I. BLOODSTAIN PATTERN ANALYSIS - AN OVERVIEW

A. USES OF BLOOD STAIN PATTERNS

When criminal investigations involve bloodshed, potentially valuable investigative information can be developed through bloodstain pattern analysis. Specific events can sometimes be logically inferred and sequenced.

1. Possible Determinations.
   Depending upon the nature and quantity of blood present the following determinations are possible:

   * The location and orientation of persons and/or objects at the time of bloodshed.
   * The movement of persons and/or objects during or following bloodshed.
   * The point(s) of origin of bloodshed.
   * The possible type of weapon used.
   * The number of blows, shots or actions.
   * Whether the suspect may also have been injured.
   * The possibility of bloodstain patterns on the assailant.
a. Determinations made from bloodstain patterns at the scene or from the clothing of principles in a case can be used to:

* Confirm or refute assumptions concerning events and their sequence.

* Position of the victim - sitting, standing, lying down

* Evidence of struggle - blood smears, blood trail, etc…

* Lack of spatter in various locations - was someone blocking the spatter? Was it the assailant or victim?

b. Determinations can confirm or refute statements made by principles in the case:

* Are stain patterns on a suspect's clothing consistent with his reported actions?

* Are stain patterns on the victim or at a scene consistent with accounts given by witnesses or the suspect?

B. PHYSICAL PROPERTIES OF BLOOD

1. Consistent

* Age and Sex of individual

* Temperature

2. Clotting

* Literature says 3-5 minutes in test tube. However, much longer on surfaces such as carpet, tile, wood and skin.

* Slower on irregular surfaces

* Slower at cooler temperatures.

3. Drying time of blood. Depends on:

* Weather

* Temperature, humidity, air movement
* Volume of blood, size of stain and surface blood is deposited on.

4. Viscosity

* The property of a fluid that resists the force tending to cause the fluid to flow.

* Blood - relative viscosity is 3.5 to 5.4 (water is 1.0).

5. Surface Tension

* The force existing in any boundary surface of a liquid such that the surface tends to assume the minimum possible area.

* Makes liquid behave as if it had a membrane over it.

* A drop of blood will not break-up in flight due to surface tension

6. Volume of a drop of Blood

   a. Effects on delivery method.

      * Finer surface - smaller drop up to a point.
      * Greater surface area of object - larger drop
      * Surface wet - larger drop
      * Curved surface - larger drop

   b. Effects of rate of delivery.

      * More drops/sec - larger drops produced
      * Blood is added to drop before it can fall.

   c. Range of values for volume of single drop of blood.

      * 0.01ml - from single hair
      * 0.05ml - from tip of finger
      * 0.13ml - from cloth
      * Reported value is 0.5 ml/drop

C. STAIN PATTERNS

1. Impact Spatter Patterns

   When blood is broken into small drops and dispersed in many directions as a result of receiving a blow.
a. Observed characteristics

* Spatter size: most 3mm to barely visible occasional larger stains (3/8”)

* Number and distribution: variable and random

* Dispersion of stains: as distance increases, dispersion increases.

* Directionality observed: angularity of stains allows projection back to impact site

b. Factors influencing Impact Spatter

* Shape and nature of the impact instrument

* Contour and nature of the object being struck

* Velocity of the impact instrument

* Friction, aerodynamics, momentum, etc…

c. Conclusions possible after careful examination of impact spatter

* Where an impact took place.

* Number of blows (minimum)
  (Note: First blow - no spatter since there is no blood present)

2. Gunshot Spatter Patterns

Spatter resulting from high energy impact from a gunshot

a. Observed Characteristics

* Spatter size: (1) “Mist Like" - atomized (0.1mm or less)
  (2) Many fine to medium stains (1 to 6mm)

* Dispersion: (1) Cone shape
  (2) Mist falls off quickly
* Directionality: Possible- just like any other impact

* Distribution: All things being equal forward spatter is greater than back spatter.

* Contact shots: Blood found in barrel

b. Factors influencing Gunshot Spatter

* Distance target is away from impact (Entrance or exit)

* Weapon and ammunition used

* Where person is shot

* Blockage of spatter by hair and clothing

c. Conclusion possible after careful examination

Spatter could be produced by gunshot. (Note: There is great overlap of blood spatter patterns produced by gunshot, other impacts and expired blood.)

3. **Large Volumes of Falling Blood and Projected Blood**

When volumes of blood 1ml or larger fall or are expelled to a surface.

a. Observed Characteristics

* Large central "circular" stain

* Radiating stains at acute angles

* Presence of secondary spatter likely

* Number of very fine stains present

b. Conclusions possible after careful examination

* Stain probably caused by blood falling or being projected to a surface. (Example: arterial spurting)

* Directionality - If target is vertical or oblique to the falling or projected blood.

