FOLLOWING BLOOD TRAILS: A SAR Perspective

Some Questions

- How often have you had to follow a blood trail?
- How about verifying reported blood evidence as being connected to the missing subject?
- How useful is this knowledge? You never know….

Break In With Blood/Track

My Thoughts and Observations

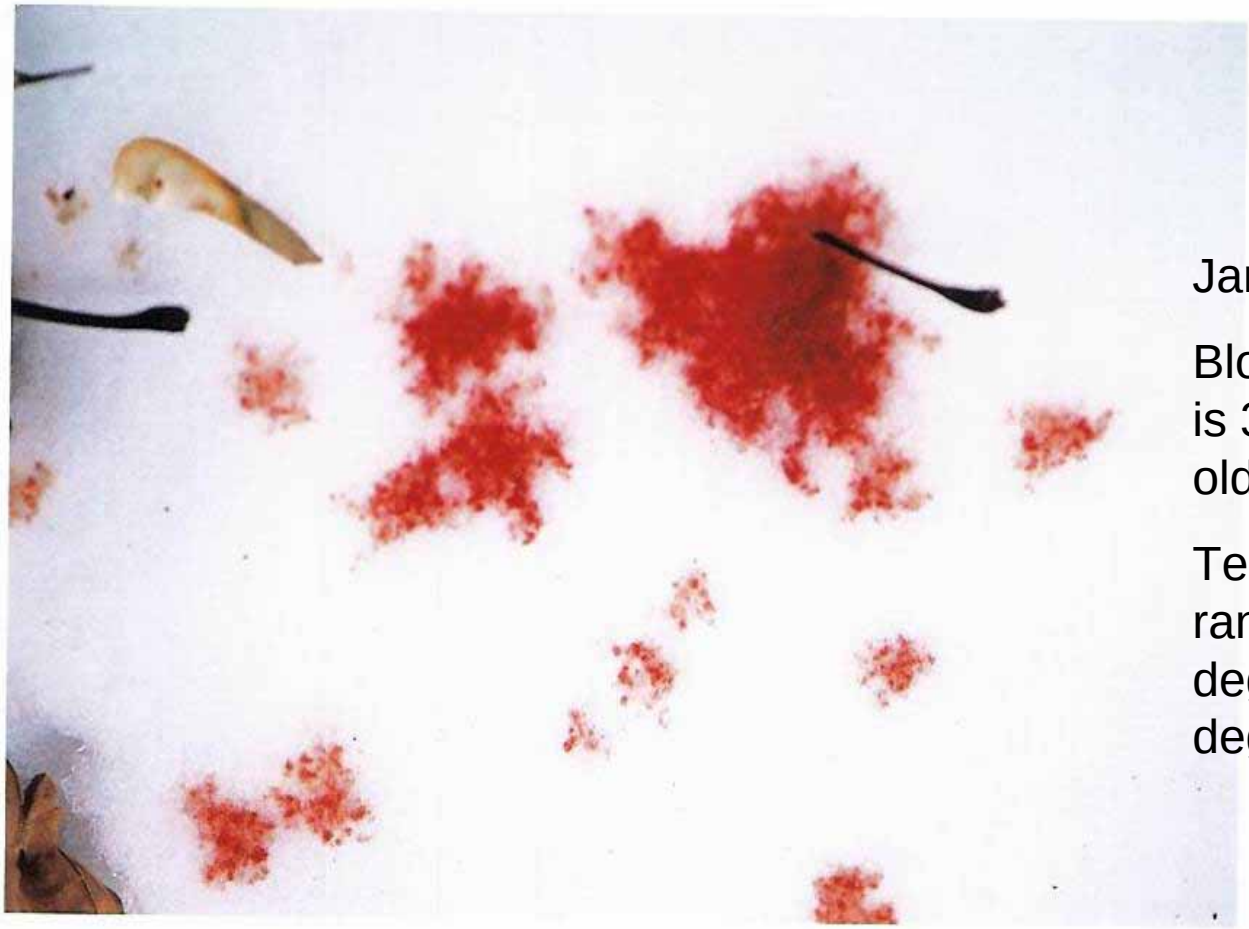
- The incidence of following blood trails and confirming blood evidence is rather low.
- Knowledge and experience on this subject does, however, come in handy for those rare moments!
- Consider it a “tool” in your SAR tool kit.
- Nothing replaces experience. You have to see blood in real life, in context, to learn.

The Purpose of this Presentation

- To provide basic information regarding blood, wounds, and trails.
- To provide an opportunity to see blood deposits in their various forms, in settings that you may encounter in the SAR world.
- To address basic field-related issues
- To encourage further interest in learning about the subject.

The Easy One: 25 minutes old

And Another



January 2006

Blood deposit is 36 hours old.

Temperature range was 16 degrees to 32 degrees.

Same Blood Trail: Note Color

Same Drop Later:
Would you know this is blood?

Slightly Different Look!

My Interest?

- A night search for what turned out to be a murdered child. The perpetrator was found in the woods, alive, having slit his wrists. He denied knowing the location of the subject.
- A colleague and I were asked to follow the blood trails/signs of passage entering into or exiting from the scene.
- My interest emerged from the various questions that night regarding following blood trails.

Facts About Blood

Biology, Deposits, Direction of Travel, etc.

