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## Probing Clues Revealed by Stains and Stain Patterns

Grant Graham, Sr., MFS, SCSA, CBPE

"Few things hold so important a place as, or involve investigations of a greater nicety, than determining the precise nature of various blood spots or stains found on fabrics, instruments..." (Tidy, C.M., 1882).

Professor Charles Tidy wrote this quote in his publication "Legal Medicine" in which he eludes to the necessity of **examining bloodstain patterns** to establish their link to specific events that occurred during an incident involving bloodshed. Today, the process of determining the precise nature of bloodstains, to which Professor Tidy referred, is known as bloodstain pattern analysis. Bloodstain pattern analysis finds its greatest contribution to modern law enforcement investigations when applied to the investigation of violent crimes, which tend to involve bloodshed.

When assessing the crime scene, the bloodstain pattern analyst examines the "dispersion, shape characteristics, volume, pattern, the number of bloodstains, and their relationship to the surrounding scene." (Bevel, T. & Gardner, R.M., 2002). In doing so, the analyst is able to draw logical conclusions to events that occurred at the crime scene. Conclusions are based on evaluation of bloodstains, their relationship to one another, and their relationship to other physical evidence at the crime scene. The conclusions must also consider investigative information and the results of other forensic disciplines such as DNA analysis, fingerprint

comparison, firearms examination, etc. It is important to know that in the absence of other information, it is generally not possible to make an evaluation based upon a single stain. Additionally, it is not always possible to obtain information from all stains. For example: A rough surface can distort spatter stains such that lines of directionality and impact angles cannot be accurately determined. However, if sufficient information is available, a trained analyst can determine the following types of information:

- The direction a given stain was traveling at the time of impact.

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- The angle of impact.
- The distance above the target surface the stain originated.
- The type of force involved in the bloodshed.
- The approximate (minimum) number of blows struck during an incident.
- The relative position of the parties involved during the incident.

(Bevel, T & Gardner, R.M., 1990)

Bloodstains present at the scene should be evaluated in conjunction with the presence and/or absence of other evidence to corroborate any conclusions. In one case reported by Rex T. Sparks of the Des Moines, Iowa Police Department (2004), the initial examination of stain patterns found in the residence of an elderly couple revealed several large pooling patterns and projected or spurt patterns in the kitchen. Projected or spurt patterns were also in three other rooms and the hallway. The projected patterns on the furniture and walls were no higher than nine inches from the floor. The elderly couple, who were uninjured, awoke in the morning to discover the aforementioned stains and alerted the police. Initial serological analysis of the stains revealed the blood was human and a DNA profile had not yet been obtained. There was no other investigative information indicating an assault of any kind had occurred. Initial suspicion was that the scene was staged using some type of device capable of delivering (projecting) blood under pressure. The absence of footwear impressions in blood and the absence of any stains (voids) in several areas along the trail of projected patterns were of particular interest.

A detailed investigation revealed nothing to suspect the couple of any wrong doing or intent, and also revealed the elderly female had a medical condition known as "chronic venous insufficiency syndrome", which is associated with varicose veins. This condition causes deteriorated veins to become engorged with blood, which are easily ruptured as the result of a bump or scratch. It is possible for these wounds to open, seal tightly and open again; explaining the presence of the aforementioned voids. DNA analysis revealed the elderly female was the source of the blood. The investigation revealed the elderly female unknowingly ruptured one of the veins in her ankle while walking through the house on the morning the incident was reported, subsequently causing the pooling and projected patterns as she moved about the house. This case example illustrates the importance of incorporating other investigative and forensic information into the bloodstain pattern analysis to arrive at a logical conclusion.

As stated earlier, bloodstain patterns observed at the crime scene relate to the occurrence events or snapshots in time. The basic patterns can be divided into four general groups; passive stains, transfer stains, projected or impact stains, and a miscellaneous category for stains that do not fit into the other groups (Bevel, T. & Gardner, R.M., 2002). Unfortunately, all of the stain patterns associated with these groups cannot be discussed herein because of the abbreviated nature of this article. However, this article will address some of the more common stains found at crime scenes.

