

Firearm Distance Determination: Science or Crystal Ball Reading

Paul Paradis
Criminalist

Fore thought

- There is no way to give someone their life back or replace lost time due to improper incarceration.
- Forensic science helps to not only determine guilt or innocence but degree of guilt.

- There is no way to know how the outcome of a case would be affected even by one “small” error.
- There is a resistance to change in the firearms examiners community. Changes to standard operating procedures are a opening for the opposition to attack previously done work.

Firearm Distance Determination

AKA:

- Muzzle to target testing
- Gunshot proximity testing

Firearm Distance Determination

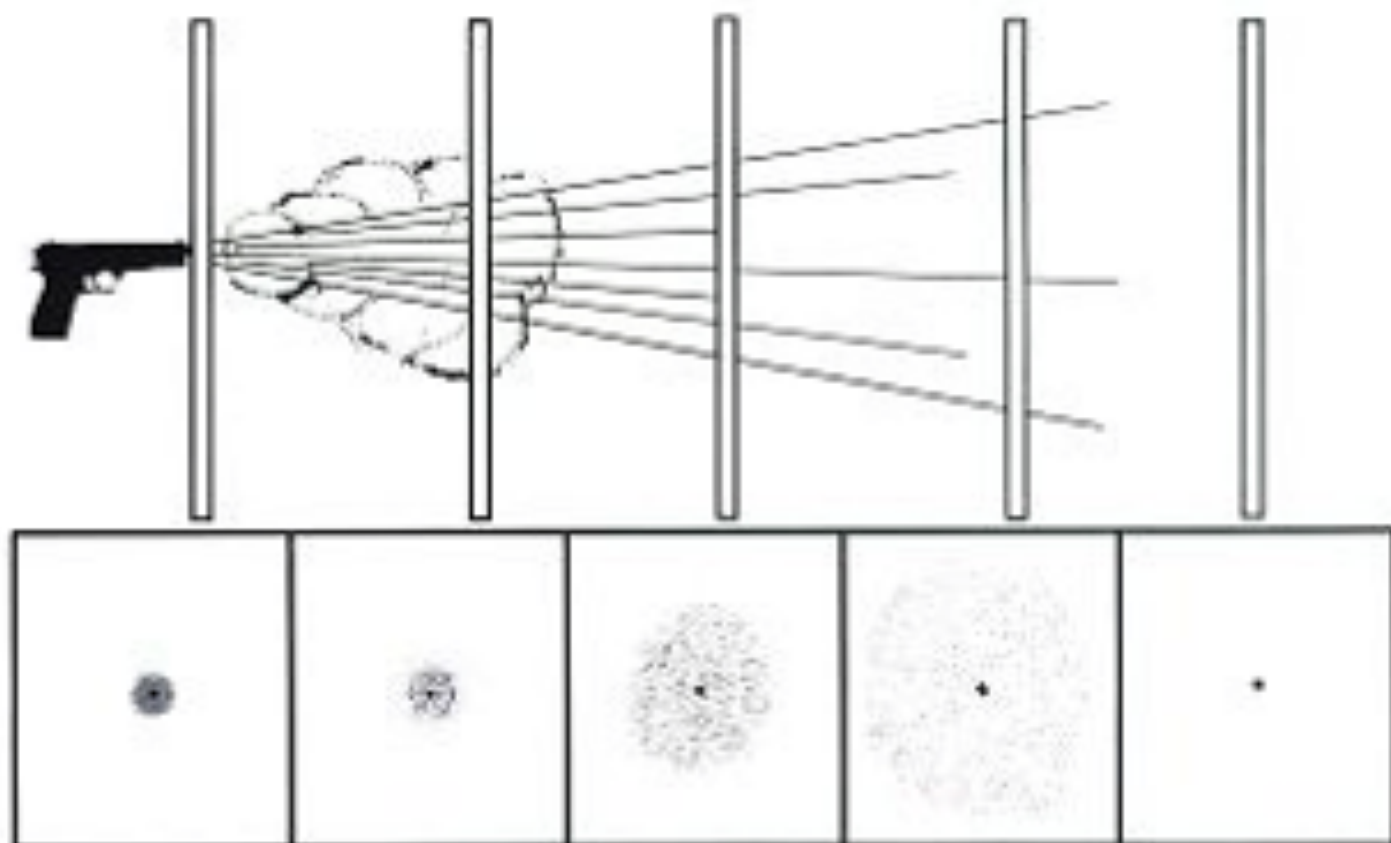
AKA:

- Muzzle to target testing
- Gunshot proximity testing
- Basically trying to establish facts, determine the veracity of statements by witnesses and suspects.

Back to the Science

What is the basis for distance determinations?

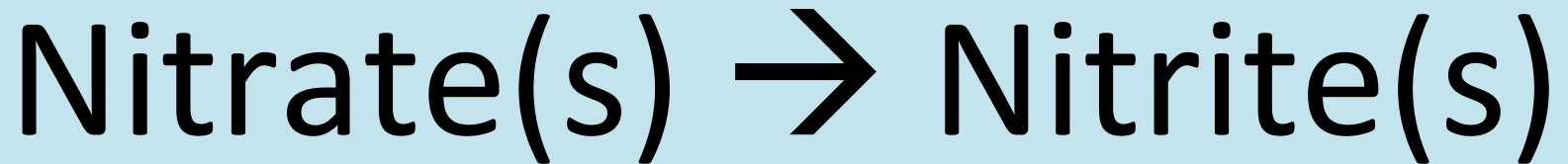
Distance Determination and Gunshot Residue



Dimensional Changes

- Diameter increases with distance
- Density decreases with distance
- Nitrite reactions as well as GP particles should both be taken into consideration in a pattern interpretation.

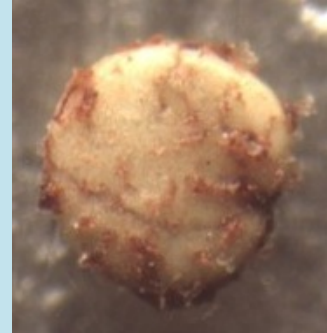
Gun Powder (GP) Chemical Change



Unburned state



One example of fired state



Variables in “order of importance”

1. Distance*
2. Barrel length*
3. Propellant burning rate*
4. Propellant type (disk, flake, ball, etc.)*
5. Caliber*
6. Muzzle to target angle
7. Target material* (surface density)
8. Primer (type, size, age, etc.)*
9. Propellant charge weight*
10. Weapon type (revolver, auto pistol, etc.)

An Empirical Study of Gunpowder Residue Patterns, F.C. Barnes et al., J. Forensic Science, July 1974 Vol. 19, No 3.