* Note: Can not tell exact height from which blood originated.
4. **Contact Patterns**

The pattern that results when a bloody surface makes contact with a non-bloody surface.

a. Factors influencing Contact Patterns

* Amount of blood present

* Force of contact

* Nature and properties of the items making contact

b. Observations and Possible Conclusions

* Identification of the item(s) that made contact
  1. Place object at scene
  2. Place people or objects in certain places
     (Note: Must do confirmatory tests!)

* Direction of movement when contact was made

* Sequence of events

* Which side of clothing blood was deposited

5. **Stain Size vs. Horizontal Distance Traveled**

When blood leaves an impact site at a given velocity, the larger size drops will travel further than the smaller size drops. (Analogy: Throwing a golf ball and a ping-pong ball at the same time - the golf ball goes further.)

6. **Blood in Horizontal Motion**

Blood dripping from a moving person or object has a horizontal velocity as well as being pulled downward by gravity. This will often cause distinct bloodstain patterns

a. Factors influencing the pattern produced

* Initial velocity when blood is released

* How far blood travels before hitting the surface

* Texture of target surface
b. Observations and Conclusions

* Direction of travel - more disruption occurs on the side of the blood stain pointing toward the direction of travel.

* Amount of Disruption - As the horizontal velocity increases or the length of fall increases there will be an increase in the disruption of the stain

* Angle of Impact - The closer the bleeding source is to the horizontal target, the more acute the angle will be when the blood hits the surface.

7. Bloody Shoe Trail

After a person has stepped into blood he will leave a bloody trail when he walks away.

a. Influencing Factors

* Amount of blood on shoe

* Type of surface walked on (carpet, cement, wood, etc…)

* Type of shoe

D. GLOSSARY OF TERMS

1. Angle of Impact  The angle at which a blood drop strikes a target surface

2. Back Spatter  Blood which is directed back towards the force which caused the spatter

3. Blood Spatter  The result of blood receiving some type of blow or impact

4. Cast Off Blood  Blood which is cast or flung from a moving object due to a change in speed or direction

5. Contact Stains  The result of a bloody object touching or coming in contact with a non-bloody object
6. **Forward Spatter**  
Blood which is directed in the same direction as the force which caused the spatter

7. **Impact Site**  
That point or area on a bloody object that receives a blow. At times it can be used interchangeably with "point of origin".

8. **Inline Stain Patterns**  
When the blood stains fall in a relatively straight line across a target surface.

9. **Point of Origin**  
That point or area from which blood originates.

10. **Secondary Spatter**  
Blood drops that originate from a blood volume when that blood volume strikes a target surface

11. **Size of Spatter**

   a. **Mist** - A bloodstain pattern consisting of individual stains which are predominately 0.1mm or smaller in diameter

   b. **Fine** - A bloodstain pattern consisting of individual stains which are predominately 3mm or smaller in diameter.

   c. **Medium** - A bloodstain pattern consisting of individual stains which are predominately 3mm to 6mm in diameter

   d. **Large** - A bloodstain pattern consisting of individual stains which are predominately 6mm in diameter or larger.

12. **Target**  
The surface on which blood is deposited

13. **Transfer Pattern**  
When a blood object leaves an identifiable pattern on the non-bloody object.
REFERENCE BOOKS

BLOODSTAIN PATTERN ANALYSIS


II. Definitions of "Good", "Bad" and "Ugly"

A. "Good" - Good work in bloodspatter analysis is when the evaluations are performed by a well trained analyst that has proper education and experience. It is best that this individual have a college degree in forensic science or a related science. Since this area of evaluation is based on science (physics, chemistry, mathematics, etc…) individuals that do not have a science degree should be challenged before they are allowed to give testimony in court. All work performed should be peer reviewed before a report is issued. A report should be written in all cases and all notes should be available for review.

B. "Bad" - Bad work is performed by individuals that simply do not know better. Either they have not been trained properly or do not have the basic knowledge to perform these types of examinations. Many good examiners can do bad work. They often do not have the scientific background to perform the examinations or get into areas of expertise that they are not qualified to make interpretations or testify to in court. Often examiners in bloodstain pattern analysis do not spend an appropriate amount of time on an analysis and jump to conclusions. Analysts in this area often side step standard forensic laboratory quality assurance procedures (e.g. peer review, annual proficiency testing, continued training…).