Drip patterns are considered passive stains. The preponderant size of drip stains is four millimeters or larger in width. These stains are typical of venous bleeding or blood dripping from

persons, blood soaked weapons or other items. Examination of these stains can reveal the direction in which the stains were traveling at the time they impact a surface. The direction is defined along the center of the long axis of the stain, in the direction of satellite spatter, spines, or scallops that are typically located at one end of the stain. If these characteristics are evenly distributed around a circular stain with the same width and length, then the stain impacted at 90 degrees. (See *Figure 1*). Blood dripping into pooled blood or a collection of drip stains in a small area indicates the blood source, typically a bleeding person, was standing stationary at that location for a time sufficient to create the stain. Blood dripping into blood exhibits two characteristics; satellite spatter around the periphery of the pool and inverted fan shaped spatter on adjacent vertical surfaces.

Clot patterns are also considered passive stains. Clots appear as a congealed accumulation of blood resulting from the collection of blood cells in fibrin and often exhibit separation of the cellular components (red blood cells, white blood cells, and platelets) and the straw colored liquid serum (plasma). The presence of clots within a stain pattern, or a disturbed clot, can be significant as a time indicator in sequencing events. For example: A clot present in spatter indicates that time sufficient for preexisting blood (injury site) to clot had to have passed prior to the spatter causing event occurring. Assigning a specific time frame to a clotted stain should be approached with caution because the rate of clotting is dependant upon environmental conditions. Wonder, A. (1985) described clotting in three stages: Initiation: 10 seconds – 1.5 minutes, firmation: 5 – 50 minutes, and retraction: 30 min – 1.5 hours. Eckert, W. & James, S. (1989) described clot initiation at 3 – 15 minutes.

Spatter patterns are considered impact stains and occur as the result of impact to a blood source. The impact results in the blood being propelled away from its source, breaking up into small droplets in a circular – semicircular pattern distribution. Spatter patterns encountered with a preponderant stain size of one to four millimeters in width are commonly associated with blunt force trauma events. Spatter patterns encountered with a preponderant stain size of less than one millimeter in width are commonly associated with gunshot or explosive type of events. A word of caution when evaluating spatter stains: There are situations in which stains meeting the aforementioned criteria are not the result of blunt force or gunshot injuries. For instance: The author was asked to examine a stain pattern with a preponderant stain size less than one millimeter. Close examination of the stains revealed air bubbles and a lighter red color within many of the stains, consistent with expiratory (coughed up blood), not spatter from a gunshot as originally thought.

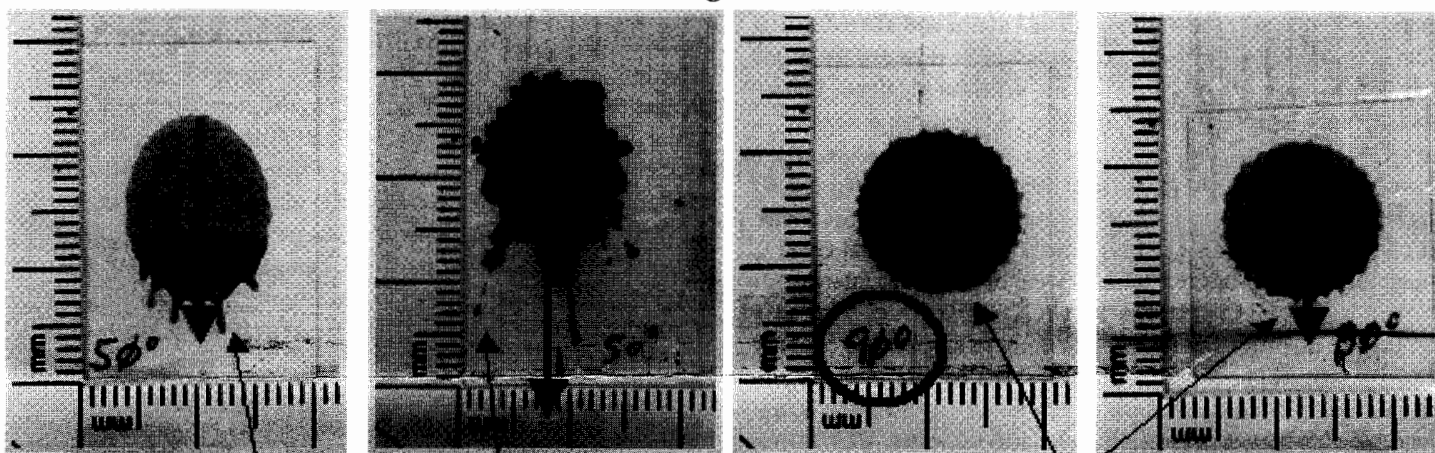
When a sufficient number of well shaped spatter stains can be related to the same impact event, it is possible to determine the angle of impact for each of the selected stains along with the collective area of origin above the target surface for the impact event. Knowing the area of origin will indicate the relative position of the victim and possibly the assailant. There are two types of spatter, forward and backspatter. Spatter that is projected away from the object creating the force is considered to be forward spatter. Conversely, spatter that is projected toward the object creating the force is considered to be back spatter.