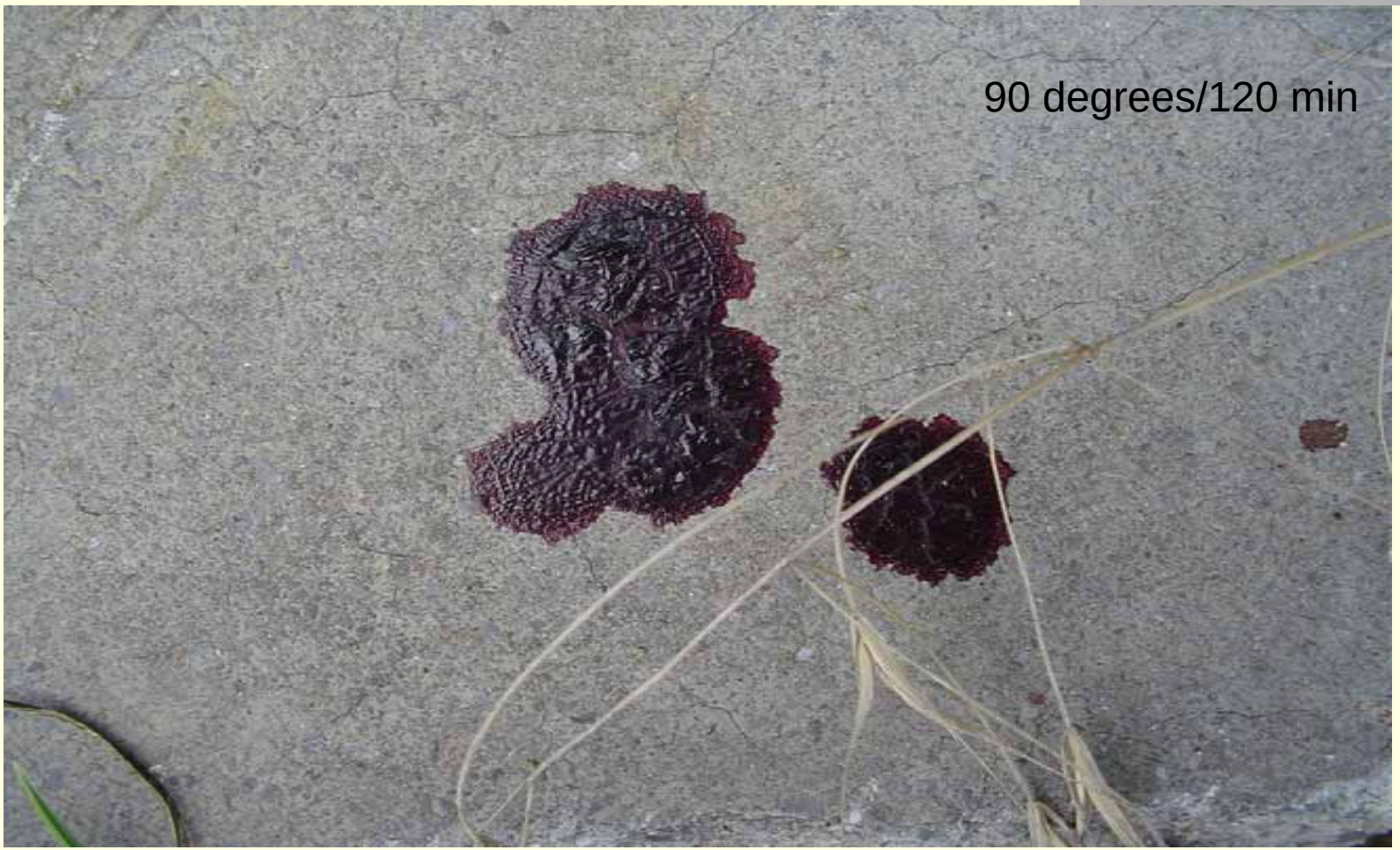
Facts About Blood

- The body's major fluid tissue, accounting for approximately 7-8% of total body weight.
- An average adult possesses approximately 5 liters of blood (5 to 6 males or 4 to 5 for females).
- Imagine 5 bottles of soda (1 liter each)

Facts, Continued

- Blood plasma is the fluid in which blood cells are suspended, and accounts for 58% of total blood volume.
- When the plasma evaporates, what remains?

This: Cellular Material



2 Weeks Later/.75 inches of rain

Blood Loss Facts

- A loss of 30-40% of total blood volume is life threatening.
- A loss of 50% will result in death within several minutes without aggressive medical intervention. Note that the blood loss can be internal or external

Surface Tension

- The property of the surface of blood (and other liquids) that makes blood drops contract into a spherical rather than teardrop shape while falling.
- This property also causes blood drops to maintain their tension while dripping/running.

Passive Blood Deposit

The Classic Drop

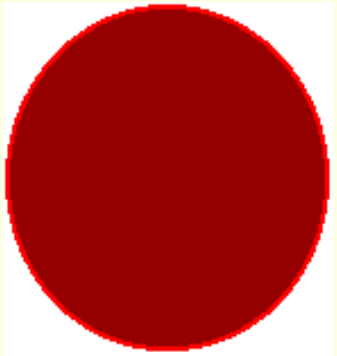


Image: J. Slemko Forensic Consulting

- Created or formed by the force of gravity acting alone.
- Subject to distortions based upon surface of deposit
- This picture represents a smooth surface and very low velocity

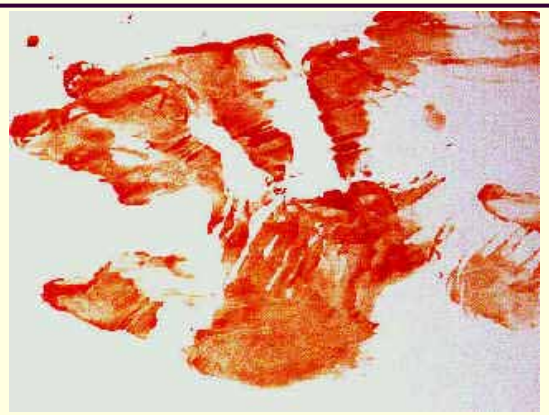
Surface Distortions: One Drop

- Linoleum Floor: w/ Scalloping and spines

- Wood/Concrete: w/ spines and “satellite spatter“

Images: J. Slemko Forensic Consulting

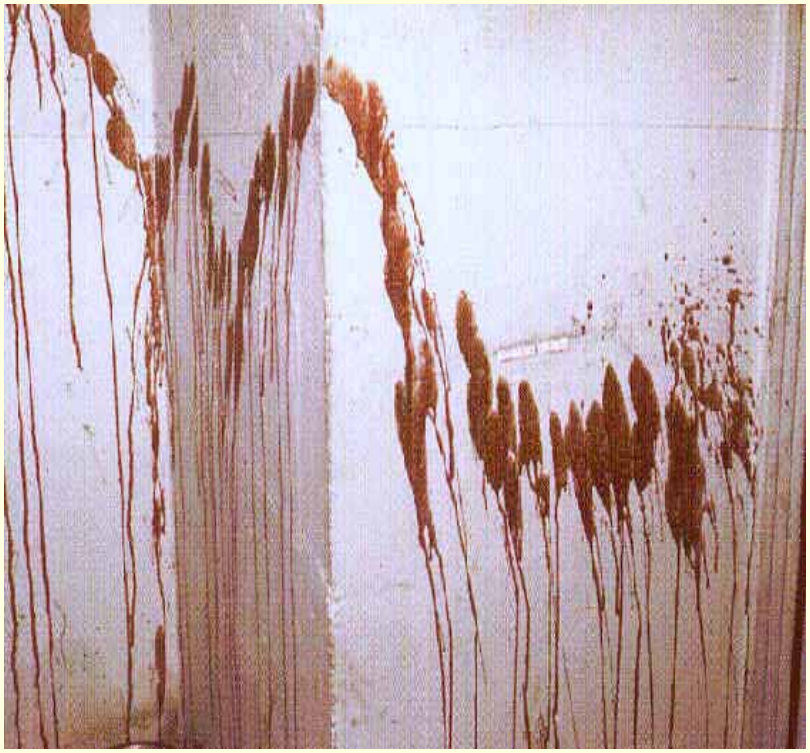
Transfer Blood Deposits



- created when an object comes into contact with blood, then leaves a pattern/impression on a second surface (ex. Floor, wall, log).

