

Trace Evidence II - B

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CHAPTER 14

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Overview

Review of last trace evidence lecture

- Hair - mtDNA

Hair DNA and a Russian Grand Duchess

Other major types of trace evidence

- Paint
- Glass
- Soil

Reminders: Hair and Mitochondrial DNA

- Mitochondrial DNA can be extracted from the hair shaft.
- Mitochondrial DNA is found in the cytoplasm and it is generally transmitted only from mother to child.
- As a rule, all positive microscopic hair comparisons must be confirmed by DNA analysis.
- Nuclear DNA analysis may allow individualization, mitochondrial DNA cannot

The Story of Anastasia

- ▶ In 1917, the February Revolution in Russia forced Tsar Nicholas II (Nicholas the bloody, 1894-1917) to abdicate the throne
- ▶ Nicholas, his wife Alexandra, their four girls and one son were held captive after the 1917 February revolution, they were held in captivity until the Bolsheviks seized power in the October Revolution
- ▶ Civil war raged throughout 1918, and in July anti-Bolshevik Russian forces approached
- ▶ Fearing that Nicholas and his family would be rescued, the local authorities passed a death sentence (some say Lenin ordered this) on the Romanovs

The Story of Anastasia

- ▶ Just after midnight on July 17, 1918, the family and four family associates were ordered to dress quickly and go down to the cellar
- ▶ Under the implication that they were to be transported to another location
- ▶ Instead they were shot execution style by a firing squad
- ▶ Those who were still breathing when the smoke cleared were stabbed

The Story of Anastasia

- ▶ Initial reports indicated that only Nicholas was executed
- ▶ Years later, it was confirmed by Russian investigators that the entire family had been murdered
- ▶ At the same time, however, a persistent rumour spread through Europe, telling of a Romanov child, Anastasia, who had survived the carnage
- ▶ Several pretenders came forward, hoping to cash in on the Romanov fortune, but they were quickly exposed as frauds

The Story of Anastasia

- In 1920, an apparently suicidal young woman was pulled from the Landwehr Canal in Berlin
- She refused to tell authorities her identity and was committed to the Dalldorf Asylum, where she lived in anonymity until 1922
- In 1922, she announced that she was the Grand Duchess Anastasia

The Story of Anastasia

- ▶ Supporters rallied for recognition of her birth right
- ▶ Critics, including Anastasia's uncle didn't believe Anna's claim and hired a private investigator who contended that Anna Anderson was in fact a Polish-German factory worker, Franziska Schanzkowska, from Pomerania (part of Poland) who disappeared in 1920
- ▶ Schanzkowska had a history of mental instability and was injured in a factory explosion in 1916, which accounted for the scars. These findings were published in German newspapers but evidence was not definitive

The Story of Anastasia

The woman who became known as Anna Anderson continued her fight for recognition, losing several court cases as the decades passed

In 1968, Anna Anderson married an American history professor, J.E. Manahan, and moved to the United States

The Story of Anastasia

- In 1970, she lost her last major suit, and the remaining portion of the Romanov fortune was awarded to the Duchess of Mecklenberg
- Anna Anderson Manahan died in 1984
- In 1991, Russian authorities found the presumed burial site of the Romanovs' and exhumed the human remains

The Story of Anastasia

- ▶ The Russians sent samples to the U.S. and Britain for DNA analysis. It was determined that the remains consisted of five females and four males
- ▶ Samples from other relatives were also assessed and it was determined that the remains were that of a father and mother and three daughters. The four other remains were unrelated
- ▶ The son Alexei and one daughter were missing

The Story of Anastasia

- ▶ To prove the identity of Alexandra and her children, the scientists took blood from Prince Philip, the consort of Queen Elizabeth II and the grand nephew of Alexandra
- ▶ Because they all share a common maternal ancestor, they would all share mitochondria DNA (mtDNA)
- ▶ The comparison between the mtDNA in Philip's blood and in the remains was positive, supporting the conclusion that the bodies were those of the Romanovs

The Story of Anastasia

- To prove the Czar's identity, who would not share this mtDNA, the remains of Grand Duke George, the brother of Nicholas, were exhumed allowing confirmation through a separate mtDNA lineage
- A Romanov daughter was missing from the burial site
- Could Anastasia have escaped and resurfaced as Anna Anderson?

