

International Association of
Bloodstain Pattern Analysts News,
Vol 14, #3, Sept., 1998, pp 1-8.
False Wave Cast-off:

**“False Wave Cast-Off; Considering
the Mechanisms of Stain Formation”**

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Wave Cast-off can be defined as a small blood droplet that originates from a larger (parent) stain as it impacts a target. The cast-off stain is usually in line with the long axis of the parent stain and occurs on the opposite side from where the parent stain first impacts. Wave cast-off can be very useful to the analyst in determining directionality of the parent stain. The presence of a tail or spine from the parent drop may also be helpful in this regard. The angle of impact and/or the target surface may alter the expected appearance of the stain, requiring a more detailed examination. Although the experienced bloodstain pattern analyst is accustomed to seeing these types of bloodstains at crime scenes, the analyst should always take care to examine the entire pattern (or surrounding stains) as smaller stains may "mimic" wave cast-off (as well as other stain patterns such as satellite spatter) in general size and location to larger stains.

When studying bloodstains and bloodstain patterns at crime scenes, one consideration is the mechanism which caused the resulting stain(s). Determining the mechanism which caused the resulting pattern(s) may aid the analyst in reconstructing the events of the crime. But as the stain patterns will vary from scene to scene, so will the mechanisms which form them. In fact, the mechanisms and processes causing bloodstain patterns can be as varied as the patterns themselves. This raises the need for analysts to consider alternate mechanisms which may have caused the resulting stains. The following occurrence illustrates this phenomenon and serves as a reminder for the need of a careful analysis.

Due to the relatively dry climate in Colorado and a physical predilection on my part, the following inelegant set of events occurred. After a tedious bout with a bloody

nose (right nostril only), I succumbed to a sneeze. I am ashamed to admit that I was unsuccessful in fully blocking the projected blood with my handkerchief and, as a result, some of the projected blood found its way to my T-shirt. Being a dedicated student to the science, I gave more than casual attention to the resulting stains.

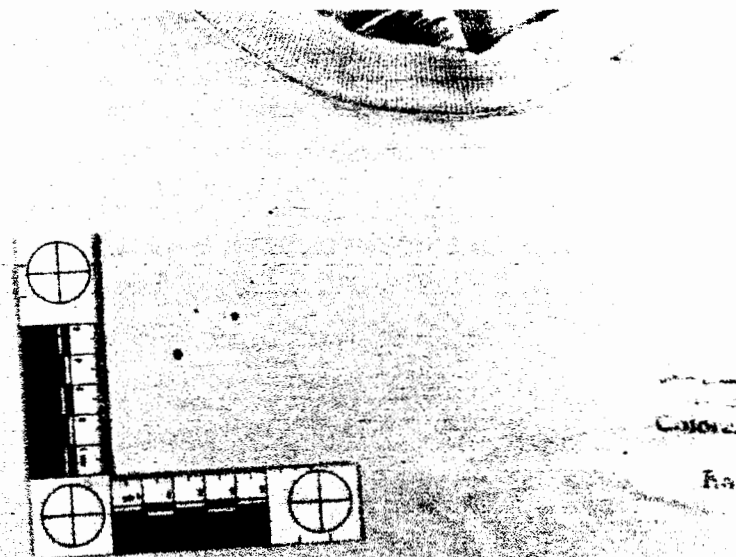


figure 1

Figure #1 shows the stain area. The bloodstains were restricted to the upper right front chest of the T-shirt, and consisted of four 1mm-2mm stains and numerous less than 1mm stains. Figure #2 shows a close-up image of the four stains. The two smaller stains above, and to the right of, the larger stains may appear to be wave cast-off to the casual observer, but a more careful examination of the stains will give the analyst a moment of pause.

