Bloodstain Pattern Analysis FOUNDATIONS & TRENDS IN FORENSIC SCIENCE

FRSC 1011: Guest Lecture

Monday, March 4, 2020



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B.Sc. (Hons) Forensic Science M.Sc. Environmental & Life Sciences Research:

- Bloodstain pattern analysis
- Forensic blood substitutes
- Forensic chemistry/presumptive testing



READ YOUR TEXTBOOK.





Lecture Content



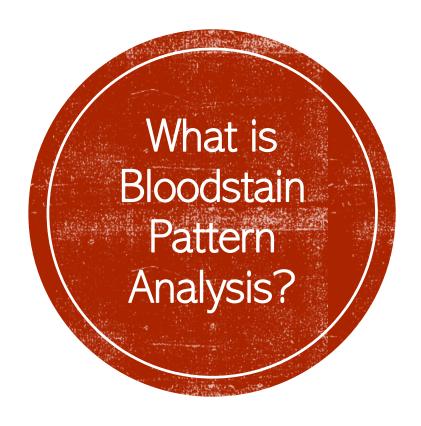
BPA'S FORENSIC HISTORY



PATTERN CLASSIFICATION



RESEARCH & TRENDS



- BPA = A subdiscipline of forensic science which focuses on "the **study** of the size, shape, location, and distribution of bloodstains" (SWGSTAIN) in order to:
 - discerning what gave rise to their origin (case context)
 - understanding underlaying mechanisms, and advancing the field (research context)



Blood source = where the blood in the pattern originates from



Bloodletting event = the action or cause which gave rise to the mechanisms used to create the pattern

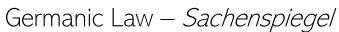


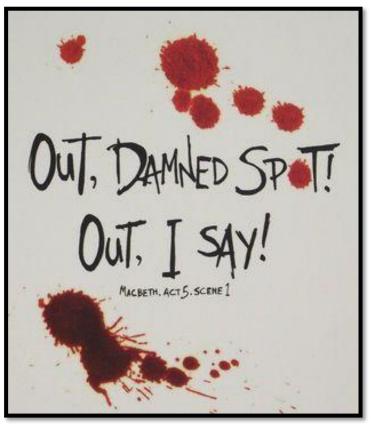
Target surface = the surface the bloodstain pattern is present on

A few terms to Start...

PART I: The History of Blood and Crime







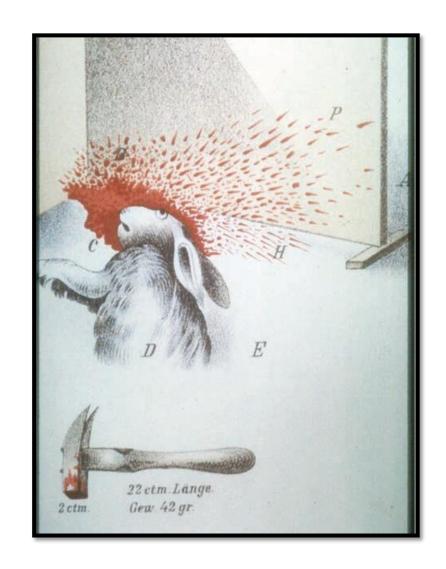
Literature - William Shakespeare



Art – Akseli Gallen-Kallela

About the rabbit...

- Dr. Eduward Pirotroski wrote, "Concerning Origin, Shape, Direction and Distribution of Bloodstains"
- Experimented with live rabbits as models for humans; tested variables & observed variation:
 - Multiple methods of attack and tools
 - Directions, size, and location of stains
- First to observe characteristics of impact and cast-off patterns



1895 - Dr. Edmund Piotrowski

"The formation, shape, and distribution of bloodstains follow specific rules and that these, allowing for many modifications considering the nature of the case, are not to be underestimated and are of great value in the judgment"

1902 – Dr. John Glaister

"As has already been pointed out, in every case in which a dead body with wounds upon it is examined *in situ*, **examinations should be carefully made for the presence of blood-stains** and their incidence upon the body and in its vicinity. The examiner must expect to **meet every possible variety of stains**, both in respect to character, incidence and magnitude..."

1904 - Dr. Hans Gross'

- Handbook fur Untersuchnungsrichter Als System Der Kriminalistik
- Detailed discussion of evaluating bloodstains, their collection & documentation
- 30 pages of his book was about BPA; it was **THE** reference at the time & republished in English in 1924



1939 — Balthazard et. al.