Images: J. Slemko Forensic Consulting

Projected Blood Deposit



- Created when a blood source is subjected to a force greater than that of gravity.
- Examples include blood projected on a wall when a bullet exits a body or blood spurting from an arterial breach (left).
- The amount of force present will impact the appearance of the spatter.

Image: J. Slemko Forensic Consulting

Other Types:

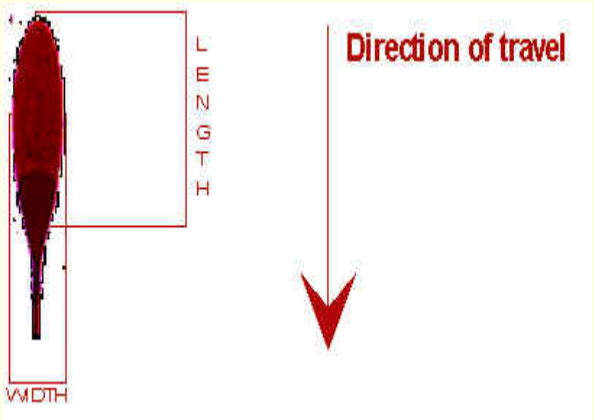
- SWIPE: When a bloody object comes into contact with a non-bloody moving object.
- WIPE: When an object moves through an existing stain.
- CAST Off: When blood is projected from the movement or termination of movement of a blood-bearing object.

Impact of Size and Shape

- The greater the force projecting the blood, the smaller the blood droplets (force breaks drops apart): drops, droplets, misting
- Larger drops can travel further than smaller drops
- The angle at which the blood strikes the target surface effects the shape of the blood stain.

Determining Direction of Travel

Tail=Direction of greatest force



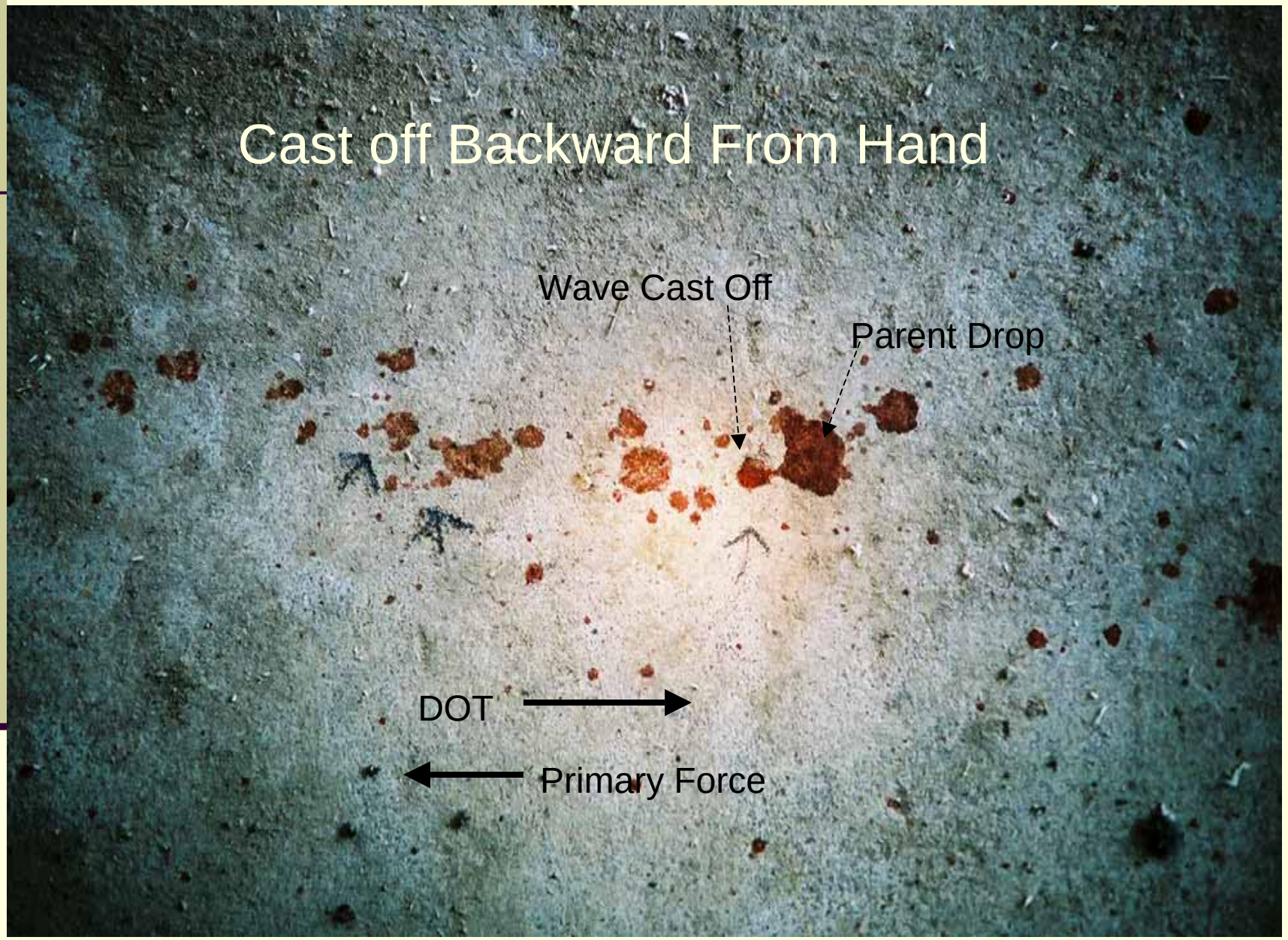
- Tail occurs when blood hits at less than 90 degrees
- Also look for “wave cast-off”, which appears like smaller drops in front of primary drop

Image: J. Slemko Forensic Consulting

But Beware!

