Some notes on blood splatter evidence

Examination and interpretation of bloodstains on and around the body, and of blood-spots, splashes and smears at the scene of the crime, are an essential part of a murder investigation. The position and appearance of blood marks on the body and its immediate surroundings will help the investigator to reconstruct the crime.

The theory behind bloodstain pattern analysis is simple: blood is a fluid and will respond accordingly to the laws of physics. Though rarely the dominant piece of evidence in an investigation, bloodstain pattern analysis can be important in the difficult process of reconstructing a violent crime.

Experts begin by taking note of a few key variables:

- spot size
- quantity
- shape
- distribution
- location
- angle of impact
- target surface

A great deal can be gleaned from the shape of blood spots and splashes found on surfaces such as floor, walls, ceiling, woodwork and furniture. The French criminologist Alexandre Lacassagne noted the correlation between the shape of blood sports and the position of the victim. Blood dropping vertically on to a flat surface form a circular mark with crenated edges, and denotes that the source was stationary at the time. Drops of blood falling from a moving object hit a flat surface obliquely and leave a spot shaped like an exclamation mark. An examination of the shape of obliquely falling blood splashes yields information about the direction and speed of impact. Such evidence helps determine the positions of victim and murderer at the time of an assault, and may also indicate the manner of violence and type of weapon used.

A line of blood spots on the ceiling of a room in which violent murder has been committed is likely to have been made by the killer wielding an axe or bludgeon in an area over his head. Smears and trails on the floor may be produced by a wounded person crawling about or by an assailant dragging the body of his injured victim. Smudges and smears on furniture and doorsteps leaving bloody fingerprints or palm prints may result from similar activities. Blood smears tend to start as drops which become ragged at one edge, indicating the direction of travel.

	*Large spots* - the blood was travelling at a relatively low velocity.
	*Small spots* - the blood was travelling at a relatively high velocity. (More force equals smaller splatter)
	*Elongated drops* - victim was moving, their speed relative to the amount the spots are stretched and how far they are spaced apart. (Also indicates directionality)
	*- large stain on a surface caused by contact with a bloody object.*
	*Void in otherwise uniform splatter* - something blocked the blood spray.
	*Cast-off* - straight, elongated lines of splatter indicating that blood was thrown by a moving object in a change of direction. (Can show how many times a victim was struck)
(from Forensic Science Centre, http://library.thinkquest.org/17133/forindex.html)	

Even when the blood stain is not evident it may still leave a tell tail fingerprint. To detect invisible blood stains, the luminol test is used, which is a chemical sprayed on carpets and furniture which reveals a slight phosphorescent light in the dark where bloodstains (and certain other stains) are present.

The specialist will try to determine what the position and shape of bloodstains at the crime scene indicate. He/she take measurements to determine the trajectory as well as execute carefully controlled experiments. These experiments will use surface materials like those found at the scene to try to reproduce what has happened.

A leading authority on blood stain interpretation gives the following tips to investigators:

- It is possible to determine the impact angle of blood on a flat surface by

measuring the degree of circular distortion of the stain. In other words, the shape of the stain tends to change depending upon the angle of impact which caused the stain. For example, the more the angle decreases, the more the stain is less circular and more long.

- Surface texture is one of the key components in determining spatter type. The harder the surface is, the less spatter will result. It is therefore extremely important to duplicate the surface in a controlled test.
- When a droplet of blood hits a surface which is hard as well as smooth, the blood usually breaks apart upon impact. This in turn causes smaller droplets. The smaller droplets will continue to move in the same direction as the original droplet.

Reference;

- Forensic Science Centre
- Blood Spatter Interpretation

More on the luminal test.

Much of **crime scene investigation**, also called **criminalistics**, is based on the notion that nothing vanishes without a trace. This is particularly true of violent crime victims. A murderer can dispose of the victim's body and mop up the pools of blood, but without some heavy-duty cleaning chemicals, some evidence will remain. Tiny particles of blood will cling to most surfaces for years and years, without anyone ever knowing they're there.

The basic idea of luminol is to reveal these traces with a **light-producing chemical reaction** between several chemicals and **hemoglobin**, an oxygen-carrying protein in the blood. The molecules break down and the atoms rearrange to form different molecules. In this particular reaction, the **reactants** (the original molecules) have more energy than the **products** (the resulting molecules). The molecules get rid of the extra energy in the form of visible light photon. This process, generally known as **chemiluminescence**, is the same phenomenon that makes fireflies and light stick glow.

The Chemical Reaction

The "central" chemical in this reaction is **luminol** ($C_8H_7O_3N_3$), a powdery compound made up of nitrogen, hydrogen, oxygen and carbon. Criminalists mix the luminol powder with a liquid containing hydrogen peroxide (H_2O_2), a hydroxide (-OH) and other chemicals, and pour the liquid into a spray bottle. The hydrogen peroxide and the luminol are actually the principal players in the chemical reaction, but in order to produce a strong glow, they need a **catalyst** to accelerate the process. The mixture is actually detecting the presence of such a catalyst, in this case the **iron** in hemoglobin.

To perform a luminol test, the criminalists simply spray the mixture wherever they think blood might be. If hemoglobin and the luminol mixture come in contact, the iron in the hemoglobin accelerates a reaction between the hydrogen peroxide and the luminol. In this oxidation, the luminol loses nitrogen and hydrogen atoms and gains oxygen atoms, resulting in a compound called 3-aminophthalate. The reaction leaves the 3-aminophthalate in an energized state -- the electrons in the oxygen atoms are boosted to higher orbitals. The electrons quickly fall back to a lower energy level, emitting the extra energy as a light photon. With iron accelerating the process, the light is bright enough to see in a dark room.

Investigators may use other chemiluminescent chemicals, such as **fluorescein**, instead of luminol. These chemicals work the same basic way, but the procedure is a little bit different.

How Investigators Use Luminol

If luminol reveals apparent blood traces, investigators will photograph or videotape the crime scene to record the pattern. Typically, luminol only shows investigators that there *might* be blood in an area, since other substances, including household bleach, can also cause the luminol to glow. Experienced investigators can make a reliable identification based on how quickly the reaction occurs, but they still need to run other tests to verify that it is really human blood.

Luminol in itself won't usually solve a murder case. It's only one step in the investigative process. But it can reveal essential information that gets a stalled investigation going again. For example, hidden blood spatter patterns can help investigators locate the point of attack and even what sort of weapon was used (a bullet makes blood splatter very differently than a knife does). Luminol may also reveal faint bloody shoe prints, which gives investigators valuable information about the assailant and what he or she did after the attack.

In some cases, luminol leads investigators to more evidence. For example, if luminol detects trace amounts of blood on a carpet, investigators may pull up the carpet and discover a lot of visible blood on the floorboards below.

One problem with luminol is that the chemical reaction can destroy other evidence in the crime scene. For this reason, investigators only use luminol after exploring a lot of other options. It is definitely a valuable tool for police work, but it's not quite as prevalent in crime investigation as presented on some TV shows. The police don't walk into a crime scene and start spraying luminol on every visible surface.