Obviously, as a witness to the bloodshed, I knew the directionality of the stains. However, I noted that the stains had characteristics which may lead an analyst to classify them as wave cast-off stains and determine an inaccurate directionality (of lower right to

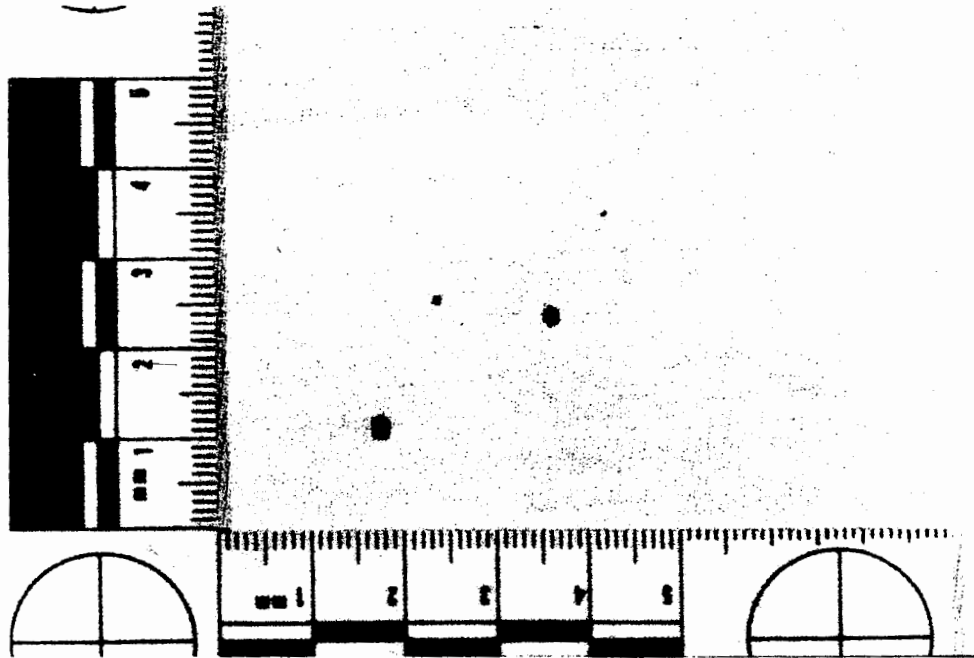


figure 2

upper left of the shirt). At first blush, the grouping of the four stains do appear to share a common trait. That is, two larger stains below, and lateral of, the two smaller stains. If one were to determine that the smaller stains were, in fact, wave cast-off from the larger "parent" stains, then the directionality would be from the lower left of the photograph to the upper right. In point of fact, we know from the above account that the directionality is actually the opposite.

In an attempt to understand and explain to myself why the stains could not be wave cast-off, I examined the stains, as well as the surrounding stains on the shirt, and noted several questionable characteristics. One characteristic was the distance between the "satellite" stain and the "parent." Although certainly not an absolute, the distance did seem rather large given the size of the stains. Several factors will, of course, influence this distance such as the volume of the parent drop, the angle of impact, and the target surface. This particular surface (an old faded cotton shirt) undoubtedly hampered the

formation of well-defined stains. In addition, the bloodstains appeared more spherical than their angle of impact would suggest (see Figures #3 and #4). While these characteristics raised questions, I did not feel that they were enough to say, one way or another, if the stains were in fact wave cast-off.



figure 3



figure 4

A continued analysis of the shirt showed the presence of the numerous less than 1mm stains lateral, and to the upper right, of the four stains (Figure #5). It has been well documented by several authors [1-3] that this size staining is frequently encountered in cases of gunshot trauma. However, it is also well documented that other mechanisms (such as blood dripping into blood, and blood which is expired) may also create similarly sized bloodstains. A search for evidence such as cartridge casings, bullets, gunshot injuries and the like should be conducted on any scene where high velocity impact spatters are present. The absence of any gunshot injuries (or other ballistic evidence) may quickly eliminate that mechanism as a source of the bloodstain pattern.