The Story of Anastasia

In 1994, American and English scientists used a tissue sample of Anderson's recovered from a Virginia hospital and compared her mtDNA with that of the Romanovs

Simultaneously, an American team compared the mtDNA found in a strand of her hair

The Story of Anastasia

- Both teams came to the same conclusion: Anna Anderson was not a Romanov
- Later, the scientists compared Anna Anderson's mtDNA with that of Karl Maucher, a great nephew of Franziska Schanzkowska.
- The mtDNA could not be distinguished from the reference, supporting the theory put forth by a German investigator in the 1920s that Anna Anderson = Franziska Schanzkowska.
- A new grave not far from the first Romanov grave, was found 2007 and two additional bodies who were Romanov's – Coble et al 2009 PLOS one 4(3):e4838 – using mtDNA, autosomal STR and Y-STR testing
- STR = Short tandem repeat

Trace Evidence II

PAINT

GLASS

SOIL

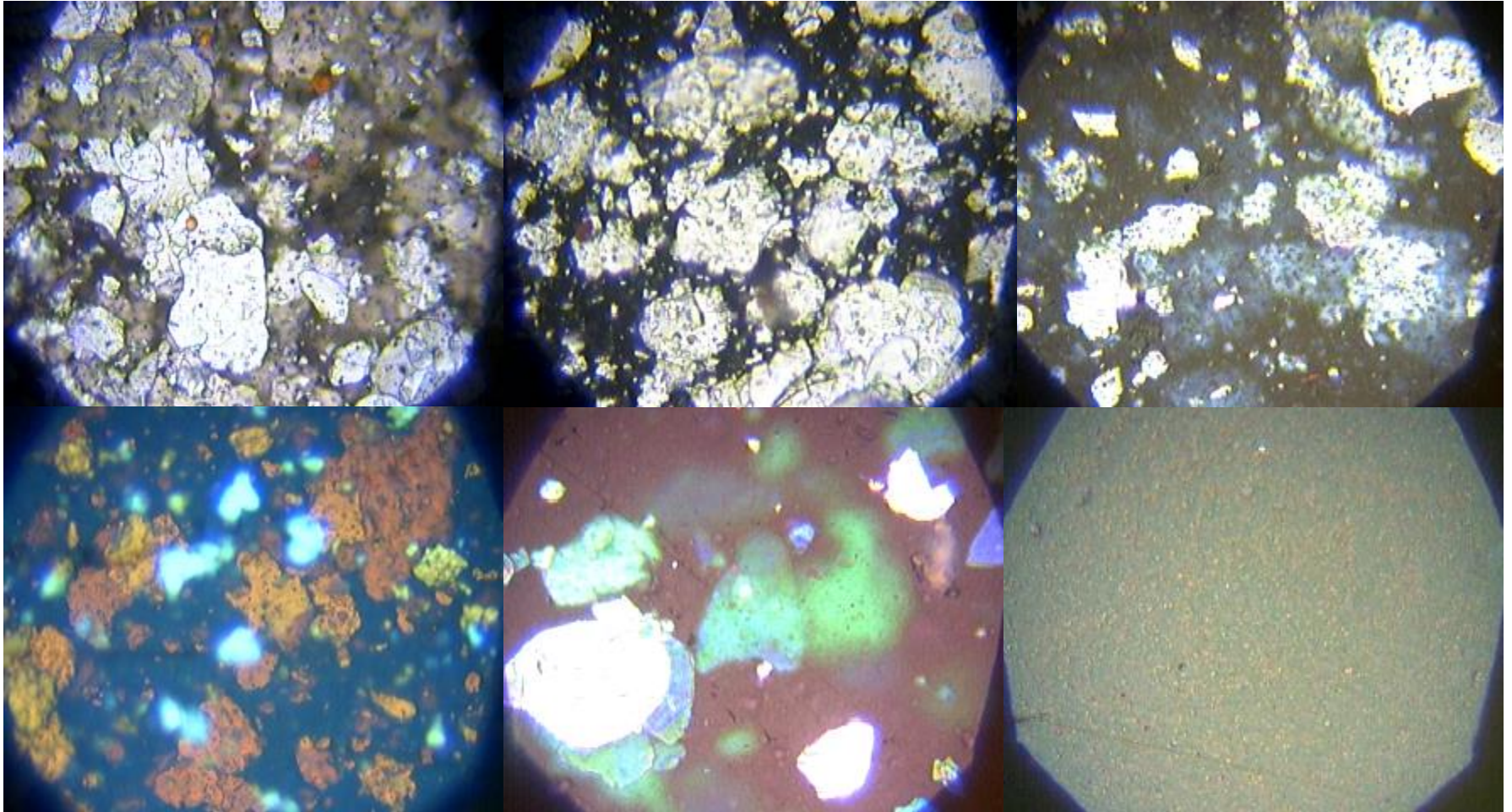
Paint