C. "Ugly" - This is the worst type of examiner. This is an individual that will intentionally distort or overextend what can be said about evidence examined. This person is a black mark on the profession. This examiner forgets that science is neutral and often intentionally only reports or gives opinions that favor the side that has retained him. He often is dogmatic and will not change his mind when presented with new evidence. He often borders on being unethical or is unethical. This examiner often produces opinions that have no scientific basis or merit. This person's background and opinions must be challenged.
III. HOW THINGS CAN TURN "UGLY" --- BART'S "TOP 6" LIST

A. Blood Spatter means BLOOD Spatter

1. Presumptive tests for blood (e.g. phenolphthalin, luminol, etc…) are just that - presumptive. Blood must be proven present by confirmatory tests.
2. The species of blood must be determined. Is it human or from some other animal?
3. If human, who did it come from? DNA testing or other blood grouping tests must be performed in most cases.

B. Must have enough of a pattern to proceed.

1. One or two small stains "does not a pattern make"! If you only have a few small stains present on a surface there is not enough information to determine the mechanism that caused the spatters.
2. Many contact blood stains do not have enough information to determine how the contact was made.
3. Saying "I don't know" or "It can not be determined" are proper responses when insufficient information is present to make any valid scientific determination.

C. Overlapping stain patterns

1. Similar blood stain patterns are produced by different mechanisms. An examiner must be very careful to include all valid possibilities when making opinions about how a certain blood stain pattern was produced.
2. Impact spatter can look like expired blood stains as well as blood spatter produced by gunshot.
3. Small spatter that appears to be produced by impact can be produced by blood dripping into blood.
4. Certain wiping contact type stains mimic impact staining and appear the same.

D. The C.S.I. Effect

1. When lawyers (Prosecution or Defense) have scientific evidence jurors tend to believe it is irrefutable. Some jurors are highly skeptical when no scientific evidence is presented.

2. When lawyers (Prosecutor in particular) do not have scientific evidence jurors hold it against them. Jurors expect more than eye witness statements and/or confessions. Jurors blame the prosecution for not finding the physical evidence. Defense claims that the scene was "botched" as in the O.J. case.
3. How lawyers counter this effect is by using a "negative evidence witness".

   a. Prosecutor - witness testifies that "the absence of evidence is not evidence of absence".

   b. Defense - witness testifies that the case is flawed because you should expect to have found certain evidence that was not found. This can go too far and in one case in federal court, United States v. Frazier, 2004 WL 2320339 (11th Cir. 10/15/04) the judge did not allow the defense to introduce such a witness.

4. Attracts more "junk science" and "junk scientists". A nightmare for judges that must act as the "gatekeeper" to admit reliable expert testimony and exclude unreliable testimony.

5. Defense has the right to get rebuttal experts in bloodstain pattern analysis in a timely manner or get a continuance. (North Carolina v. Eva Kathleen Barlowe; No. COA02-579; filed: 15 April 2003)

E. Ethics

1. Many individuals in bloodstain pattern analysis do not belong to a professional society or know about a "code of ethics".

2. A few individuals are known to "puff" their credentials, follow non scientific procedures and over extend what can be said with the evidence examined. It has been very difficult to get professional organizations to take any action against these individuals.

3. Each case that is tried needs to be examined on an individual basis. If you think something is wrong with a person's ethical conduct then you should get an independent evaluation of the evidence and check on the background of the suspected unethical person. If appropriate you should present this to the judge or bring it forward during cross-examination. (North Carolina v. Michael Peterson; 2003)

4. There are a number of web sites that cover ethics issues in forensic science:

   b. Truth in Justice http://truthinjustice.org/
F. Qualifications of Analysts in Bloodstain Pattern Analysis

1. Criminalist (Forensic Scientist) vs. "Crime Scene Reconstructionist"

I suggest that only trained scientists should be used to testify about blood spatter evidence. This is a discipline that is based on science and is a part of forensic science not general police work. Although police officers can be trained to observe and do some very good blood spatter interpretations, they lack the fundamental scientific background to make sure their observations and interpretations stand up to scientific scrutiny. All conclusions need to have a scientific basis. Non-scientists often do not understand the "scientific method" and give opinions that are no more than a good guess.

2. Scientific Basis for all opinions.

I can not over emphasize enough the need to make sure that all opinions given by a person in blood stain pattern analysis have some scientific basis. An examiner should not be able to simply justify his conclusion by saying, “In my experience I have never seen anything produce a pattern like this but a gunshot (or expelled blood from the mouth or nose etc…)”. They must be able to produce some scientific basis for the conclusion.