* Gunshot Proximity Testing A **Comprehensive Primer** in The Background Variables and Examinations of Issues, Nichols Ronald G., AFTE Journal– Volume 36 Number 3– Summer 2004

Mentioned in AFTE article by Nichols

- Environmental factors
- Bullet design
- Primer condition and formulation
- Bore condition
- Misc. Issues (Intermediate objects, bleeding covering particles as well as carrying them away, squib loads)

SWGGIN Guidance

- SWGGIN (angle not mentioned and all reference articles were from AFTE)

Likelihood of Errors

- “If the examiner is handicapped without some of the information or evidence, then the potential for interpretational errors is high”.

Gunshot Proximity Testing A Comprehensive Primer in The Background Variables and Examinations of Issues, Nichols Ronald G., AFTE Journal– Volume 36 Number 3– Summer 2004 page 193

Consumptive/Destructive?

- SWGGUN Guideline for Gunshot residue Distance Determinations 2.0
- “The above tests are generally considered destructive to the evidence and the examiner must document the examination and evaluation including photography and standardized worksheets”.

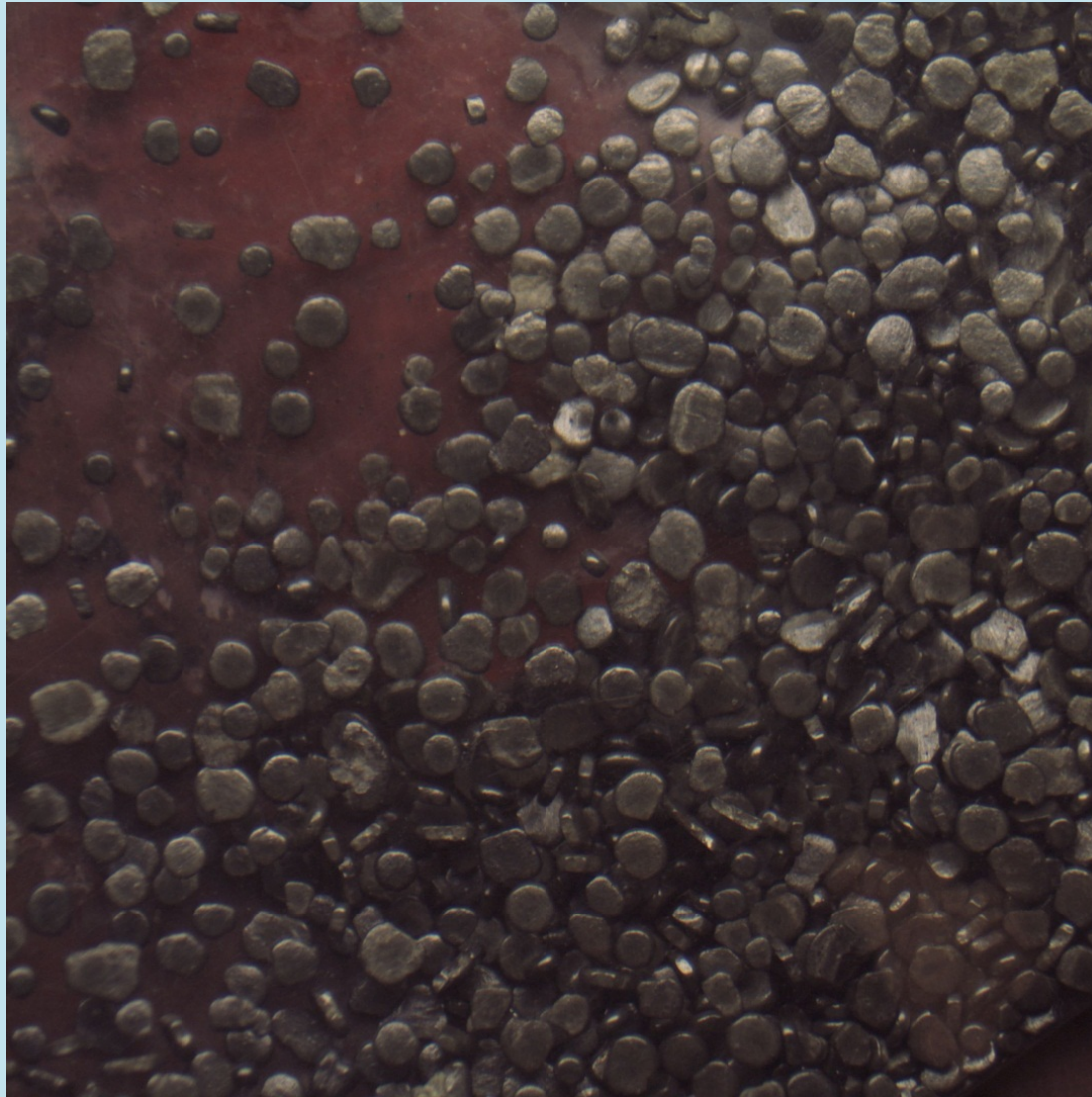
Common Mistake 1

- Only looking at the evidence from the outside portion and failure to look at layered clothing. The backside of the clothing needs to be inspected as well as clothing undergarments etc. that were secondary layers
- Multiple cases have been found where someone was wearing the clothing inside out and only the outside was viewed or tested.

Common Mistake 2

- Belief that all GP particles will be detected by Greiss/Modified Greiss/or other chemical testing