- ▶ Paint spread onto a surface will dry into a hard film that can best be described as consisting of pigments and additives suspended in the binder.
- ▶ One of the most common types of paint examined in the crime laboratory involves finishes emanating from automobiles.
- ▶ Automobile manufacturers normally apply a variety of coatings to the body of an automobile.
- ▶ These coatings may include electrocoat primer, primer surfacer, basecoat, and clearcoat.

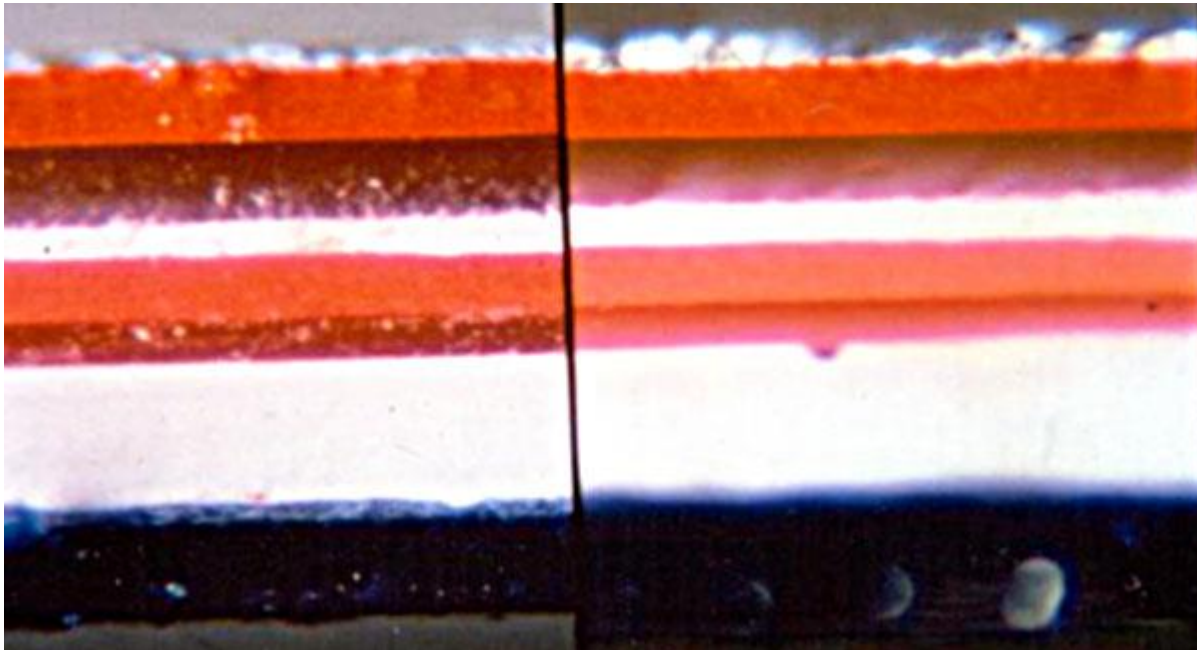
Methods for Paint Comparison

- The wide diversity of automotive paint contributes to the forensic significance of an automobile paint comparison.
- Questioned and known specimens are best compared side by side under a stereoscopic microscope for color, surface texture, and color layer sequence.
- Pyrolysis gas chromatography (GC) and infrared spectrophotometry are valuable techniques for distinguishing most paint binder formulations, adding further significance to a forensic paint comparison.