- Blood can be “cast off” from moving hand, arm, or other body part while a person is in motion.
- The blood can be cast off forward or backward at less than 90 degrees.
- So, confirm direction of travel by other evidence.

Cast off Backward From Hand



Determining Direction of Origin

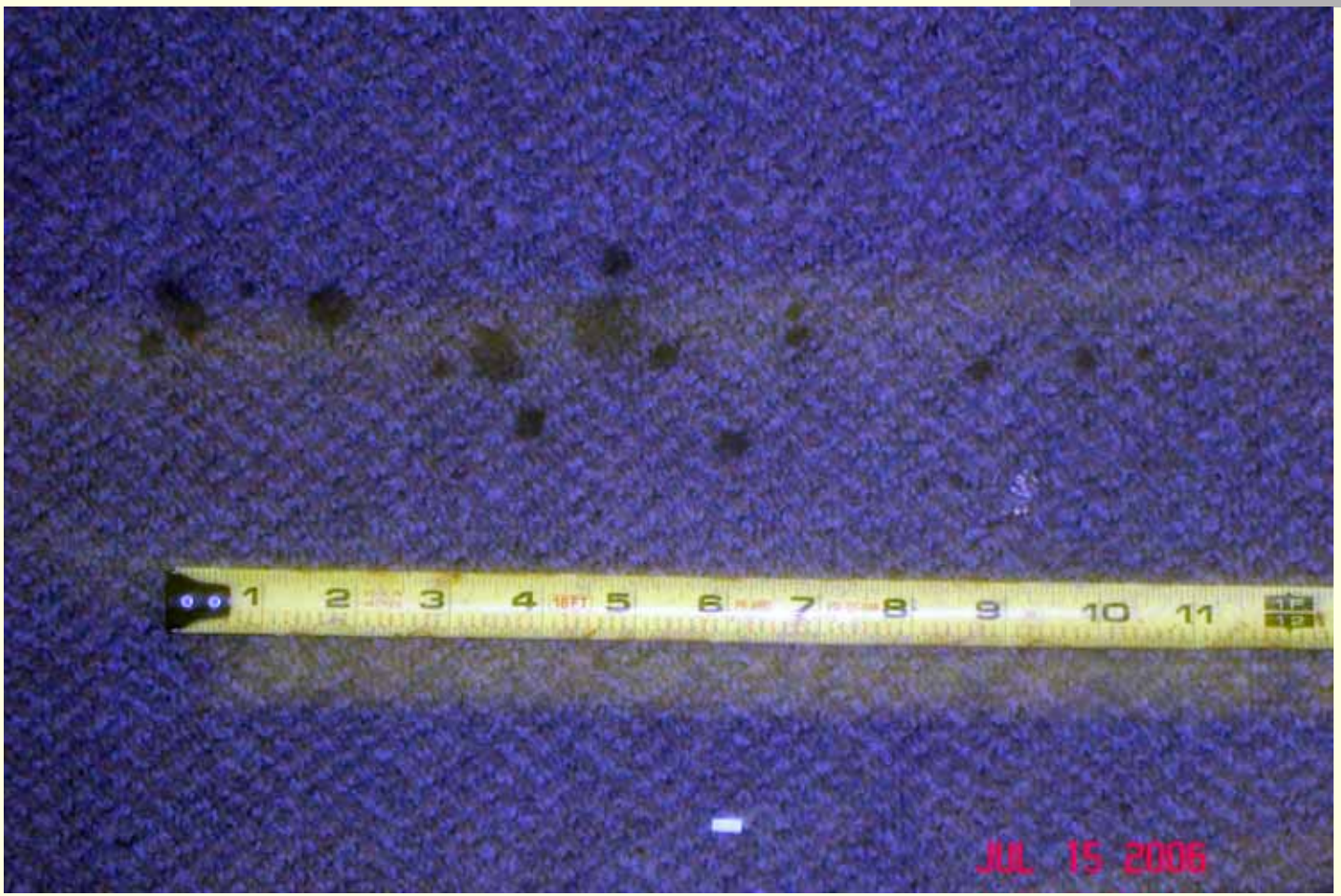
- Blood moved down wall 1.5 inches to lowest point in less than 10 minutes

- Spines indicate direction of most force. By drawing individual lines, the point of origin(s) can be traced

Direction of Primary Force?
Differences in Appearance/Color?

Direction of Primary Force?

Crime Scene: Blood On Carpet Approximately 8-11 hours old



Wounds

Impact on Blood Deposits

Wounds and Clotting

- Wounds bleed due to damage to surrounding blood vessels. The body responds by spontaneously contracting the nearby blood vessels (vasoconstriction).
- A clot will form and, if left undisturbed, will stop the bleeding.
- Severe or life threatening blood loss can occur prior to clot formation when injured vessels are large or numerous, although there is not necessarily a direct correlation in this regard.

Examples

- A large artery may be completely transected, but stop bleeding due to vasoconstriction.
- A smaller blood vessel with an incomplete tear may result in death without appropriate medical attention (ex. direct pressure on the wound).
- Differences in body tissue at the site of an injury can impact blood loss. For example, a large wound in fatty tissue would bleed less that a smaller wound in highly vascular tissue (ex. scalp injuries).

Types of Wounds and Deposits (Cunningham)

- Arterial blood is spurted out at regular intervals, and represents a life threatening wound. The blood is highly oxygenated, and will be bright red. The subject will weaken quickly, rest often, and will die without quick medical attention.
- Venous blood is generally constant and results in a dark red trail of blood drops. Usually not life threatening, the subject will be able to move long distances. The individual may slow down over time unless the blood loss is stopped.
- An injury to the lungs often results in a pink frothy blood trail, often accompanied by phlegm clots. The subject will be limited in movement without assistance.
- Severe Head Injury usually results in heavy, slimy, glutinous blood deposits. The subject will not have traveled far.

Following Blood Trails

Important Considerations

Is It Blood or Not?

What Else Could It Be

- Many things can look like blood.
- Ex: Poke berries excreted by birds!
- Look for:
  - Absence of signs of human passage
  - Non-human indicators: berry fibers, skin, seeds, etc.