- Wrote: "Edute Des Goutes De Sange Projecte"
- Emphasised the necessity not only to look at stains at crime scenes, but to understand (research) the mechanisms which gave rise to their origin; includes:
 - Trajectories
 - Fluid dynamics
 - Target Surfaces
 - Movements
 - Limitations & Variations

BPA in Cases & Courts

VOL. III.

THE QUEEN V. ELLIOTT.

95

[HIGH COURT OF JUSTICE, ONTARIO.]

BEFORE THE HONORABLE JOHN ALEXANDER BOYD, CHANCELLOR, THE HONORABLE MR. JUSTICE ROBERTSON, AND THE HONORABLE MR. JUSTICE MEREDITH, SITTING AS A COURT OF APPEAL FOR CROWN CASES RESERVED.

THE QUEEN v. ELLIOTT.

Confession—Interrogation by police officer of accused in custody
—Evidence—Admissibility of answers—Answers not unduly
or improperly obtained.

1. Admissions made by a prisoner to a police officer in respect of the charge upon which he is in custody, are admissible in evidence although made in response to questions put by the officer, if the trial judge finds that the answers were not unduly or improperly obtained having regard to the circumstances of the particular case.

ARGUED: June 12, 1899. DECIDED: June 22, 1899.

The following case was reserved by MacMahon, J., for the opinion of a Court of Criminal Appeal:—

- 1899 to Today
 - 570 cases on CanLII

- IABPA Survey (Polacco, 2018 Research)
 - # of Crime Scenes Attended per year world wide = 8500
 - 61.5% of these scenes involve bloodstain evidence

Premise of BPA in Forensic Science



Bloodstains pattern information is consistent & reproducible



Context, situation, or circumstances = "what happened", not "whodunit"

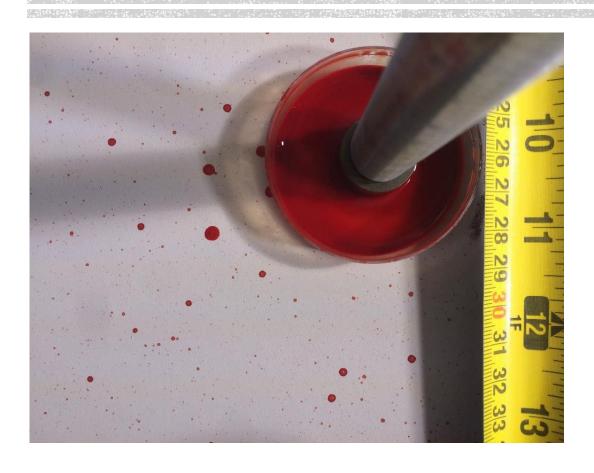


BPA should be used in conjunction with other areas of forensic science

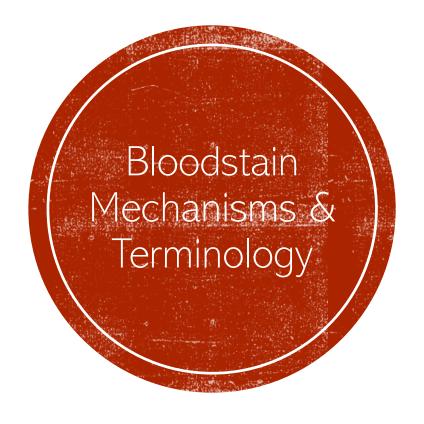


Analysis can Be objective!

PART II: Pattern Classification



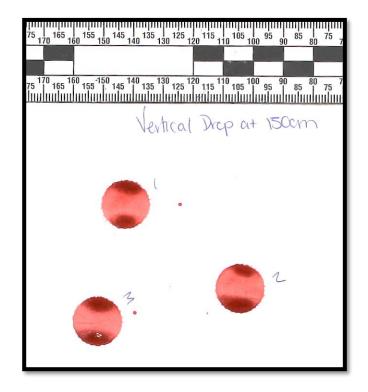
- Bloodstain analysts have classified patterns & developed terminology (SWGSTAIN)
- Things to consider:
 - Gravity & Air Resistance
 - Surface texture
 - Height
 - Angle
 - Blood source (human vs. analogues)
 - If it's actually blood

