The aim of this *Prospects* column is to bring you information about some of the very different and stimulating careers that can develop from an interest in the biological sciences.

Police forensic investigator

Fotolia

Every UK police force employs a team of highly trained people who specialise in the recovery of forensic evidence from scenes of crimes. Their titles differ from force to force. Until recently they were known as scenes of crime officers, or SOCOs. Nowadays they are often called crime scene investigators (CSIs) or forensic scene investigators (FSIs). They are the people you see on the news — wearing white hooded suits, gloves and masks — when reporters are filming at a serious crime scene.

In recent years, police forensic investigators have been the subject of a great deal of media interest. Their actions are reported regularly in newspaper articles. Books and television programmes often focus on their role. But what is it like to be a forensic investigator? What is required to get the job, and what is required of you once you have it?

Key words

Evidence
Crime scene
Fingerprints
DNA profile

Getting the evidence

In general, the role of a forensic investigator is to identify and recover items of forensic evidence (see Box 1) from crime scenes. A large proportion of criminals are convicted on the strength of forensic evidence, and so it is important that every opportunity to recover evidence is maximised.

Despite the impression that the media might give, forensic investigators deal with a variety of crime scenes — as well as those involving death. They will attend any scene where there is the potential to collect forensic evidence that may help the police to catch an offender, or enable them to exclude someone from suspicion. Less serious offences, so-called 'volume crime', such as burglaries and vehicle crime, are what forensic investigators spend most of their time dealing with (see Figure 1). Of course, they are also required to attend, document and investigate more serious scenes such as murders, sexual assaults, road traffic accidents, arsons, shootings and suicides.

Scenes of volume crimes do not differ from more serious scenes in terms of the evidence that can be recovered. In general, forensic

Box 1 What is forensics?

- 'Forensics' refers to the use of something for legal purposes. Forensic science, then, is the application of science in a legal setting.
- A police forensic investigator is not the same as a forensic scientist. A forensic scientist works primarily in a laboratory, and is involved with the analysis of the evidence that the forensic investigator has collected from the crime scene.
- The term 'footwear impression' tends to be used instead of 'footprint' — the latter implies a mark made by the foot itself, rather than by the shoe.
- Blood is an excellent source of DNA, despite the fact that red blood cells have no nucleus — the DNA originates from the nuclei of white blood cells (leucocytes).
- Saliva in its pure form contains no DNA — in reality, however, it is an excellent source due to its contamination with cells from the individual's mouth.
- Some bodily fluids, as well as other commonly available substances, will fluoresce under ultraviolet light (see Figures 2 and 3). Blood, however, does not fluoresce.

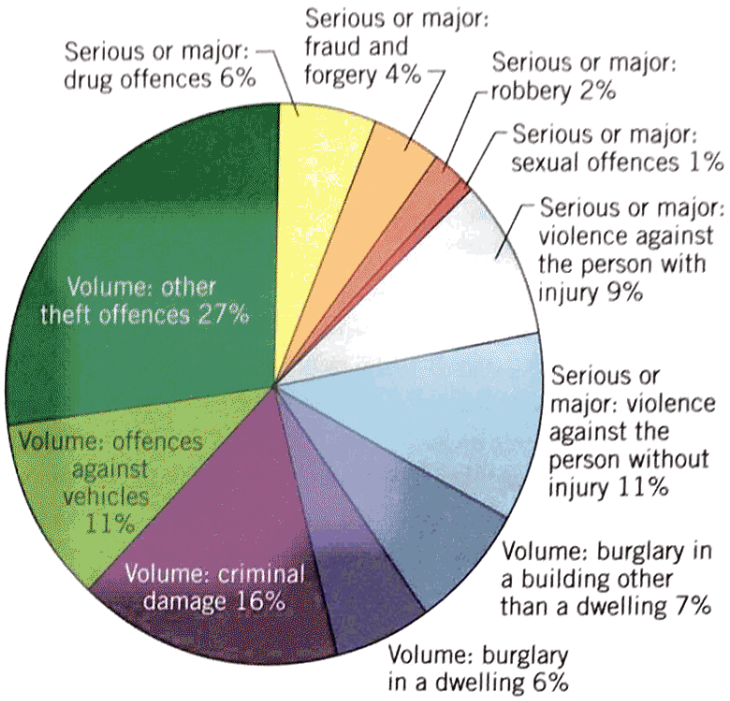

Figure 1 A pie chart of volume crimes versus serious and major crimes recorded in England and Wales, September 2010 to September 2011.

investigators will consider the possibility of recovering at least the following from any crime scene they visit.

Fingerprints

Moisture and grease can be transferred from the hand (or foot) of someone who has come into contact with a surface, leaving a pattern (see Figure 2). The pattern that is left is dictated by the arrangement of the ridge detail of the skin. These patterns are unique to the individual, which allows fingerprint experts to be absolutely certain when they link them to that person — even identical twins have fingerprints that differ from each other, despite having identical DNA profiles. The study of fingerprints is known as dactyloscopy (*dactyl* = Greek for finger or toe).