Example of a Blood Trail

- December 2005
- 13 hour old trail
- Temperature below freezing
- Note subject footprints
- DOT confirmed by tails and footprints

Explanation?

Two Hours Old at 90 Degrees

Blood Trail Can Be Intermittent

- A blood clot can form, leaving no blood trail.
- Clots can be dislodged or disrupted, leaving a trail.
  - Ex. From muscle contraction during movement, or as a result of movement of any bone fragments within a wound.
- A wounded individual may compress a wound while resting, thereby allowing for clot formation once again.
- Other causes could include changing blood pressure or blood flow from the wound site due to muscular activity, resulting in an increased heart rate.

Blood Trails and Types of Deposits

- A blood trail can include:
  - Misting: very fine drops
  - Droplets: less than 5 ml.
  - Drops: more than 5 ml.
  - Pools

  Each of these age differently

Role of Gravity!

- Blood
  - seeks the lowest point
  - maintains its surface tension as long as volume is present.
  - Moves, leaving mini runs or trails.
  - Pools in collecting features.


Note Blood Continuing Down Stem


2 hours later at 90 degrees

Blood Trail and Drop

This blood deposit dripped multiple times, collecting in the pool on the lower blade.

The suspended drop is frozen in place. Temperature = 16 degrees with strong winds.

It remained in this position for at least 18 hours.

Blood Pooling: Sub 32 degrees F

18 hours later

Why is Gravity an Important Consideration?

- Blood may initially hit only the upper surface of leaf litter, grass, or other objects.
- This may only leave the slightest indication of the presence of blood.
- It can drip or run quickly to the lower surface, where a larger pool may form.
- The larger pool may not be visible without careful observation.

Places to Look: Inside Leaf Curls

Look in Layers of Grass


Warning: Dried Blood Shatters When
Stepped Upon

Tracking Blood at Night

Considerations

Tracking Blood at Night

- Wet Blood reflects light
- Dried Blood Pools and Drops reflect light.
- Where there is volume, dried blood is crystal like. The multiple cracks reflect light in different directions.
- This works best when light source is held at a low angle.

Note Properties of Dried Blood

Reflective Quality: 2 Hours at 90 Degrees Fahrenheit

Best Light Source?

- There are many opinions regarding following blood trails at night, and whether certain colored lenses are better than others.
- In our experiments, wet or dried blood did not appear dramatically different with red, green, or blue lenses. Amber lenses did, however, make a difference.
- In general the best contrast was noted with a clear, medium intensity light source. Very strong lights tended to wash out contrast.

How Much Do You Want To Carry?

- There are a number of different flashlights that are marketed as being of great benefit for the purpose of following blood trails at night.

- From a search and rescue perspective, it would be difficult to justify the purchase and carrying of a light specific to this one purpose, as the incidence of following blood trails is often not great.

Impact of Surface on Deposits

Role of Absorbsion, Background Color, and Texture

Absorbsion of Blood: Differences? (45 Minutes/16 degrees)

15 Hours Old: Differences? (temperature range 40-60 degrees)

2 Hours Old
at 90 Degrees/Partly Sunny

1.5 Hours Old at 90 Degrees: Stone

1.5 Hours Old at 90 Degrees: Leaf

Comparison? Explanation?

Impact of Brown Background Color: 45 Minutes at 16 degrees

Impact of Green Background Color at (45 Minutes)