Remington Golden Sabre



Remington Golden Sabre

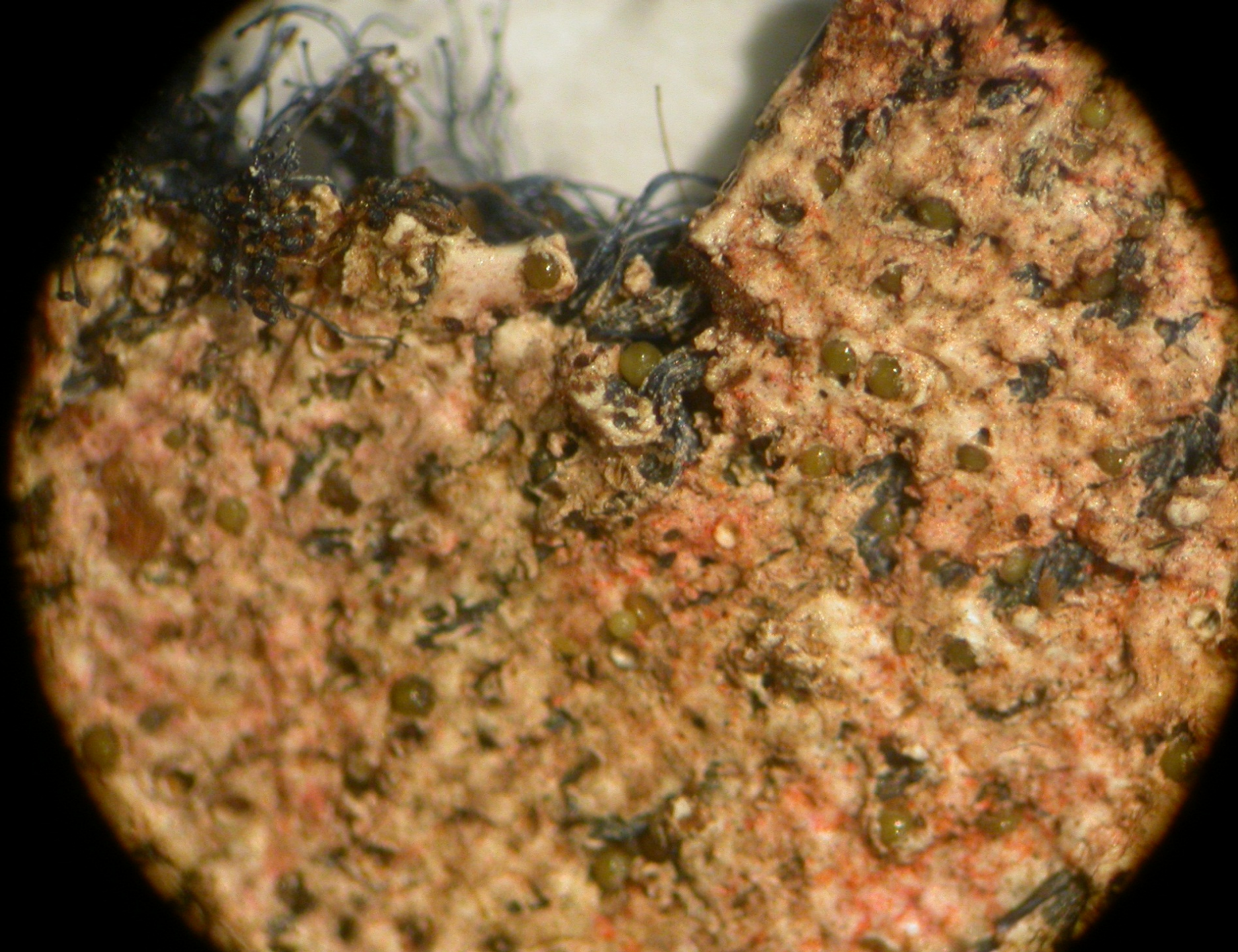


This particle and 5 other were not detected by Modified Griess

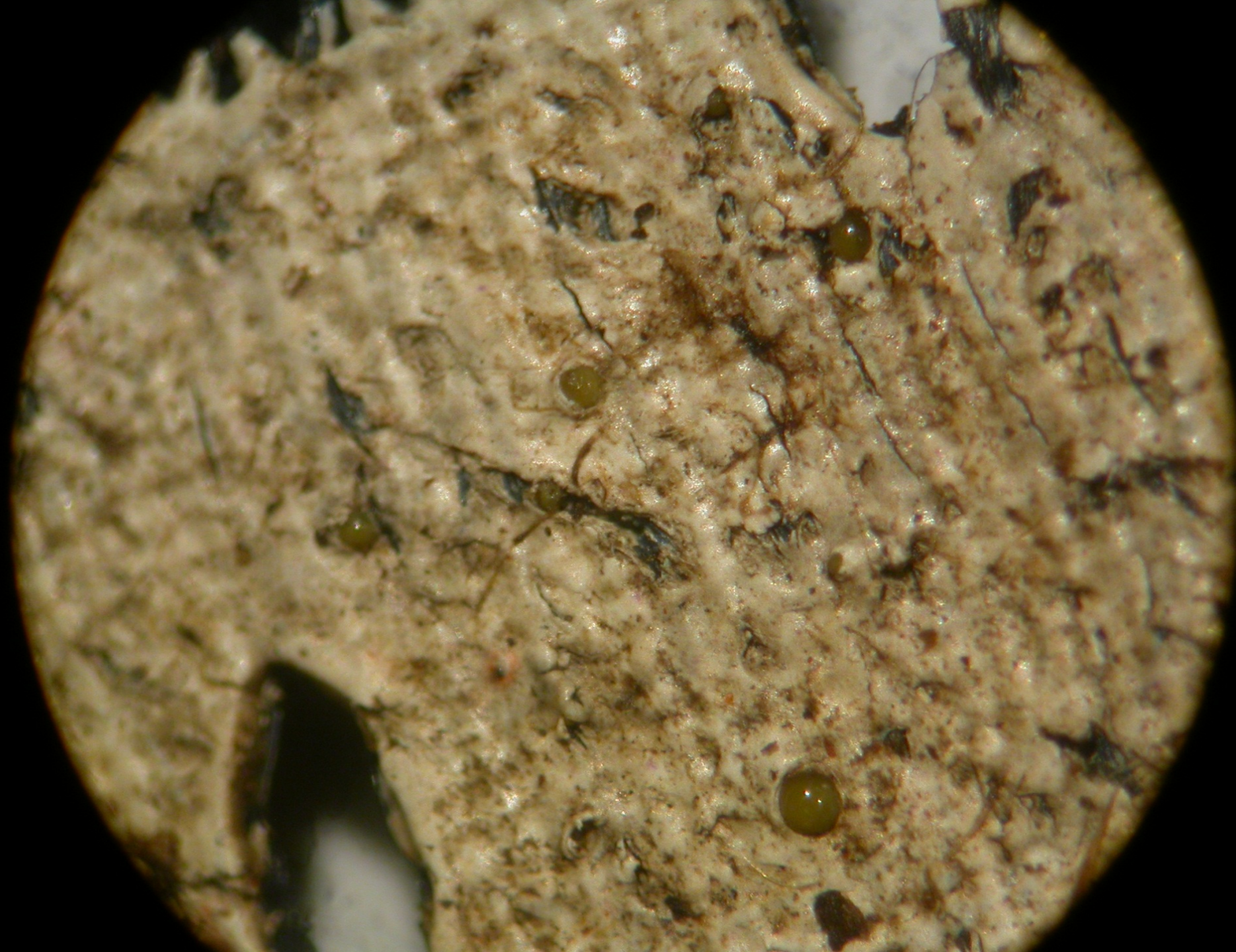


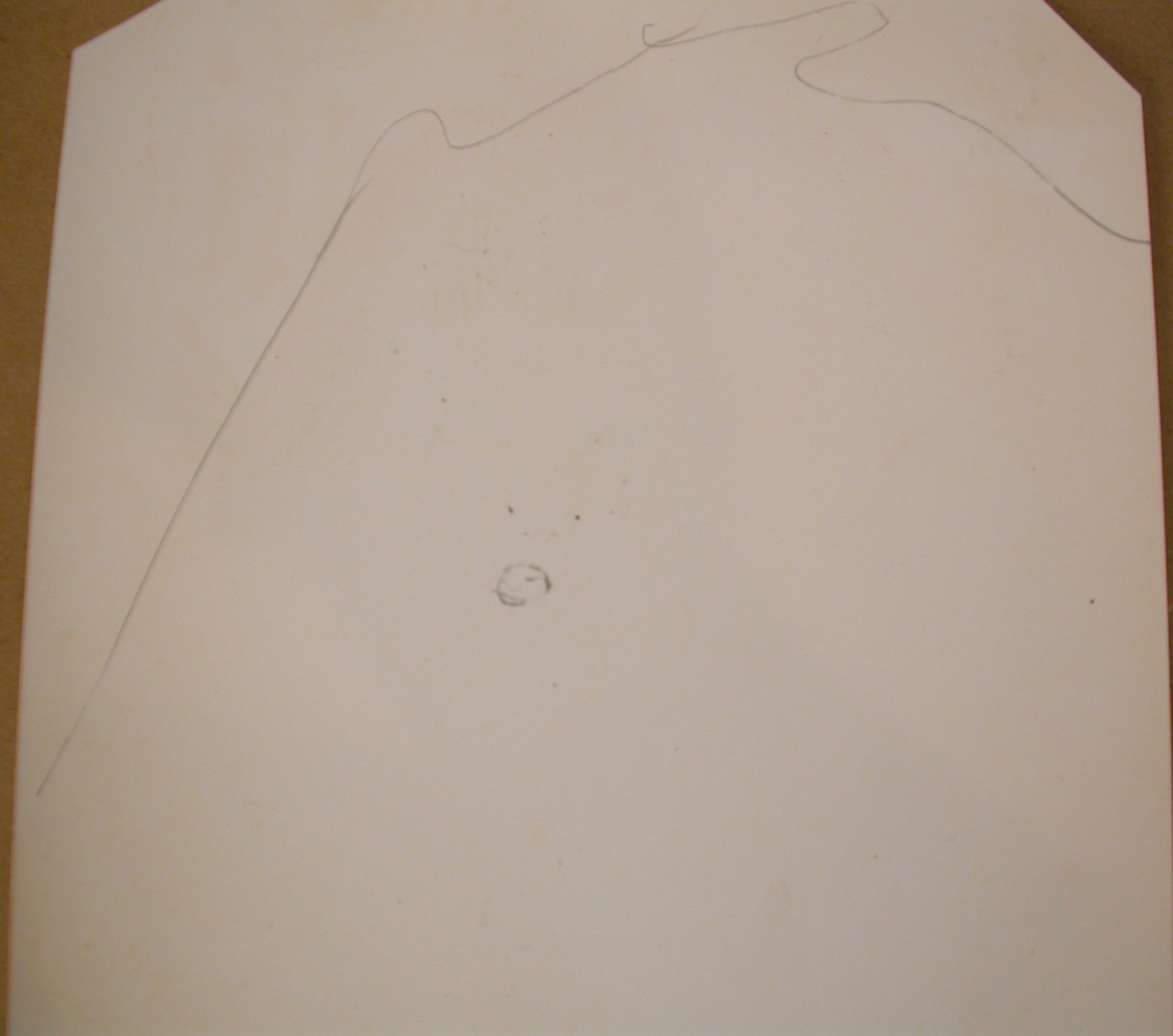
Examiner Statement

- The evidence was visually, microscopically, and chemically tested and no gun powder residues were found.