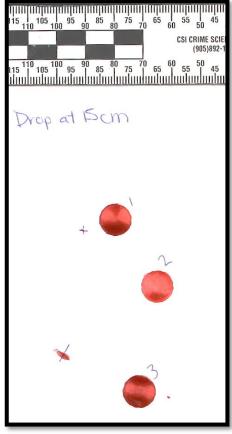


- Passive Stains:
 Blood can be passively dripped onto a surface
- Transfer stains:
 Blood can be transferred from one surface to another
- Projected & Impact Stains:
 Blood can be set into motion and impact a surface in a variety of ways

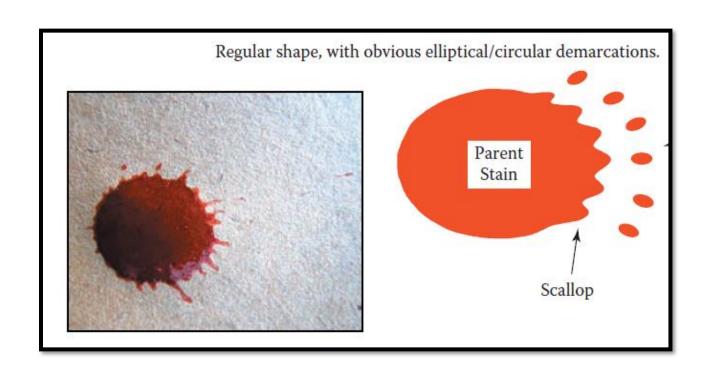
Passive: Drip Stains

• A **bloodstain** resulting from a falling drop that formed due to gravity.

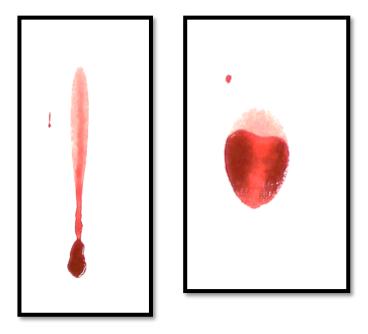




More on Drip Stains

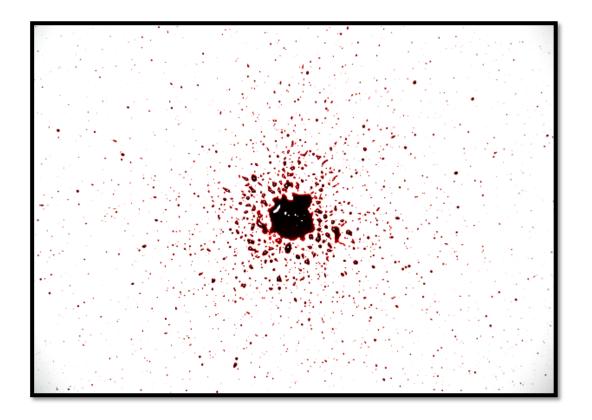


Influence of Impact Angle



Passive: Drip Pattern

• A bloodstain pattern resulting from a liquid that dripped into another liquid, at least one of which was blood.



Passive: Pool Pattern

• A bloodstain resulting from an accumulation of liquid blood on a surface.



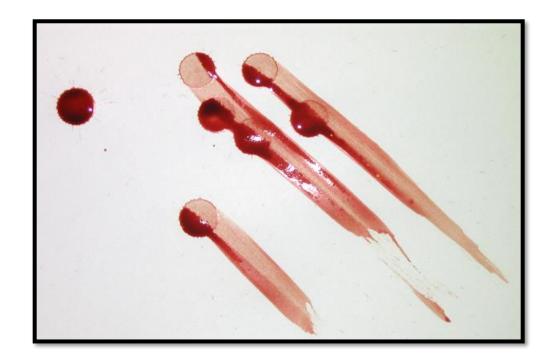
Transfer: Transfer Pattern

• A bloodstain resulting from contact between a blood-bearing surface and another surface.



Transfer: Wipe Pattern

• An altered bloodstain pattern resulting from an object moving through a preexisting wet bloodstain.



Transfer: Swipe Pattern

• A bloodstain

pattern resulting from the

transfer of blood from a

blood-bearing surface onto

another surface, with

characteristics that indicate

relative motion between the

two surfaces.



Projected & Impact: Projected/Arterial Pattern

• A bloodstain pattern resulting from the ejection of a volume of blood under pressure.



Projected & Impact: Splash Pattern

• A bloodstain pattern resulting from a volume of liquid blood that falls or spills onto a surface.