Forensic investigators can find fingerprints in two main ways. If the surface in question is suitable, they can use a fingerprint brush and special powders to visualise the otherwise invisible fingerprint. If unsuitable for powdering, they can recover the item or surface, and have it chemically treated in a laboratory in order to visualise the fingerprints.

DNA

Although more commonly encountered in scenes of violent or sexual crimes, offenders can leave DNA at any crime scene. Of the various possible sources, blood and saliva are the most frequently found at volume crime scenes. Semen, hair with an attached root, and skin cells are other sources.

The sample is recovered from the crime scene and sent to a forensic laboratory for DNA profiling (Biological Sciences Review, Vol. 24, No. 2, pp. 34–37). This is the analysis of a number of specific chromosomal loci. For each locus, the number of possible variations is known. The variant at each locus is given a number. The list of numbers for all the loci tested forms the DNA profile. Comparison of this profile against a database is then easy. It is simply a matter of comparing one set of numbers against a long list of other

Figure 2 Fingerprint. If an offender has a foreign substance, such as dirt or blood, on their fingers, this can be transferred onto a surface when touched, leaving a fingerprint made from that substance. In the case of this photograph, the substance fluoresces under specialist light sources, allowing us to see the ridge detail clearly.

similar sets to find the one that matches. The odds of a match like this occurring by chance, and not due to the fact that the DNA samples came from the same person, run into several billion to one.

Samples do not always yield a full DNA profile — hairs are a good example. If a hair is pulled forcefully from an individual's head, often a small amount of the tissue that holds the hair in place in the follicle is torn away too, and this tissue *will* give a full profile in most cases. However, if the hair is shed naturally, this tissue will not be present. The cells in the shaft of a hair do not contain nuclei, but they do contain mitochondrial DNA (mtDNA). This is inherited only from the maternal line. The consequence of this inheritance is that all biological brothers and sisters share the same mtDNA as their mother. This means that, even without a full DNA profile, it might be possible to link a sample to a family, which may help to steer the investigation in a meaningful direction.

Fibres

'Every contact leaves a trace' is a phrase on which a lot of forensic science is based. If contact between two fibrous materials occurs, some fibres will be swapped between them. If the forensic investigator can find fibres that are thought to be foreign to a scene, they will be recovered. They can then be sent to a forensic laboratory to identify what they are made of. Suppose a comparison sample is available, for example fibres from a jumper belonging to a suspect who police officers think may have been involved in a crime. Forensic scientists will be able to say whether it is possible that the fibres originated from the same source or not. The same applies to any fibre found on the offender's jumper. These fibres can be examined to see whether they could be consistent with something picked up from the crime scene.

Ryan Howell

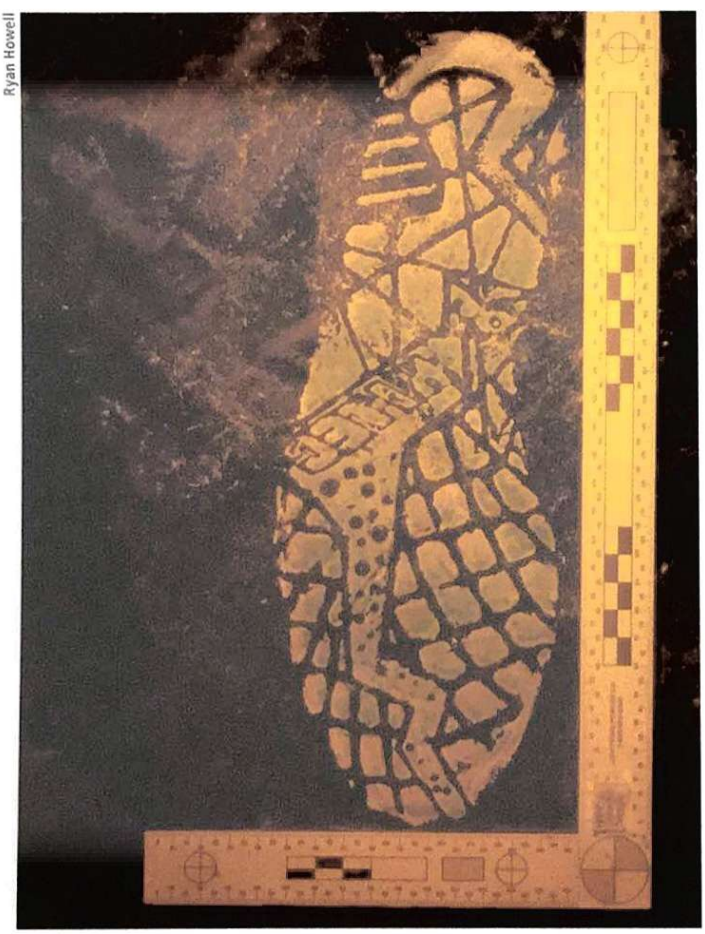

Figure 3 Footwear marks at a crime scene can be photographed to record the detail, for use in comparisons with the shoes of a suspect. A scale is used so that the footwear mark can be reproduced to actual size. In this case, the footwear mark was made in a substance that fluoresces when a special light source is shone on it.