- Then how do you explain this...



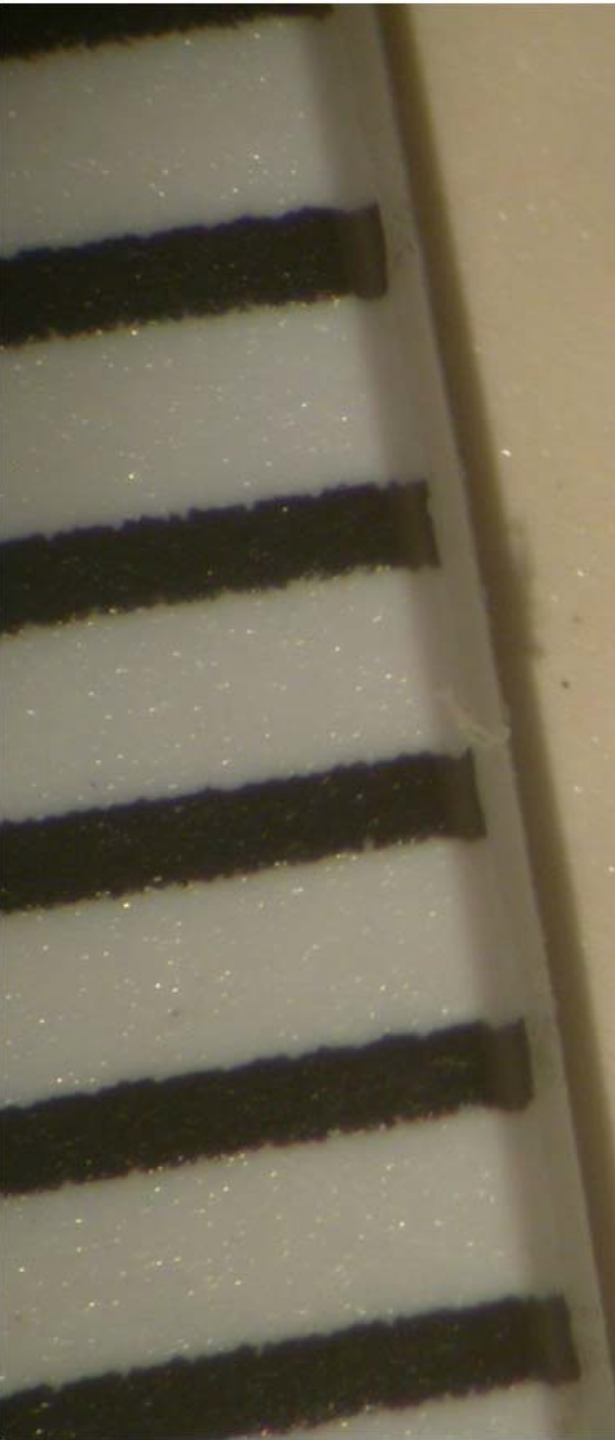












- The current theory is that unburned particles will pick up soot containing nitrites that will be detected by chemical testing.
- While this is possible it does not happen all of the time as illustrated previously

