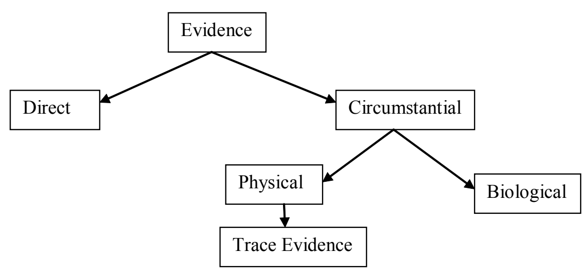

Figure 1: Classification of evidence.

Classification of evidence shown in Figure 1

Express Analysis

Fibre analytical front have witnessed a tremendous development which has made the greatest impact in fiber examination in recent years due to the introduction of the diode array spectrophotometer for examining and comparing fiber colour. Due to these new instruments record across the entire spectral range simultaneously, measurement only takes about 1 second, and thus it is possible to screen many suspect fibers from collectives very rapidly. A collective is a group of fibers of a particular generic type sharing the same colour (spectral pattern) and the same morphology. The direct result of this at some forensic labs has been to incorporate visible range diode array micro spectrophotometers, where optical properties of the fibers can be observed under bright field, polarized and fluorescence illumination and the colour spectra recorded, using only one micro-scope. In addition, these instruments allow the possibility for photo documentation. A further consequence is the development of an on-line case protocol system, the information being input directly at the work station. All information concerning case analysis is networked to any one of a number of terminals located throughout the fiber section. A brief describe the on-line protocol may be-the title page is where all administrative details of the case are entered, and where the links are found which lead to the pages concerned with the fiber analysis and evaluation. Special forms may also be included for recording notes on textile construction and damage if required.

All details of control and recovered fibers can be entered using drop-down menus–for example fiber type, delusterant, colour, fluoresence, cross section, melting point, optical properties etc. Additional information can also be added if desired. At a later stage, by using a search routine it is possible to sort the recovered fibers into groups showing the same characteristics (for example blue, delustred, peanut shaped acrylic fibers that fluoresce purple, yellow and orange

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under different filter combinations). At this stage the spectra have not been taken into account.

Finally, spectra recorded from potential matches between control and recovered fibers can also be stored and compared in the networked system. The software allows a choice of criteria which can be used as search parameters. It is possible to create spectral libraries and to search them for examples of a particular spectrum. For example, the hits are listed in a window on the right of the screen, with the best fit to the spectral match being sought being at the top. The correlations coefficient is shown in a second column. A value of 1 would represent an exact match. As the values fall, the degree of coincidence with the desired spectrum becomes less and less.

Securing and Retrieving Evidence

It is generally known that the most widely practiced method of recovering transferred fibers is the use of adhesive tape but now it has been improved. The use of so called "1:1 serial taping", where the area of one piece of tape represents exactly the same area on the object being taped, was pioneered in Germany. It has the advantage that when dealing with a corpse, it is possible to show that any transferred fibers found have been recovered from a very specific location. If these fibers can be shown not to originate from the victim or anything in his/her environment then there is a strong possibility that they were deposited by the suspect. Such a finding may have two advantages: it may provide an investigative lead which can narrow the choice of suspects; the pattern of fiber distribution may help to reconstruct events during the crime like strangling, attack from the rear etc.

Due to so many tape lifts, their evaluation becomes something of a logistical problem. In addition, a number of conditions must be met, and even an experienced evaluator must take care to avoid providing information leading in the wrong direction. It has been suggested that a compromise in taping may provide the best answer, where the body area is still subdivided into small areas, but the total number of tapings would be limited to about 34. This would speed up the complete process considerably, while still providing more elaborate information than is available with regular taping. Apart from the examination of transferred fibers, examination of textiles, threads, ropes, string, laces, wicks and textile tapes may also be involved. Very often information about the construction, finishing and possible origin of an item is requested. Such examinations require extensive knowledge of textile finishing and production processes, but can lead to a wider range of applications for fiber analysis.

In future, it may become worthwhile that such cases are examined in a regional centre where special expertise is available. The forensic science service in the UK has used fibers very successfully to deal with volume crime (car theft). They issued a very simple car seat fiber taping kit and pre-printed information form to local police. These are returned to the laboratory and can be examined very rapidly for fibers likely to have originated from a suspects clothing, providing the police with a quick and satisfactory outcome in approximately 70% of submissions. Although not a new idea in itself, this is an innovative way of putting fiber evidence to good use.

Conclusions

Whenever two people come into contact with each other, a physical transfer occurs. Hair, skin cells, clothing fibers, pollen, glass fragments, debris from a person's clothing, makeup, or any number of different types of material can be transferred from one person to another. To a forensic examiner, these transferred materials constitute what is called trace evidence. It's very difficult for the criminal to avoid or clean trace evidence as in most cases he/she may not be aware of it. Proper retrieval and examination/use of these trace evidences by a forensic scientist can send the criminal behind bars. Continuation of this situation is highly desirable and if the increasing possibilities for exchange visits between personnel employed in various laboratory systems can be realized, then at least in the fibers area, international cooperation will prove truly beneficial. Further, the quality of scientist and system can be enhanced by the global coordination and training which will ultimately lead to a crime free world.