Note Darker Appearance

Transferred Blood Fingerprints on Car Mirror at 1.5 hours

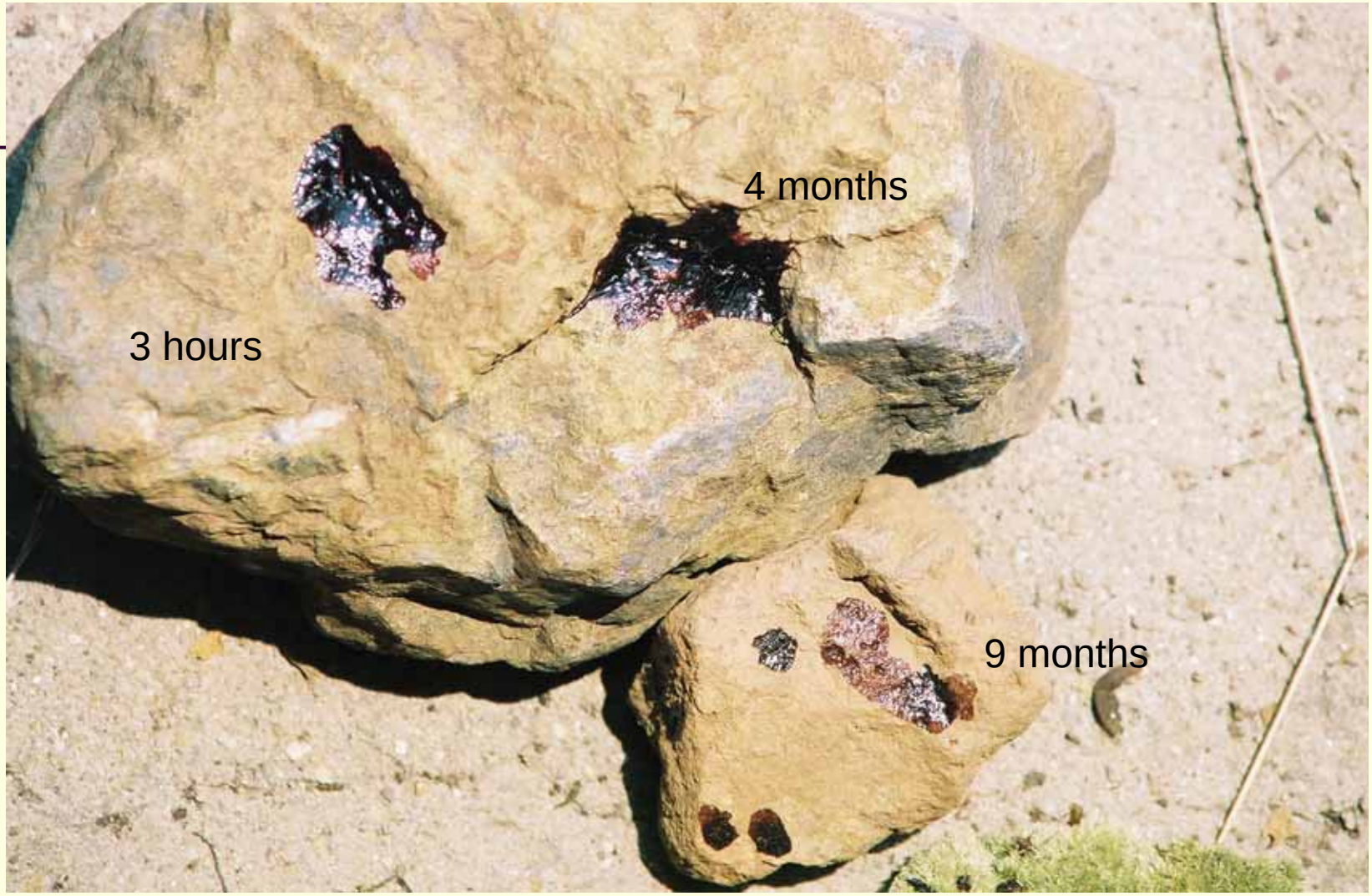
Influences in Aging

Time, Temperature, Etc

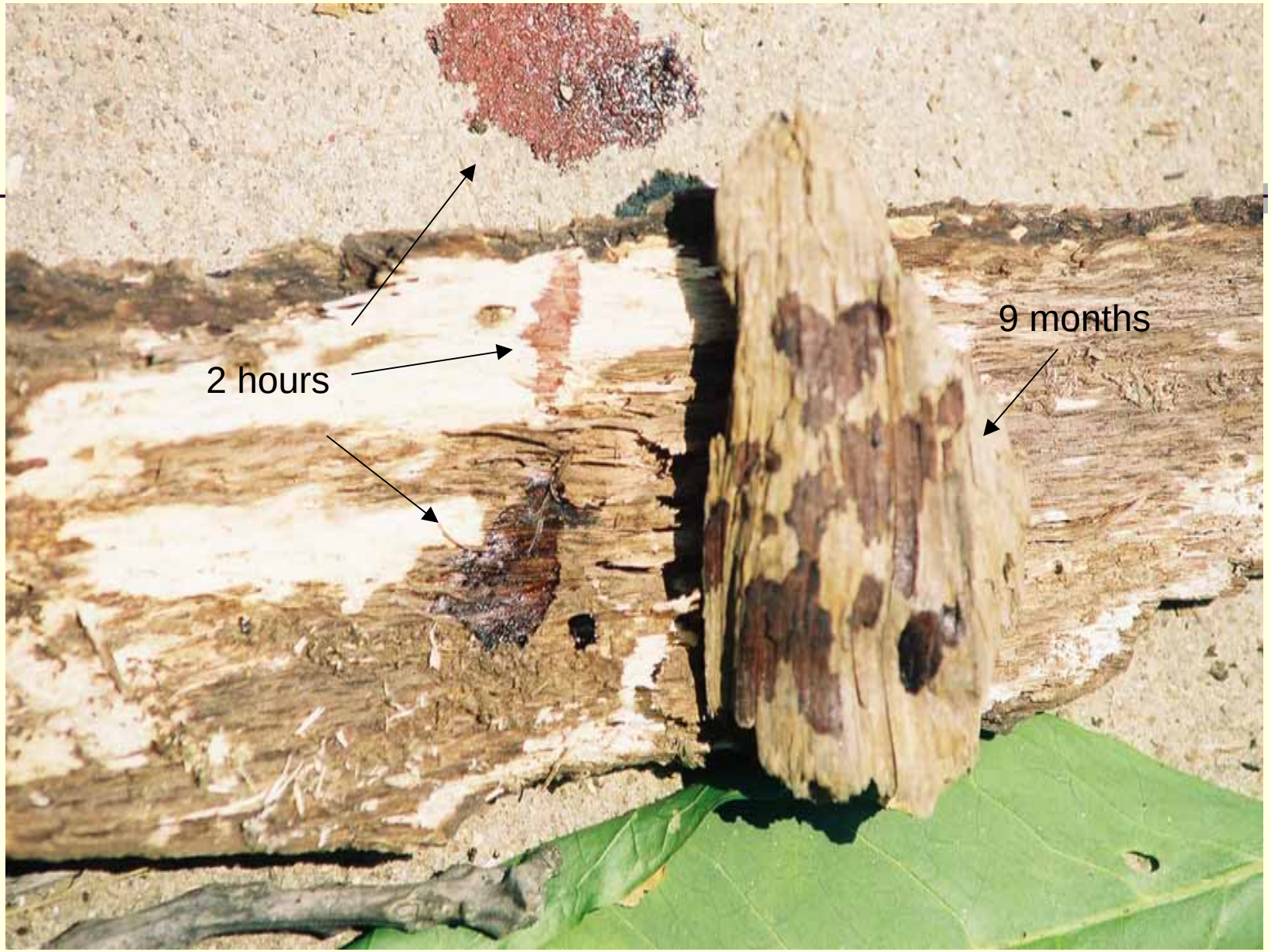
Factors Affecting Aging and Appearance of Blood:

- Like any sign of human passage, blood deposits change over time.
- There are any number of factors that influence this aging process.
- This would include the volume of the blood deposit, temperature, weather patterns, and the baseline surface on which the blood has been deposited.
- All must be taken into account when attempting to age a blood trail.

Most Recent to Oldest? How Old?


4 months
3 hours
9 months

Guesses?


2 hours
9 months

Example

- Timed study using 1/8th inch diameter blood drops.
- Controlled indoor environment.
- 54 degrees versus 70 degrees.
- The lower temperature slowed the aging process and appearance by at least 90 minutes.

What We Are Saying Is:

Blood Deposits are hard to age in the field!

Confirm with the totality of evidence present!

Some Research on Drying Rates

	Temp	Size	Drying Time (minutes)
Facial Tissue	38 F	16mm	120
	75 F	17mm	30
Carpet	38 F	6 mm	300
	75 F	7 mm	55
Glass	38 F	10 mm	360
	75 F	10 mm	45

Some Wisdom From The Ages

- **“…too much reliance should never be placed upon one observation since it may be the exception to the general rule. It is the combined evidence of a number of different indications which strengthens and confirms the conclusions to be drawn from them individually.” Harold Gatty, 1958**

Field-Related Issues

Measurement, Collection, Etc.

Should You Collect Specimens?

