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BLOODSTAIN PATTERN ANALYSIS

Understanding how a particular bloodstain pattern occurred can be critical physical evidence, because it may help investigators understand the events of the crime. Bloodstain patterns occur in a multitude of crime types—homicide, sexual battery, burglary, hit-and-run accidents—and are commonly present. Bloodstain pattern analysis is employed in crime reconstruction or event reconstruction when a part of the crime scene requires interpretation of these patterns.

However, many sources of variability arise with the production of bloodstain patterns, and their interpretation is not nearly as straightforward as the process implies. Interpreting and integrating bloodstain patterns into a reconstruction requires, at a minimum:

- an appropriate scientific education;
- knowledge of the terminology employed (e.g., angle of impact, arterial spurring, back spatter, castoff pattern);
- an understanding of the limitations of the measurement tools used to make bloodstain pattern measurements (e.g., calculators, software, lasers, protractors);
- an understanding of applied mathematics and the use of significant figures;
- an understanding of the physics of fluid transfer;
- an understanding of pathology of wounds; and
- an understanding of the general patterns blood makes after leaving the human body.

Sample Data and Collection

Dried blood may be found at crime scenes, deposited either through pooling or via airborne transfer (spatter). The patterns left by blood can suggest the kind of injury that was sustained, the final movements of a victim, the angle of a shooting, and more. Bloodstains on artifacts such as clothing and weapons may be crucial to understanding how the blood was deposited, which can indicate the source of the blood. For example, a stain on a garment, such as a shirt, might indicate contact between the person who wore the shirt and a bloody object, while tiny droplets of blood might suggest proximity to a violent event, such as a beating.

Analyses

Bloodstain patterns found at scenes can be complex, because although overlapping patterns may appear simple, in many cases their interpreta-
Workshops teach the fundamentals of basic pattern formation and are not a substitute for experience and experimentation when applying knowledge to crime reconstruction. Such workshops are more aptly applicable for the investigator who needs to recognize the importance of these patterns so that he or she may enlist the services of a qualified expert. These courses also are helpful for attorneys who encounter these patterns in the course of preparing a case or when preparing to present testimony in court.

Although there is a professional society of bloodstain pattern analysts, the two organizations that have or recommend qualifications are the IAI and the Scientific Working Group on Bloodstain Pattern Analysis (SWGSTAIN). SWGSTAIN’s suggested requirements for practicing bloodstain pattern analysis are outwardly impressive, as are IAI’s 240 hours of course instruction. But the IAI has no educational requirements for certification in bloodstain pattern analysis. This emphasis on experience over scientific foundations seems misguided, given the importance of rigorous and objective hypothesis testing and the complex nature of fluid dynamics. In general, the opinions of bloodstain pattern analysts are more subjective than scientific. In addition, many bloodstain pattern analysis cases are prosecution driven or defense driven, with targeted requests that can lead to context bias.

**Summary Assessment**

Scientific studies support some aspects of bloodstain pattern analysis. One can tell, for example, if the blood spattered quickly or slowly, but some experts extrapolate far beyond what can be supported. Although the trajectories of bullets are linear, the damage that they cause in soft tissue and the complex patterns that fluids make when exiting wounds are highly variable. For such situations, many experiments must be conducted to determine what characteristics of a bloodstain pattern are caused by particular actions during a crime and to inform the interpretation of those causal links and

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138 See “Bloodstain Pattern Examiner Certification Requirements.” Available at theiai.org/certifications/bloodstain/requirements.php.
their variabilities. For these same reasons, extra care must be given to the way in which the analyses are presented in court. The uncertainties associated with bloodstain pattern analysis are enormous.

AN EMERGING FORENSIC SCIENCE DISCIPLINE: DIGITAL AND MULTIMEDIA ANALYSIS

The analysis of digital evidence deals with gathering, processing, and interpreting digital evidence, such as electronic documents, lists of phone numbers and call logs, records of a device’s location at a given time, e-mails, photographs, and more. In addition to traditional desktop and laptop computers, digital devices that store data of possible value in criminal investigations include cell phones, GPS devices, digital cameras, personal digital assistants (PDAs), large servers and storage devices (e.g., RAIDS and SANS), video game consoles (e.g., PlayStation and Xbox), and portable media players (e.g., iPods). The storage media associated with these devices currently fall into three broad categories. The first, magnetic memory, includes hard drives, floppy discs, and tapes. The second, optical memory, includes compact discs (CDs), and digital versatile discs (DVDs). The third, electrical storage, includes USB flash drives, some memory cards, and some microchips. These items are the most commonly encountered in criminal and counterintelligence matters, but laboratories have been asked to examine such items as scuba dive watches in death investigations and black boxes in aircraft mishaps.

The proliferation of computers and related devices over the past 30 years has led to significant changes in and the expansion of the types of criminal activities that generate digital evidence. Initially, computers were either the weapon or the object of the crime. In the early days, most computer crime involved manipulating computer programs of large businesses in order to steal money or other resources. As computers became more popular, they became storage containers for evidence. Drug dealers, book makers, and white collar criminals began to keep computerized spreadsheets detailing their transactions. Digital cameras and the Internet have made child pornography increasingly available, and computers act as a digital file cabinet to hold this contraband material. Finally, digital media have become witnesses to daily activities. Many individuals have two cell phones with text messaging and/or e-mail capability, several computers, a home alarm system, a GPS in the car, and more; even children often possess some subset of these items. Workplaces use magnetic card readers to permit access to buildings. Most communication involves some kind of computer, and by the end of each day, hundreds of megabytes of data may have been generated about where individuals have been, how fast they got there, to whom they spoke, and even what was said. Suicide notes are written on