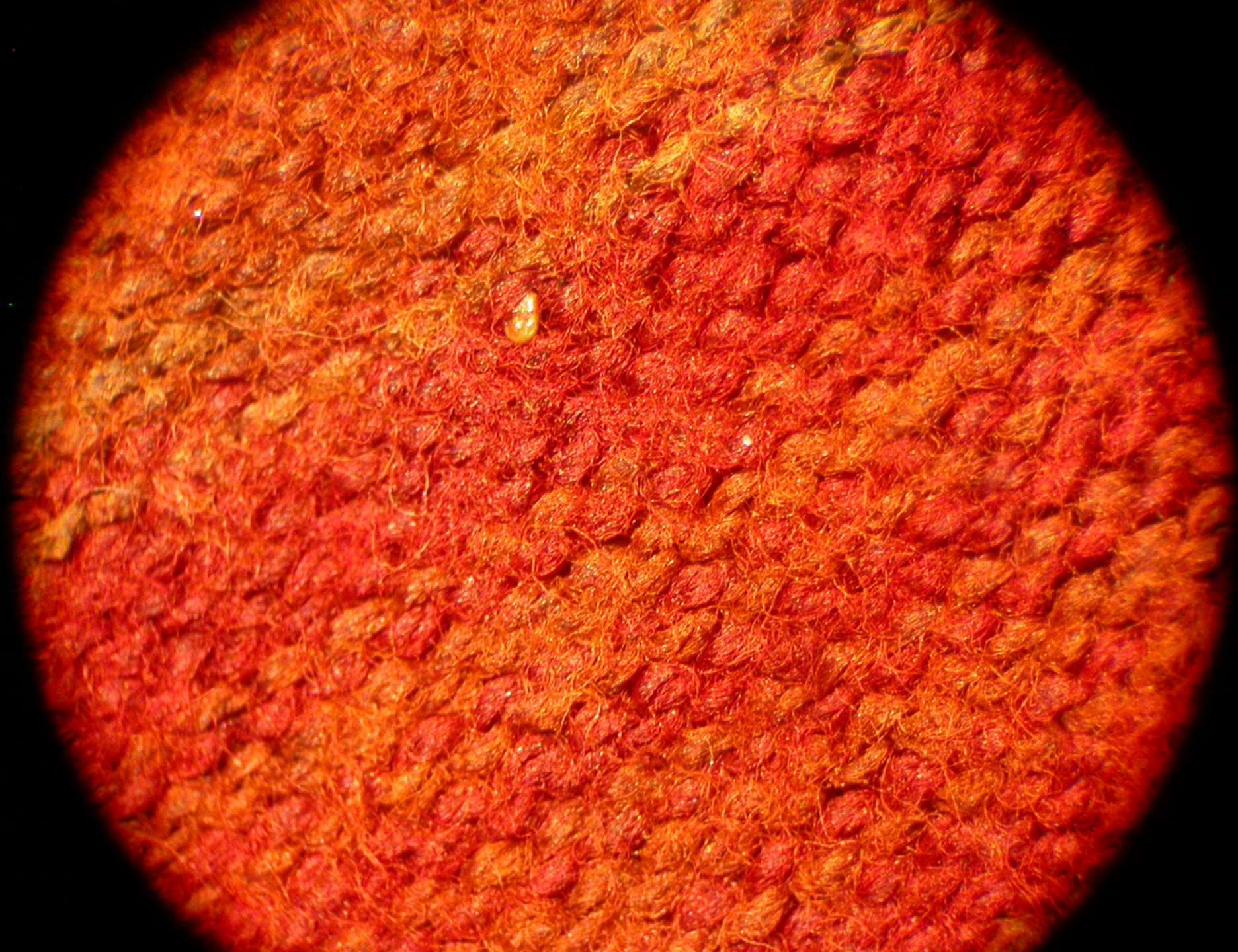
Research needed?

- How often does the chemical testing miss GP particles or nitrites?
- Does the lack of the “shell” around a gunpowder particle breaking off cause loss of any or all nitrites?
- If a particle does not have a reaction on one side could nitrites be on the other side?
- Can nitrite particles blow off a particle in flight?