- No, except in very rare circumstances!
- Proactive Discussion with Law Enforcement regarding evidence finds
- Measure location from fixed and permanent objects as reference points (GPS helpful)
- Sketch and photograph noting orientation and distribution. Keep detailed notes.
- If possible, take the entire blood stained object (ex. Leaf, rock, twig)

Collecting Specimens (Cont'd)

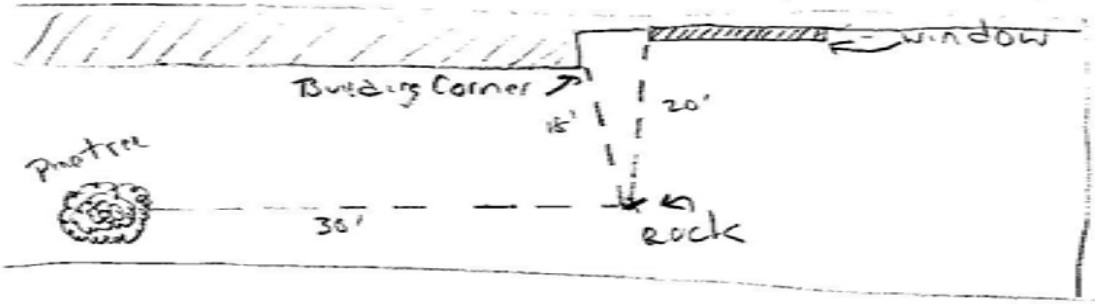
- Use gloves and cotton swabs/distilled water.
- Take blood sample AND nearby "unstained" area.
- Separate swabs and object into paper bags or constructed envelopes (not plastic)
- Seal bags. Note description of items, date/times collected, locations, your initials on seals.
- Keep chain of custody preserved!

Field Notes

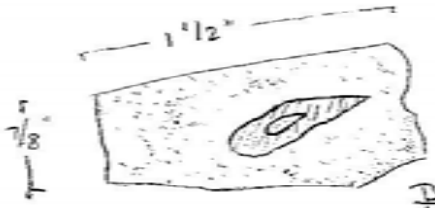
- Time and Date
- Environmental Conditions
- Color of deposit
- Degree of dampness of deposit
- Location
- Any items that have been collected or moved
- Other notable issues
- Draw to scale, note placement, and describe

Blood Deposit

July 17, 2006
12:10 P.M. @ 91° F
Humidity 60% - full sun
Location - 17 735087 E
4352525 N
18 feet from building corner
20 feet from broken window
30 feet from pine tree base
Gainesboro, VA - parking lot
full sun-exposure
Baseline Surface - Rock w/ flat top - 1/4" Thick



School break in Rock removed from location due to car accident traffic marked with

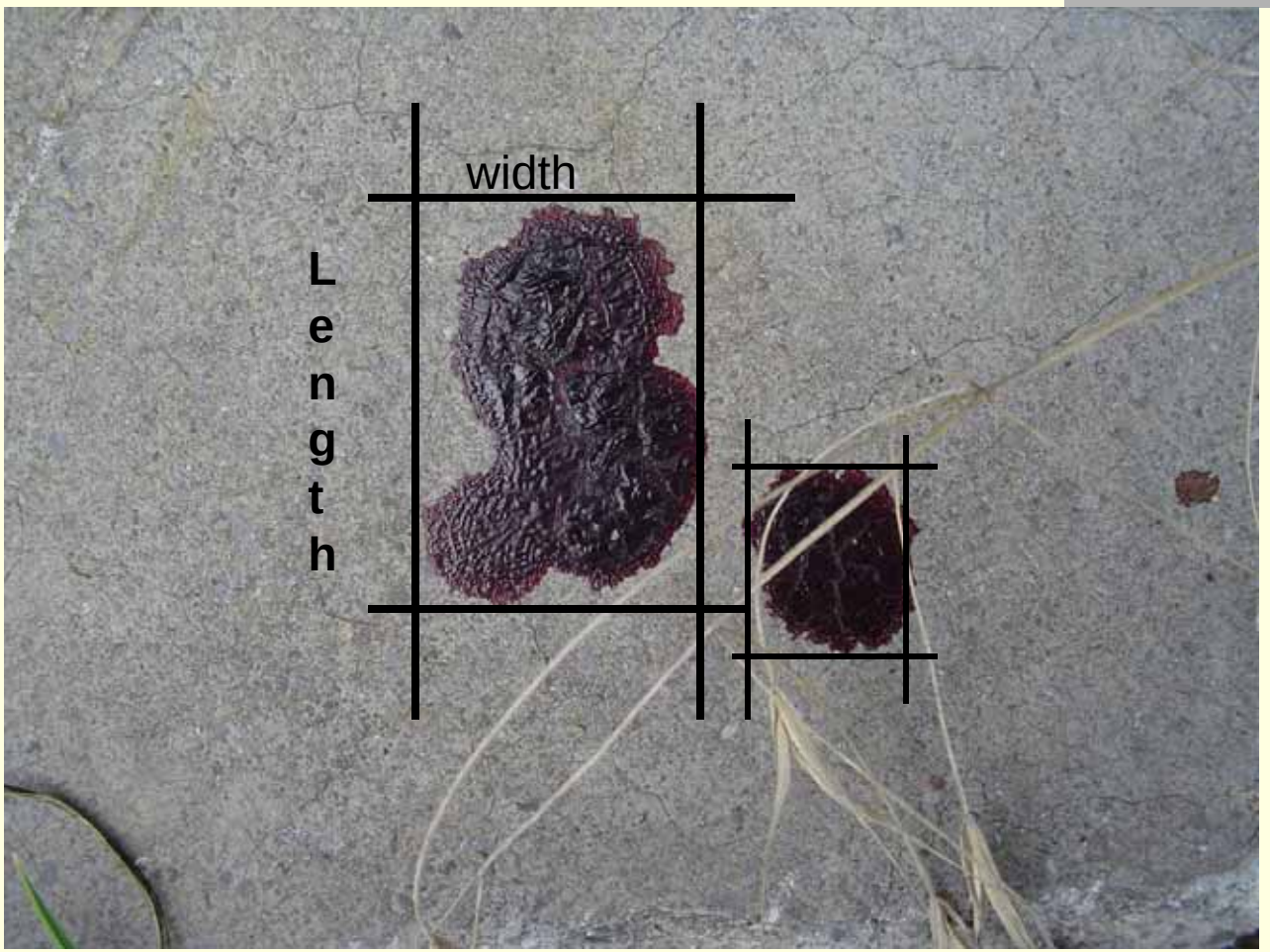


	Black	Red
Deposit -	7/8" length 1/4" wide	1/4" length 1/16" wide

Overall Color - Black w/ bright red center
(dried) (looking)