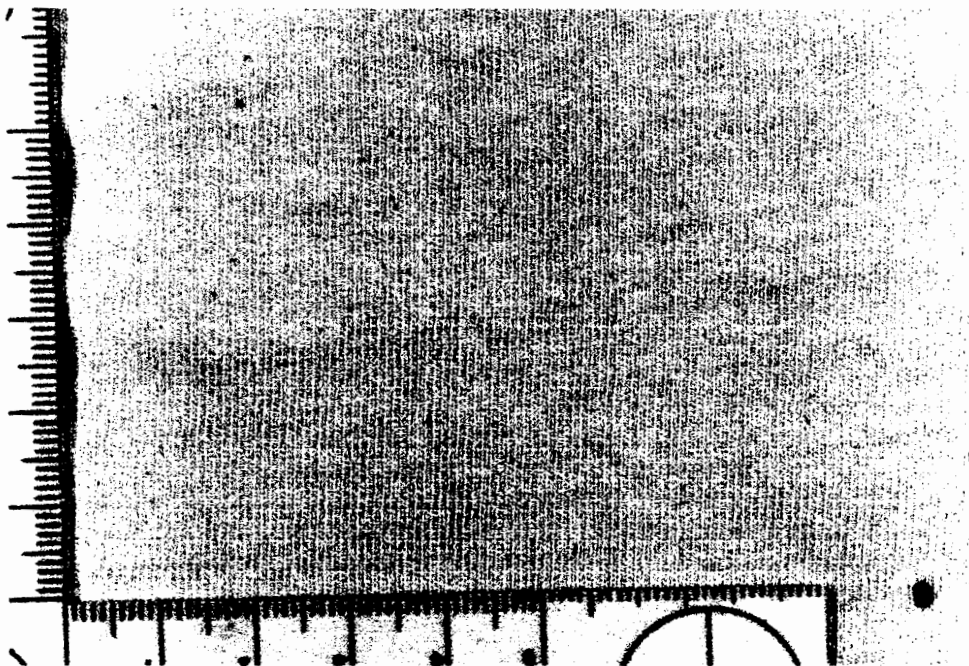


figure 5

Stain patterns caused by blood dripping into blood are usually of higher volume than the stains on the shirt and produce numerous stains of varied size. In addition, a key characteristic of a blood dripping into blood pattern is the "pooled" area of blood caused by the accumulation of low velocity droplets below the blood source. Since no such area on the shirt could be found, this mechanism could be eliminated. It should be noted,

however, that people wearing shirts (and other items of clothing) are mobile, and as such, the entire scene should be checked for a blood-dripping-into-blood pattern, as the wearer of the shirt may have been adjacent to the event and then moved to another location.

Other possible mechanisms which may cause 1mm and smaller stains, include injuries associated with machinery, explosions, and some automobile accidents [4]. Obviously, events of this magnitude would tend to produce extensive injury and thus a higher volume of blood loss than seen on the shirt. In addition, the victim is usually present (or at least available for examination at the hospital or morgue) at these types of scenes and thus will undoubtedly aid in the analysis.

Another possibility is that the two groupings of bloodstains were deposited at different times and caused by different mechanisms. Although this scenario is possible, it would be very difficult to determine, at least in this case, without further evidence.

Of course, there are many other mechanisms (such as flicking the blood-soaked bristles of a toothbrush) which may produce similar stains, but having explored the more common mechanisms which may have produced the bloodstain pattern observed on the shirt, I felt confident that I could reasonably eliminate all of the above mechanisms except expiration. With this in mind then, the resulting stains could not be attributed to wave cast-off, as the location of the blood source (the nose) was opposite of the presumed directionality.

Although such a limited bloodstain pattern would likely never be encountered at an actual crime scene, it provides a reminder to us all that a careful examination of all stains, not just groupings of stains, is needed for a complete and fair analysis. In examining the bloodstain patterns, the analyst must also explore the possible mechanisms which may lead to the formation of the observed pattern. Those of us who lack the experience gained by

working numerous bloodstain scenes over many years, may tend to overlook (or be unaware of) other possible mechanisms of bloodstain pattern formation. This type of “tunnel vision” (assuming for instance, that high velocity impact spatters must have been caused by a gunshot injury) may come with a heavy price to the analyst in the form of a compromised and flawed examination. Exploring other possible formation mechanisms strengthens and supports a professional, competent analysis.

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