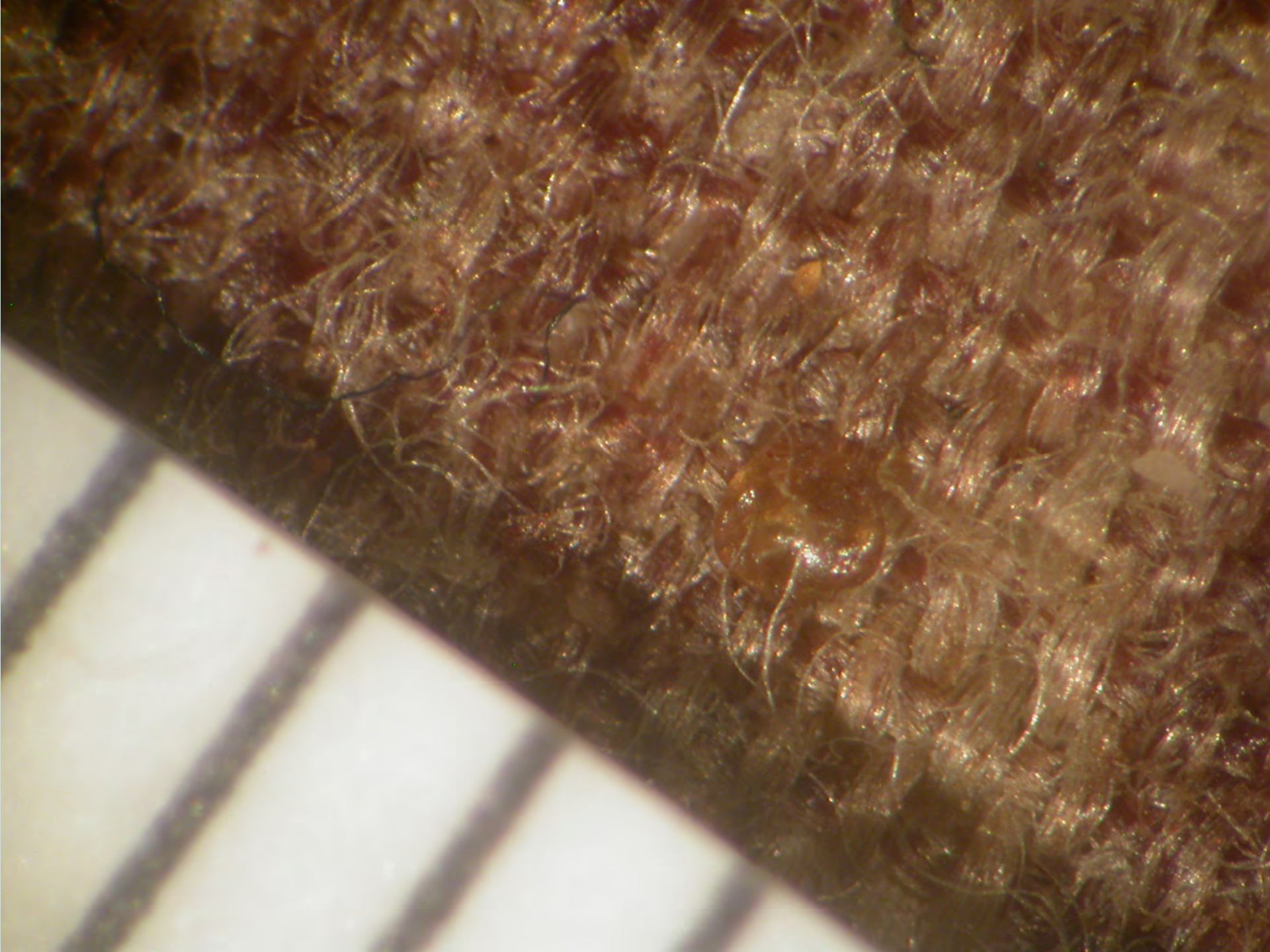
Common Mistake 3

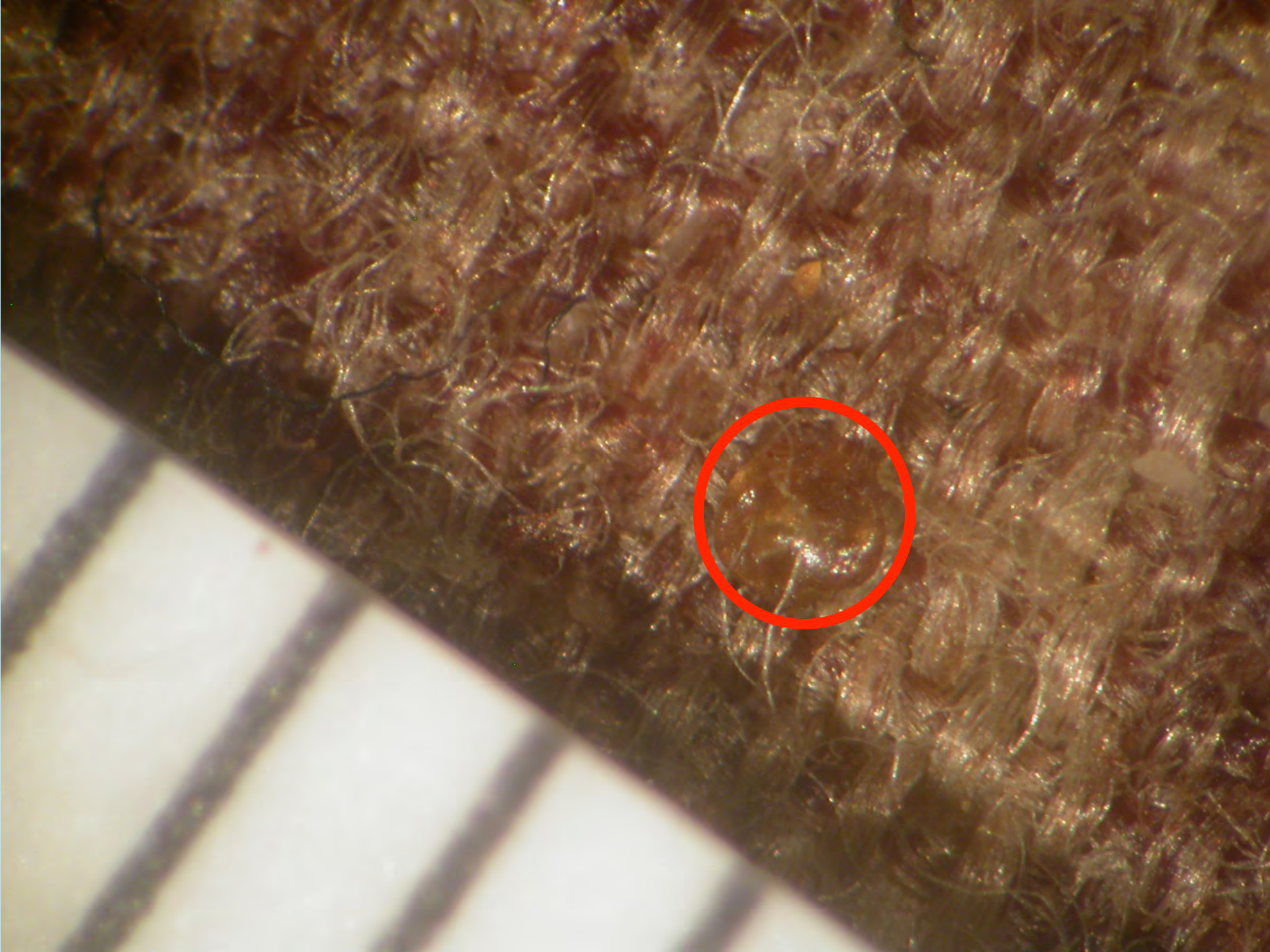
- Failure to recognize Gun Powder Particle(s) due to?