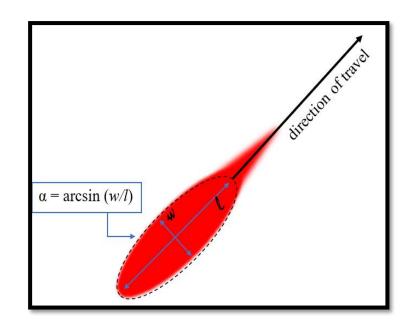
Projected & Impact: Cast-off Pattern

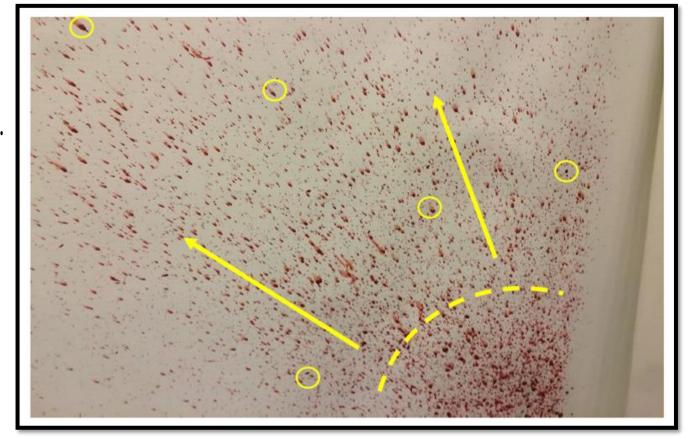
• A bloodstain pattern resulting from blood drops released from an object due to its motion.



Project & Impact: Impact Patterns

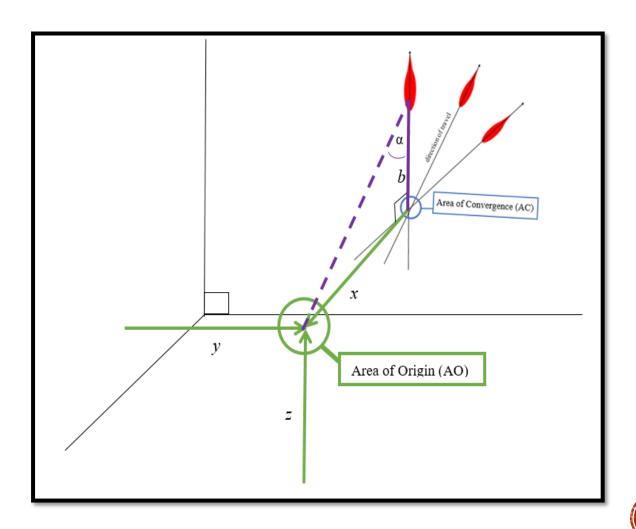
A bloodstain
 pattern resulting from an
 object striking liquid blood.





Where was the blood source?

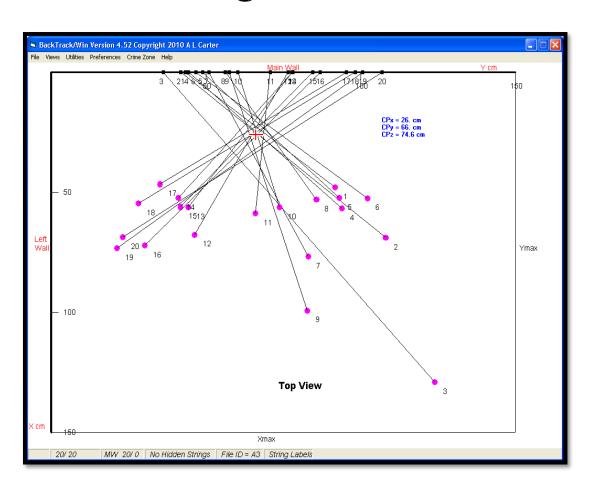
- Area of Convergence: The area containing the intersections generated by lines drawn through the long axes of individual stains that indicates in two dimensions the location of the blood source.
- Area of Origin: The threedimensional location from which spatter originated.