Cast-off patterns are considered impact or projected stains and occur when blood is propelled from the surface of an object in motion or when the object comes to a sudden stop. The object from which the blood is being flung could be a weapon or the persons involved in the incident. Cast-off patterns are often seen as inline, circular to oval stains with the same direction. The line can be straight or curved, and can continue from one surface onto another. It is not uncommon to see cast-off stains on the ceiling or even on the back of an assailant's shirt and/or pants. Finding cast-off stains on the clothes of a suspect in a blunt force trauma incident not only links the suspect to the

of the intermediate object. For instance: In a blunt force trauma incident one might expect to see spatter radiating outward from the victim's position on the floor. But, close examination of the pattern reveals an area void of spatter where the assailant was kneeling adjacent to the victim. The void pattern suggests two pieces of information: one, the proximity of the assailant to the victim, and two, that spatter consistent with the blunt force trauma will likely be on the assailant's clothing and/or shoes. Void patterns may also be present if an item (suspect, victim, or other object) has been removed from or moved within the scene. The voids can be found in spatter, flow, and pooling

Pattern transfers occur when a blood-stained object contacts a surface, leaving behind a shaped impression. Typically the transfers are in the form of partial impressions from footwear, fingerprints, weapons, or any other bloodstained item. Correlating a pattern transfer with a specific object can assist with sequencing events and identify the location of persons and objects within the scene. Some transfers patterns bear no characteristics to further identify the type of transfer or its source. These patterns should still be noted, as they may become significant later in the investigation.

Figure 1



Cast-off Wave

Satellite Spatter

Scallops

crime, but can associate the suspect with actions consistent with causing the blunt force trauma. The direction of the pattern can indicate whether the blow was delivered right to left or left to right, or whether it is a forward or backward swing. This information can aid in determining the location of the assailant and with which hand the blows were delivered. However, this will not indicate whether the assailant is right or left handed.

Voids are a pattern in the miscellaneous grouping of bloodstains. Voids are typically observed in spatter stains, but can also be observed in flow and pool stains. When related to spatter, voids occur when there is an intermediate target between the impact point and the primary spatter receiving surface. The result is a reverse shadow effect revealing a lack of spatter in a specific area of the pattern, sometimes indicating the nature or shape

patterns, sometimes indicating the nature or shape of the missing/moved object.

The stains most often encountered at crime scenes are transfer patterns. Common transfer patterns encountered at crime scenes are: swipes, wipes, and pattern transfers. Swipe stains are created when a bloodstained object contacts and moves across a surface leaving behind a stain. Wipe stain occurs when an object contacts and moves into or through a preexisting bloodstain. In both swipe and wipe stains, sequencing and direction of movement can be determined. By their nature, wipe stains indicate the occurrence of two events, one being the event that caused the original bloodstain and the second event being the wiping motion. A pattern that is characteristic of a wipe stain is skeletonization. Skeletonization occurs when a bloodstain has been disturbed, but the outline of its original shape is still visible.