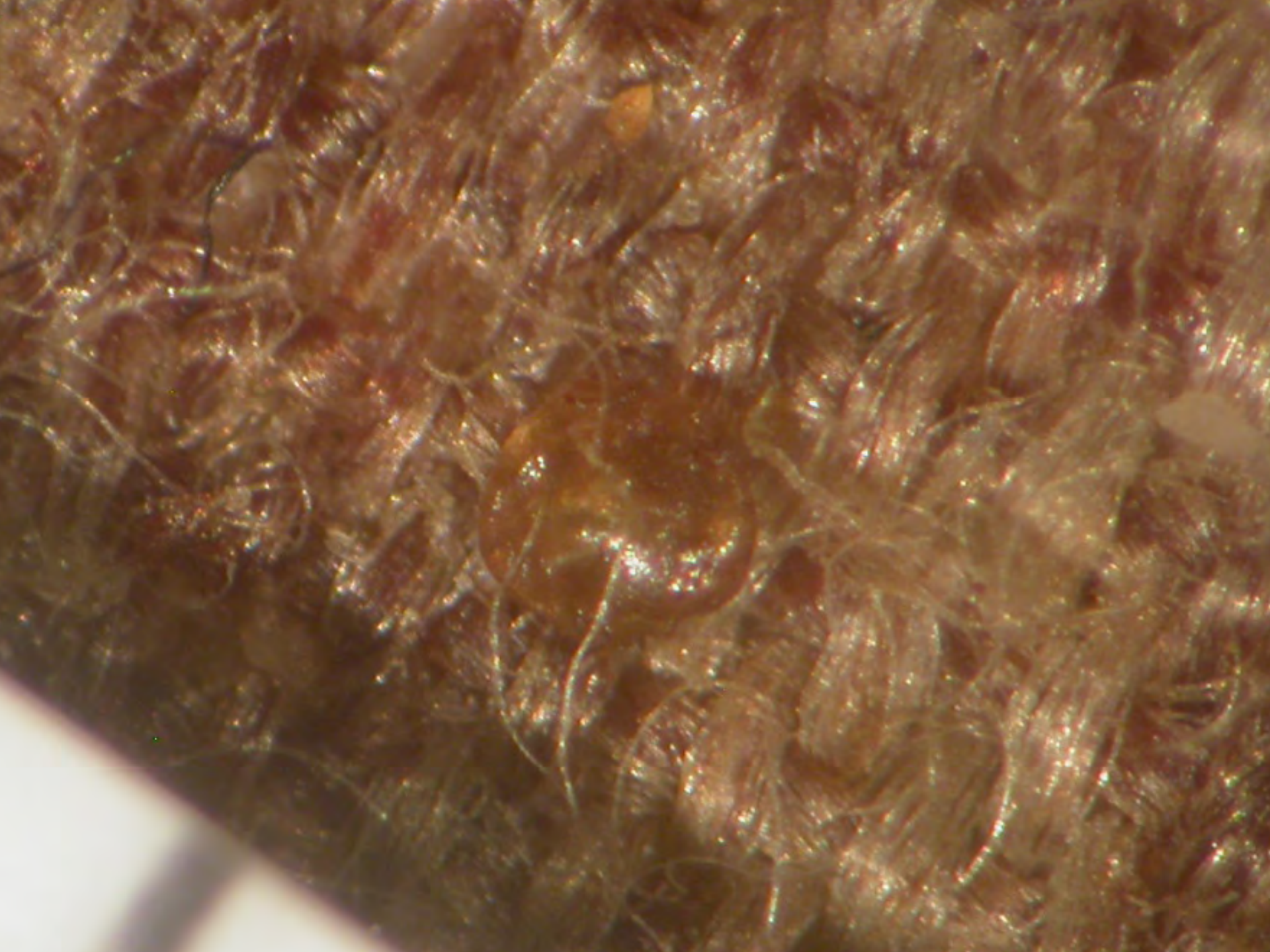




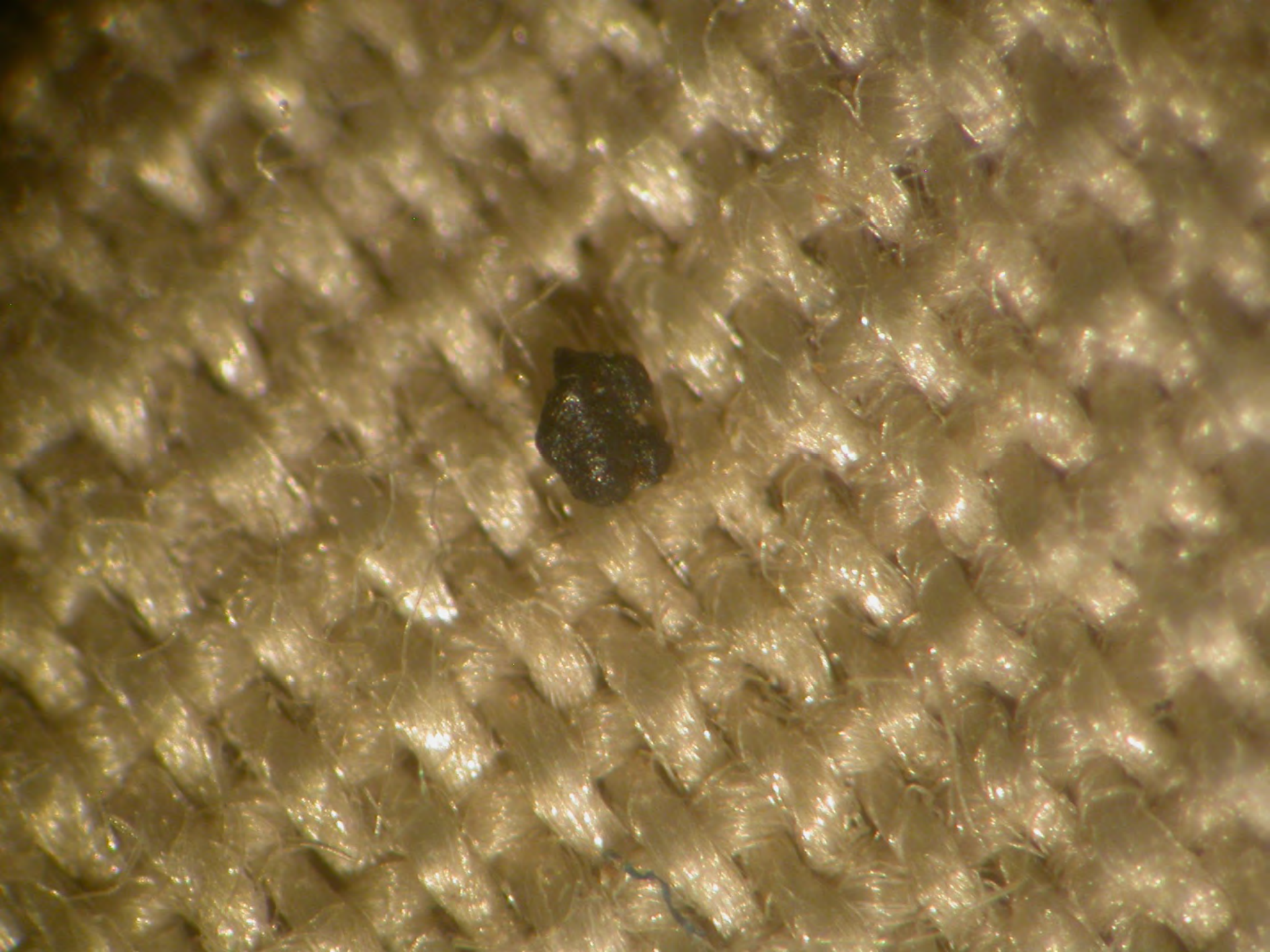


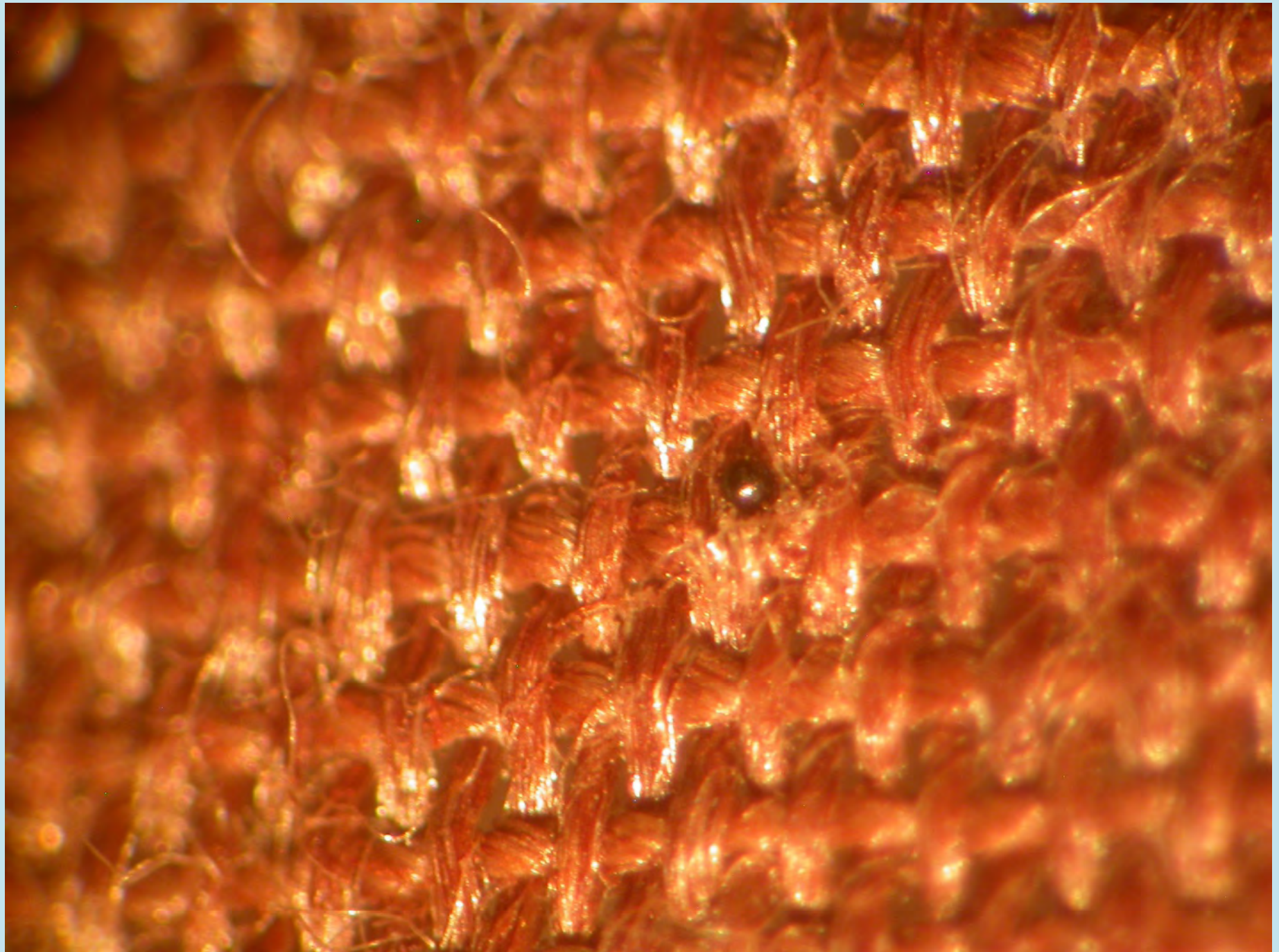












Common Mistake 4

- Failure to compare gunpowder from test fires to evidence.

Lucien C. Haag “Shooting Scene Reconstruction”

- “The lesson to be learned here is to insure that any test patterns are produced with ammunition comparable to the ammunition discharged in the actual incident. Reliable numerical distance determinations can only be accomplished by empirical evaluation of the type of gun and ammunition involved in the specific case. Numerical range-of-fire estimates based on past experience but without such testing leaves firearm examiners, crime scene investigators, and pathologists on tenuous ground, and open to legitimate attack.” Page 70

Edward E. Hueske “Practical Analysis and Reconstruction of Shooting Incidents”

Visual Examinations

- “A word of caution is in order concerning visual comparisons of residues and distance assessments at shooting scenes.”
- “Different brands of ammunition can produce markedly different residue patterns for the same weapon fired at the same distance.”

Page 143

Paul Paradis' quotes:

- Only using the same brand of ammunition does not mean that the same gunpowders were used in prior or subsequent loadings.
- Therefore visual comparisons—at a minimum—should be done as well; manufacturers some times change powders.

Common Mistakes 5 & 6

Testing too small an area.

Failure to investigate angle fired.

Please note: Absence of medical and autopsy reports greatly increases the likelihood of error!

Top

P13-647
Item L22K
36 Inches

Top

P13-647
Item L22K
36 Inches



Common Mistake 7

- Failure to use correct material for test fires.



What other issues do we not know or disagree on?

- How do we prove our answers?

Blood and Water Issues

- What percentage of chemical reactions are inhibited due to blood? How do we qualify and quantify blood-covered garments versus chemical reactions?
- Water/Rain? How soluble are nitrites?

Technical Factsheet on: NITRATE/ NITRITE

Due to its high solubility and weak retention by soil, nitrates are very mobile in soil, moving at approximately the same rate as water, and has a high potential to migrate to ground water.