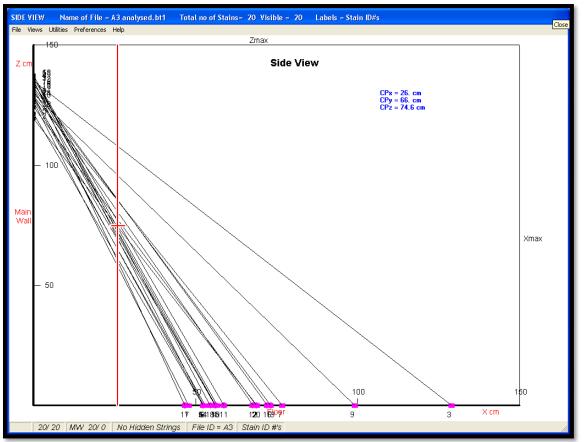


Finding the Blood Source: Stringing



Finding the Blood Source: Software



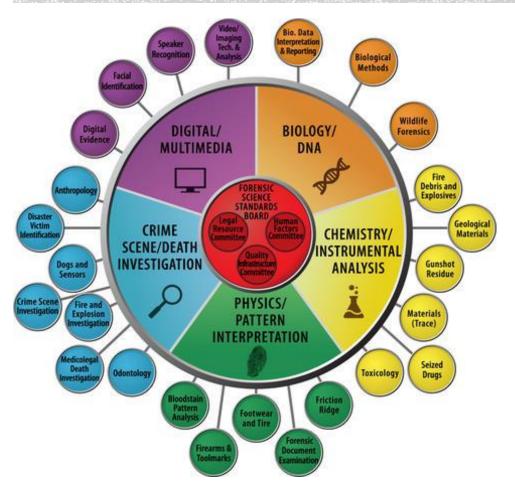


More than one Pattern? It's complex.





PART III: Research & Trends in BPA





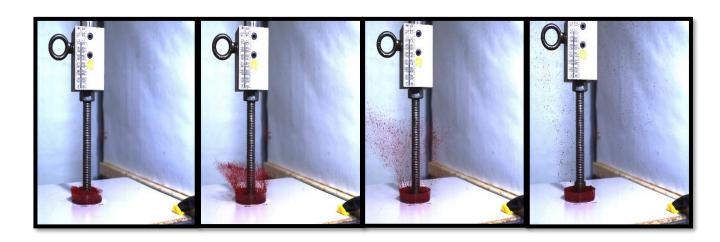
Research needs:

- Behaviour of Blood of Blood Outside the Body
- Bloodstain Pattern Classification
- Bloodstain Pattern Analysts (Bias, Experience)
- Bloodstain & Surfaces

Research at TRENT: Patterns

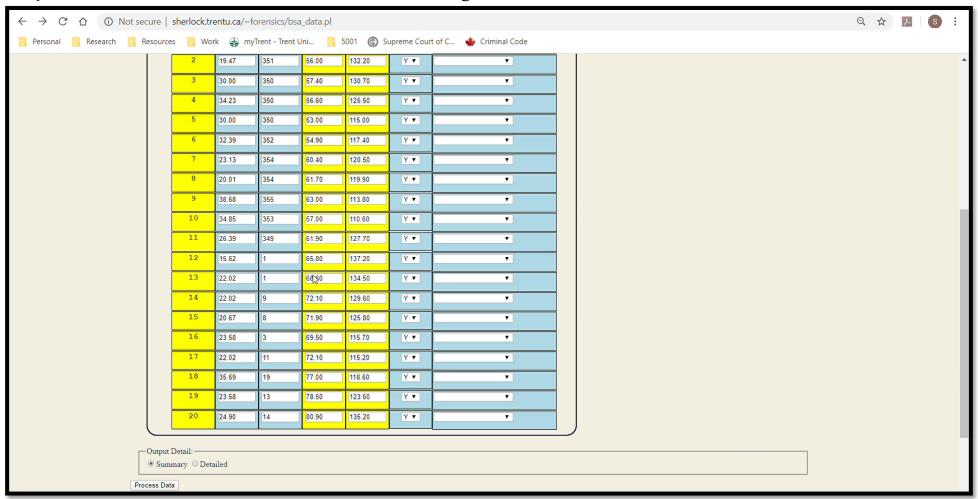
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- Orr A, Illes M, Beland J, Stotesbury T. Validation of **Sherlock, a linear trajectory** analysis program for use in bloodstain pattern analysis. Canadian Society of Forensic Science Journal. 2019;Mar 4:1-7.