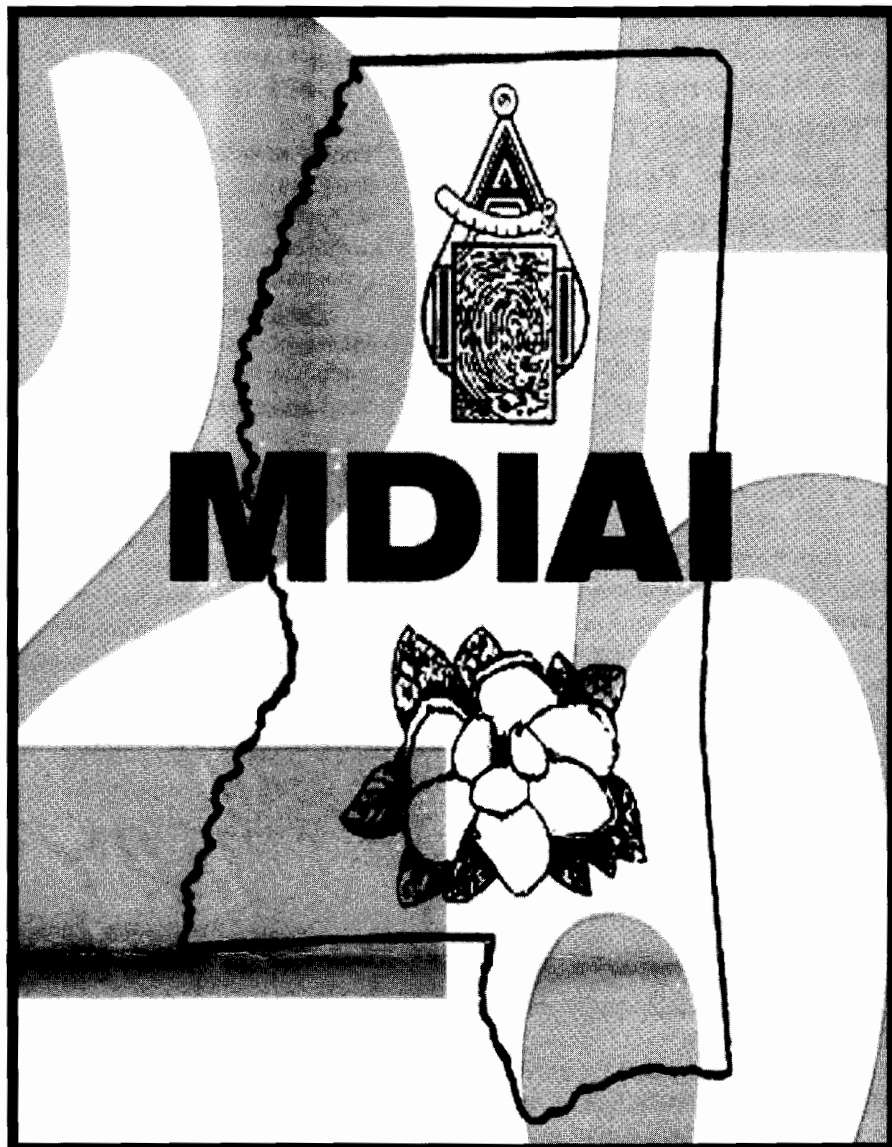
Although it is certainly important to evaluate bloodstain patterns at the crime scene, it also imperative to obtain the clothing worn by the suspect at the time of the incident. Stain patterns on the suspect's clothing can be used to corroborate or refute statements, and can be a direct link to the events of violence perpetrating the crime. "Those who administer beatings will usually themselves become spattered with blood. The absence of blood on the accused's clothing does not, however, prove non-participation..... To the contrary, it is possible to beat someone and not receive backspatter." (MacDonell, H.L. 1993). Mr. Mac Donell's insight holds true for other stain patterns found on clothing as well. In a sense, when the suspect's clothing bears bloodstains, the clothing can be viewed as a crime scene unto itself; each stain having the potential to reveal the events associated to the wearer of the garment.

It is important not only to observe the stain patterns present at a crime scene, but it is crucial to the analysis to recognize the type of pattern, its characteristics, and how the stain relates to the scene in order to render logical and meaningful conclusions. Caution should be exercised in trying to draw conclusions from all bloodstain patterns at the scene. Some stains will only reveal the type of pattern and cannot be associated to a significant event. Bloodstain pattern analysis is one of the many tools available to the investigator and crime scene analyst. Its application directly relates to the reconstruction of events and can be an effectively used to prove or disprove facts and circumstances at issue in an investigation.

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