Analysis

Reference Source

EPA 600/4-79-020 353.1; 353.2; 353.3; 300.0; 354.1

Standard Methods 418C; 418F

ASTM D3867-85A; D3867-85B

Method Number



How to Correct Procedural Errors

- Crime scene techs need more training on handling evidence.
- Training and procedures vary from agency to agency. Often the examiners who are teaching are not qualified to teach. We need to set standard complete protocols not only in performance of case work but also to qualify those training new examiners.
- Set standards for operating procedures and documentation.
- Photographs of gun powder particles and chemical reactions are important to the documentation and review process and should be mandatory.
- Disputes between examiners must be reported and resolved.

How to Correct Systemic Errors

- The use of sworn officers as forensic scientists creates an “us against them” attitude. Forensic labs should not be under political or financial control of law enforcement agencies.
- Continuing education and testing by outside sources should be mandatory to reduce educational inbreeding. A good example would be the Forensic Science Initiative which was discontinued by the Dept. of Justice.
- More funding research for both forensic labs and defense practitioners.
- A federal agency to investigate complaints of improper procedures, testing, and testimony.

- Sufficient time needs to be allotted for examiners. Typically examiners are pressured to get “it” done quickly.
- Good science needs proper funding!
- Examiners’ testimony should be subject to external peer review by reasonable request when testimony is:
 - not supported by reports, documentation, or science;
 - outside the area of expertise; or
 - sufficient cause for review is shown.
- All reports of review should be released for public review.
- Hiding known mistakes by lab management should be a criminal act.

What role could/should NIST play?

- Advocate for a body with legal review and oversight powers.
- Research in general.
- Research of potential errors, by request.

Contact Info

Paul Paradis

Phone: 719-630-7070

2816 W. Pikes Peak Ave

Colorado Springs, CO 80904

email: paul@paradisefirearms.net