Orientation

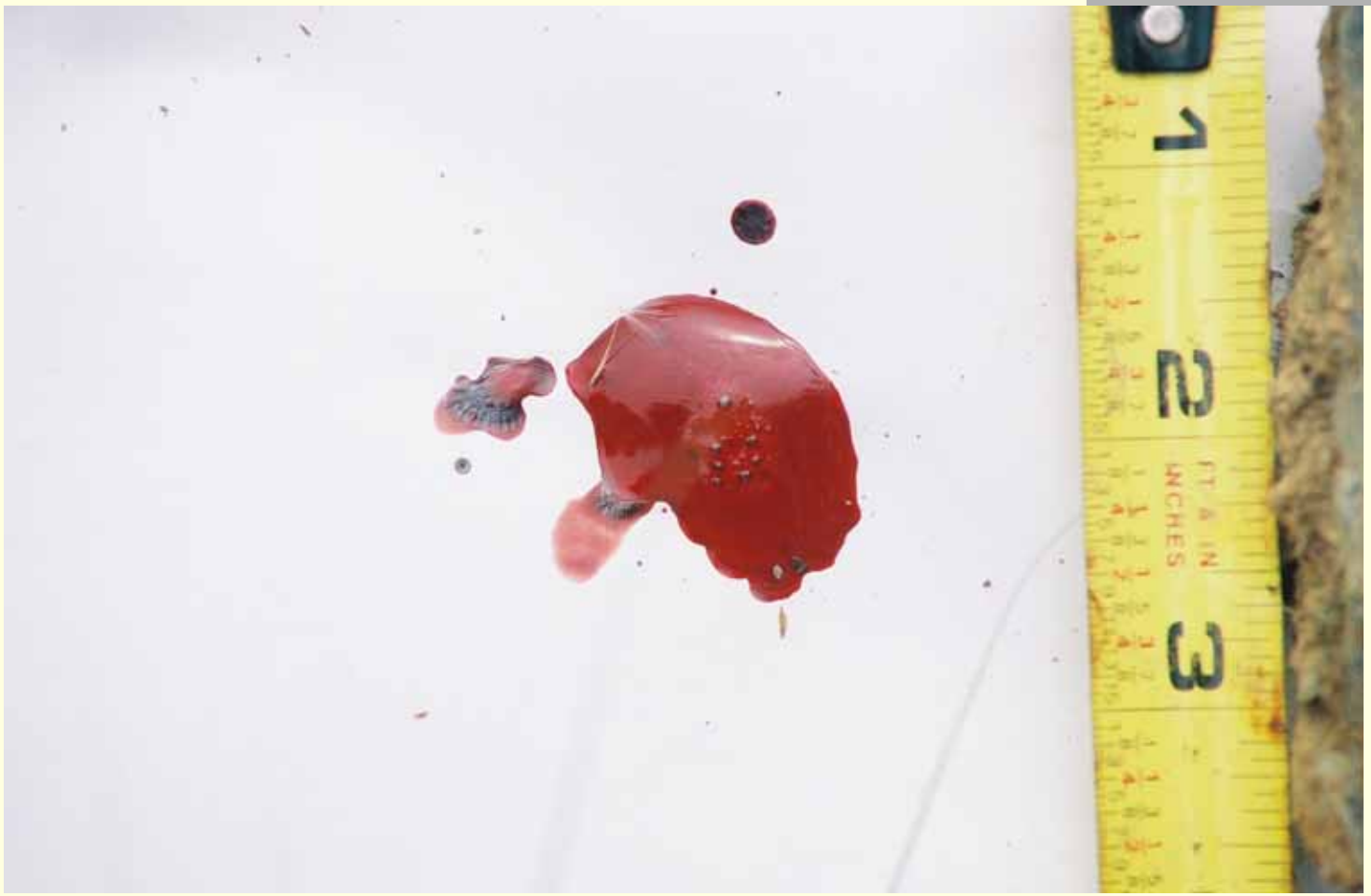
Measuring Blood Stains



Timed Blood Studies

Observations

1 Hour at 90 Degrees: Note Evaporation via bubbling



Same Drop at 2 Hours/90 Degrees: Aging Continues

25 minutes after deposit: 18 degrees

2 hours after deposit: 16 Degrees

18 hours after deposit: 36 Degrees

45 Minutes v. 18 Hours

Aged 2 and 48 Hours

Blood as an Attractant

Yes, Animal and Insect Activity Can Draw Your Attention to Blood Deposits

Squirrel Tracks

What Have We Learned?

Here is Your Test

Blood Type/Source: Analysis?

- Found on the edge of a rural dirt parking lot with no lighting.
- Medium: Paper towel
- What clues are present that indicate the source of the blood?
- What else can you see that may explain this?

Nearby Clue

Authors

- Unless otherwise noted, this presentation is based upon the research and field work of Mark Gleason and C. Steve Frye. The presentation was created by Mark Gleason.
- Both are members of the Virginia-based Search and Rescue Tracking Institute (www.sarti.us).
- This presentation may be used by others for educational purposes, with proper credit given to the authors or referenced sources.

Credits and Thanks

- Photographs on slides 19-22 are used with the expressed permission of Joe Slemko, of J. Slemko Forensic Consulting. **email:** jslemko@bloodspatter.com; **website:** www.bloodspatter.com
- Poke Week photograph from Kevin Brewer.
- Information regarding the properties of blood, wounds, and blood clotting was obtained, in part, from discussions with Dr. K. Miller, Search and Rescue Tracking Institute.
- Information regarding types of wounds and resulting blood trails are from the work of Tyron J. Cunningham from his 2004 publication entitled, “Scout Craft and Scout Tracking”

Credits and Thanks

- Information regarding blood drying rates, collection issues, and terminology provided, in part, by the Frederick Co. Virginia Sheriff's Department
- All other photographs and information provided by Mark Gleason and Steve Frye (SARTI), with additional photographs by Will Dotson (SARTI) and Tina Smith.
- We thank all of those injured and bleeding individuals who laid trails, whether on purpose or not, and whether they realized it or not, that resulted in these photographs.