Further reading

Forensic Science Service (2004) *The Scenes of Crime Handbook.*

Jackson, A. R. W. and Jackson, J. M. (2008) *Forensic Science* (2nd edn), Pearson Prentice Hall.

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Footwear detail

Footwear prints (see Figure 3) are a useful method of determining whether someone has been at the scene of a crime. If they walk within a crime scene, they will inevitably leave footwear marks. These are often invisible to the naked eye but can be developed in the same way that fingerprints can. The make and model of shoe can be identified and, due to individual wear patterns on the shoe itself, the mark can be linked to a specific shoe.

Trace evidence

Glass fragments, paint chips and many other materials and items may be left at a scene. Analysis of these at a forensic laboratory can be useful. For example, a fleck of car paint may be unique to a particular make and model of car, giving officers information about the possible vehicle the offender is driving. It is also useful for direct comparisons — for example, comparing a sample of glass from a smashed window to fragments of glass from an offender's hair.

Tool marks

When a tool such as a screwdriver or a pair of bolt cutters is used on a surface, it will often leave a mark. This mark can be linked directly to the tool, if the tool is found, due to the wear patterns that develop on the surface of the tool during its use over time. This evidence is important in linking a suspect who is found with a tool to the scene of a crime. If possible, the whole mark will be removed from the scene. Sometimes removing the surface in its entirety is not practical, in which case a cast is made of the tool mark instead.

Photographs

As well as recovering forensic evidence, forensic investigators are also police photographers. This means they take the necessary photographs at scenes of crime, as well as injury photography and other photographs that may be necessary for documentation or for court purposes.

Careers

If you are considering a career as a forensic investigator, it is important to recognise that you will have plenty of

company. Owing to the amount of media attention the role receives, and the unusual and fascinating nature of the job, competition is fierce. This is especially true at a time when police budgets are being reduced and the recruitment of new candidates has been put on hold temporarily.

Applicants come from a variety of backgrounds, but a university degree is becoming increasingly important. A degree gives grounding in scientific principles and helps to distinguish you from other candidates. While degree programmes in forensic science are available from various institutions, a degree in a traditional science, such as biology, may be of more benefit.

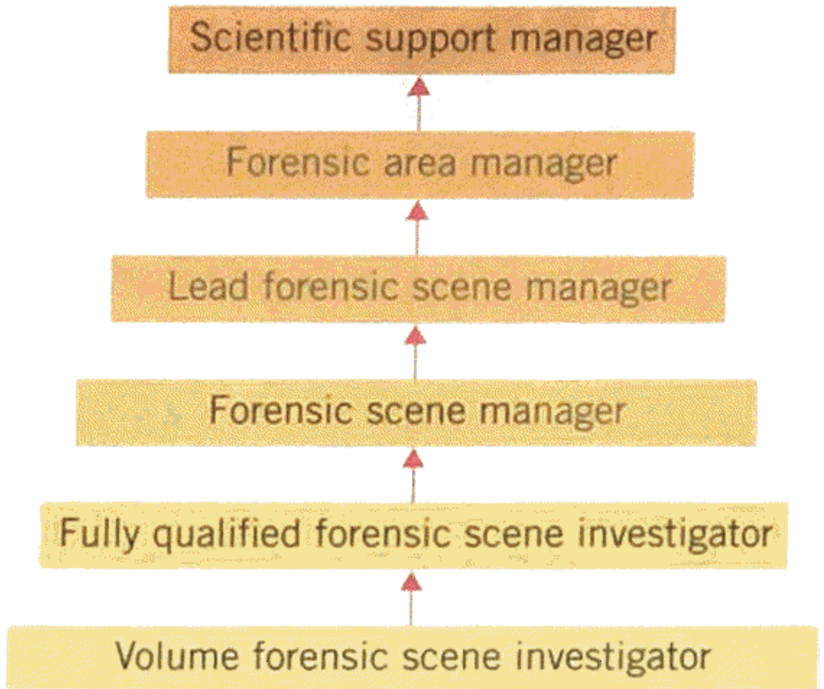

Figure 4 Career progression for a police forensic investigator.

An interest in photography would also be valuable, and the ability to work under sometimes unpleasant and stressful conditions is vital. Most importantly, do not underestimate the level of hard work that will be required once you are in post, and the hours of often painstaking and monotonous tasks that will be required of you.

Most forces will have a structure similar to that shown in Figure 4. A prospective candidate can expect to start in a volume forensic scene investigator capacity. Applications would be accepted from individuals straight from university and successful individuals would be given training by the police force in question.

There is little glamour to be found in this role. What you will experience instead is a career like no other. You will be challenged, you will have to think for yourself, and you will have to be able to adapt to the situation in order to recover the best evidence possible. You will have to be meticulous in maintaining the integrity of the evidence you recover, and you will almost certainly have to present evidence in court, defending your actions and decisions. Ultimately, you will be instrumental in the identification and the bringing-to-justice of those who break the law.

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