The Impact Device





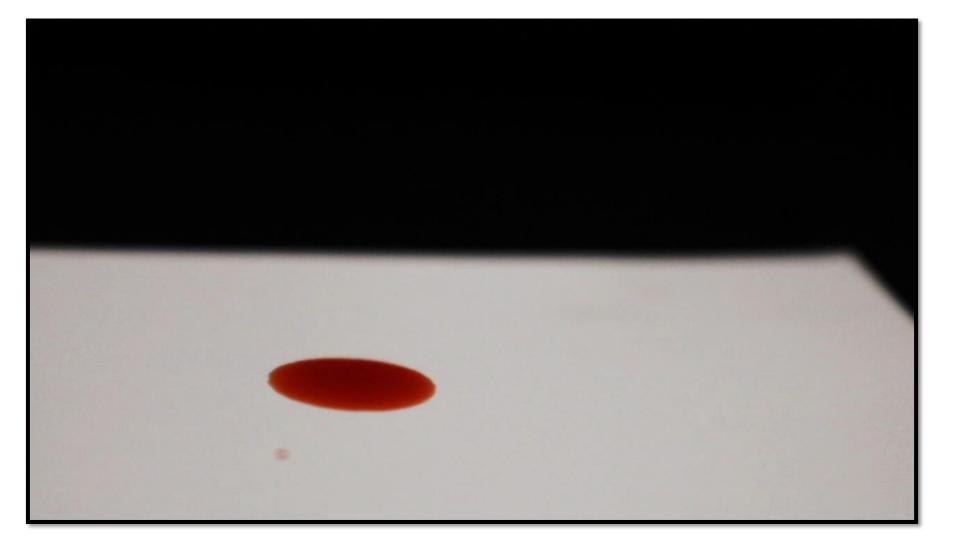
Impact Pattern Analysis with Sherlock



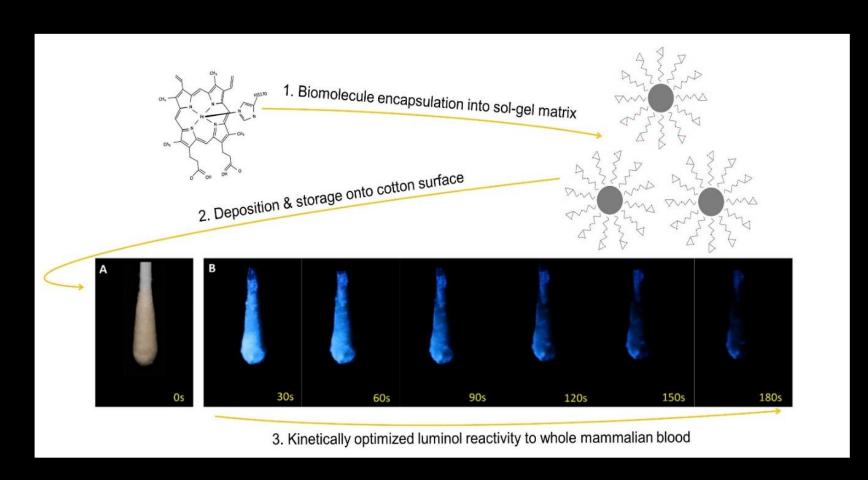
Research at TRENT: Blood Substitutes

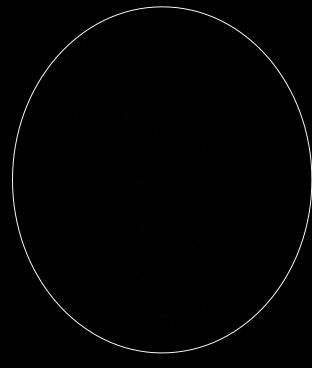
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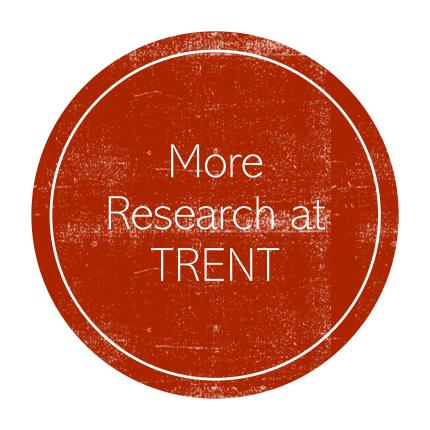
The FBS Project: Origins & Ongoing at TRENT



FBS, that Glows!







- FBS with DNA
- Impact of snow on drip stains
- Spectroscopic methods of determining the age of bloodstains
- MALDI & bloodstained fingerprints
- Optimizing & validating bovine blood
 & several others!...

Questions & Contact

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