3. SWGSTAIN (Scientific Working Group on Bloodstain Pattern Analysis)

This is an international working group established by the FBI to establish guidelines to be followed by practitioners in this field. This group is working hard to establish the minimum requirements for a person to do this work. These requirements are not established at this time but will most likely include requirements in:

a. Minimum education
b. Participation in a mentorship program
c. Competency (Proficiency) testing
d. Continuing Education
e. Following standards in report writing
f. Peer review
APPENDICES


A Summary Assessment of All Disciplines

Prepared by: Karen Runyon
Forensic Document Examiner
Minneapolis, Minnesota


Bloodspatter Pattern Analysis Section (pp 177-179)
### Appendix I

<table>
<thead>
<tr>
<th>Discipline</th>
<th>Summary Assessment</th>
<th>Validation</th>
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<tbody>
<tr>
<td>Biological Evidence</td>
<td>“DNA analysis is scientifically sound for several reasons: (1) there are biological explanations for individual-specific findings; (2) the 13 STR loci used to compare DNA samples were selected so that the chance of two different people matching on all of them would be extremely small; (3) the probabilities of false positives have been explored and quantified in some settings (even if only approximately); (4) the laboratory procedures are well specified and subject to validation and proficiency testing; and (5) there are clear and repeatable standards for analysis, interpretation, and reporting. DNA analysis also has been subjected to more scrutiny than any other forensic science discipline, with rigorous experimentation and validation performed prior to its use in forensic investigations.”</td>
<td>DNA scientifically sound</td>
</tr>
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| Analysis of Controlled Substances | ** “The chemical foundations for the analysis of controlled substances are sound, and there exists an adequate understanding of the uncertainties and potential errors.”**  
** “SWGDRUG has established a fairly complete set of recommended practices.”**  
** “It is questionable, however, whether all of the possible combinations recommended by SWGDRUG would be acceptable in a scientific sense, if one’s goal were to identify and classify a completely unknown substance…..but the SWGDRUG recommendations do not ensure that these tests will be used. This ambiguity would be a less significant issue if the reports presented in court contained sufficient detail about the methods of analysis.”** | Drug Chemistry scientifically sound  
Ambiguity in recommendations  
Reporting practices insufficient |
| Friction Ridge Analysis       | ** “…there is limited information about the accuracy and reliability of friction ridge analyses…”**  
** “We have reviewed available scientific”** | Limited information  
ACE-V not valid |
| Evidence of the validity of the ACE-V method and found none.”
| “Currently, there is no requirement for examiners to document which features within a latent print support their reasoning and conclusions.”
| “Some scientific evidence supports the presumption that friction ridge patterns are unique to each person and persist unchanged throughout a lifetime.”
| “None of these variabilities—of features across a population of fingers or of repeated impressions left by the same finger—has been characterized, quantified, or compared.”
| “To properly underpin the process of friction ridge identification, additional research is also needed into ridge flow and crease pattern distributions on the hands and feet.”
| “..., more research is needed regarding the discriminating value of the various ridge formations and clusters of ridge formations..., research has begun to build some of this basis”
| “There is also considerable room for research on the various factors that affect the quality of latent prints.”
| **No documentation**
| **Some scientific basis for friction ridge uniqueness**
| **No quantification of features**
| **Additional research needed**
| **Additional research needed**
| **Additional research needed**

| Shoeprints and Tire Tracks
| “the committee is not aware of any data about the variability of class or individual characteristics or about the validity or reliability of the method.”
| “SWGTREAD is moving toward the use of standard language to convey the conclusions reached.”
| “But neither IAI nor SWGTREAD addresses the issue of what critical research should be done or by whom, critical questions that should be addressed include the persistence of individual characteristics, the rarity of certain characteristic types, and the appropriate statistical standards to apply to the significance of individual characteristics.”
| “Also, little if any research has been done to address rare impression evidence. Much more
| **No data on characteristics or method reliability**
| **No standard conclusions**
| **No research on critical issues**
| **Little research needed**
| **More research needed**

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<tr>
<th>Toolmarks and Firearms Identification</th>
<th>Insufficient studies</th>
<th>Additional studies needed</th>
<th>Lack of defined process</th>
<th>Scientific knowledge base fairly limited</th>
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<tr>
<td>✫ “Sufficient studies have not been done to understand the reliability and repeatability of the methods.”&lt;br&gt;✫ “…additional studies should be performed to make the process of individualization more precise and repeatable.”&lt;br&gt;✫ “A fundamental problem with toolmark and firearms analysis is the lack of a precisely defined process.”&lt;br&gt;✫ “Although some studies have been performed on the degree of similarity that can be found between marks made by different tools and the variability in marks made by an individual tool, the scientific knowledge base for toolmark and firearms analysis is fairly limited.”</td>
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<tr>
<td>Analysis of Hair Evidence</td>
<td>No frequency statistics</td>
<td>No standards</td>
<td>No scientific support for solo use</td>
<td>No studies</td>
</tr>
<tr>
<td>✫ “No scientifically accepted statistics exist about the frequency with which particular characteristics of hair are distributed in the population.”&lt;br&gt;✫ “There appear to be no uniform standards on the number of features on which hairs must agree before an examiner may declare a “match.”&lt;br&gt;✫ “The committee found no scientific support for the use of hair comparisons for individualization in the absence of nuclear DNA.”&lt;br&gt;✫ “Microscopy and mtDNA analysis can be used in tandem and may add to one another’s value for classifying a common source, but no studies have been performed specifically to quantify the reliability of their joint use.”</td>
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<tr>
<td>Analysis of Fiber Evidence</td>
<td>No set standards</td>
<td>No studies</td>
<td>No studies</td>
<td>No studies</td>
</tr>
<tr>
<td>✫ “…but no set standards, for the number and quality of characteristics that must correspond in order to conclude that two fibers came from the same manufacturing batch. There have been no studies of fibers on which to base such a threshold. Similarly, there have been no studies to inform judgments about whether</td>
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| Questioned Document Examination | **“The scientific basis for handwriting comparisons needs to be strengthened.”**  
**“Recent studies have increased our understanding of the individuality and consistency of handwriting and computer studies and suggest that there may be a scientific basis for handwriting comparison, at least in the absence of intentional obfuscation or forgery.”**  
**“Although there has been only limited research to quantify the reliability and replicability of the practices used by trained document examiners, the committee agrees that there may be some value in handwriting analysis.”**  
**“Analysis of inks and paper, being based on well-understood chemistry, presumably rests on a firmer scientific foundation. However, the committee did not receive input on these fairly specialized methods and cannot offer a definitive view regarding the soundness of these methods or of their execution in practice.”** | Scientific basis for HW needs to be strengthened  
Suggests there may be a scientific basis  
Limited research to quantify practices  
May be some value  
No comment on other document examinations |
| Analysis of Paint and Coatings Evidence | **“...analysis of paints and coatings is based on a solid foundation of chemistry to enable class identification.”**  
**“These studies have concluded that more than 97 percent of the samples could be** | Class identification solid for chemistry foundation |
| Analysis of Explosives Evidence and Fire Debris | "The scientific foundations exist to support the analysis of explosions, because such analysis is based primarily on well-established chemistry." **By contrast, much more research is needed on the natural variability of burn patterns and damage characteristics and how they are affected by the presence of various accelerants." **...many of the rules of thumb that are typically assumed to indicate that an accelerant was used (e.g., "alligatoring" of wood, specific char patterns) have been shown not to be true." **"Experiments should be designed to put arson investigations on a more solid scientific footing." | Chemical analysis foundation exists
Research is needed
Interpretation basis known to be untrue
Research is needed |
| Forensic Odontology | "Despite the inherent weaknesses involved in bite mark comparison, it is reasonable to assume that the process can sometimes reliably exclude suspects." **...but there is still no general agreement among practicing forensic odontologists about national or international standards for comparison." **"...no scientific studies support this assessment, and no large population studies have been conducted. In numerous instances, experts diverge widely in their evaluations of the same bite mark evidence which has led to questioning of the value and scientific objectivity of such evidence. **The committee received no evidence of an existing scientific basis for identifying an individual to the exclusion of all others. That same finding was reported in a | No agreement and no standards.
No scientific studies
No large population studies
No evidence of an existing scientific basis |
<table>
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<tr>
<th><strong>Bloodstain Pattern Analysis</strong></th>
<th><strong>Digital Evidence</strong></th>
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</table>
| **“Scientific studies support some aspects of bloodstain pattern analysis.”**  
**“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 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.”** | **“Three holdover challenges remain: (1) the digital evidence community does not have an agreed certification program or list of qualifications for digital forensic examiners; (2) some agencies still treat the examination of digital evidence as an investigative rather than a forensic activity; and (3) there is wide variability in and uncertainty about the education, experience, and training of those practicing this discipline.”** |

**Disciplines Not Addressed:**

- Anthropology
- Engineering Sciences
- Entomology
- Pathology
- Psychology and Behavioral Science
- Toxicology

Numerous tests and examinations conducted within each discipline
Appendix II

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 spurting, 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-
tions are difficult or impossible. 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


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.