Paint Microscopy



Comparison Microscopy of Paint

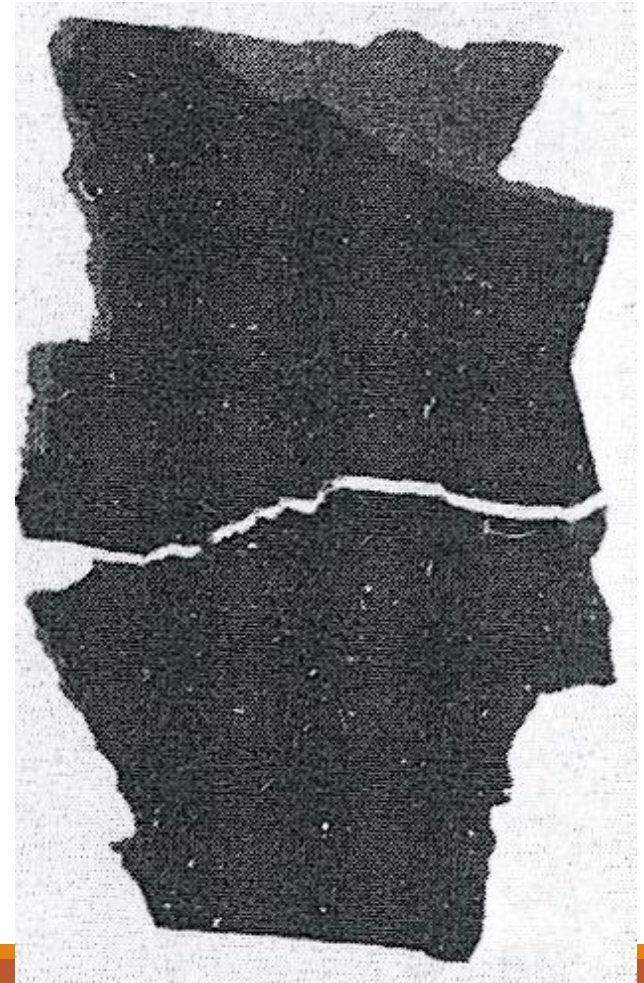


<http://www.forensicsciencesimplified.org/trace/how.html>

Examination of Paint

Morphological comparisons

- Piecing together the unknown paint chip with a reference



Methods for Paint Comparison

- Solid materials, such as paint, may be heated or pyrolyzed to high temperatures so that they will decompose into numerous gaseous products to flow through the Gas Chromatography (GC) column.
- Crime laboratories are often asked to identify the make and model of a car from a small amount of paint and will make use of color charts for automobile finishes or the PDQ database.

International Forensic Database

The International Forensic Automotive Paint Data Query (PDQ)

- Chemical and color information pertaining to original automotive paints
- Including the make, model, year and assembly plant of the vehicle
- Hosted by Canada, Contributors include:
 - RCMP
 - Provincial Forensic Laboratories in Ontario and Quebec
 - 40 American Forensic Laboratories
 - Police Agencies in 21 other countries

Collection and Preservation

- Paint chips are most likely found on or near persons or objects involved in hit-and-run incidents.
- Paper druggist folds and glass or plastic vials make excellent containers for paint.
- Paint smeared or embedded in garments or objects require the whole item to be packaged and sent to the laboratory.
- Uncontaminated standard/reference paint must always be collected.
- Tools used to gain entry into buildings or safes often contain traces of paint, requiring the tool be collected, along with reference paint samples.

Glass Fragments

Glass is a hard, brittle, amorphous substance that is composed of silicon oxides mixed with various metal oxides.

Amorphous solids have their atoms arranged randomly, unlike crystals.

Tempered glass is stronger than normal glass due to rapid heating and cooling.

Laminated glass found in car windshields has a layer of plastic between two pieces of ordinary window glass.

Glass Fragments

For the forensic scientist, the problem of glass comparison is one that depends on the need to find and measure those properties that will associate one glass fragment with another while minimizing or eliminating other sources.

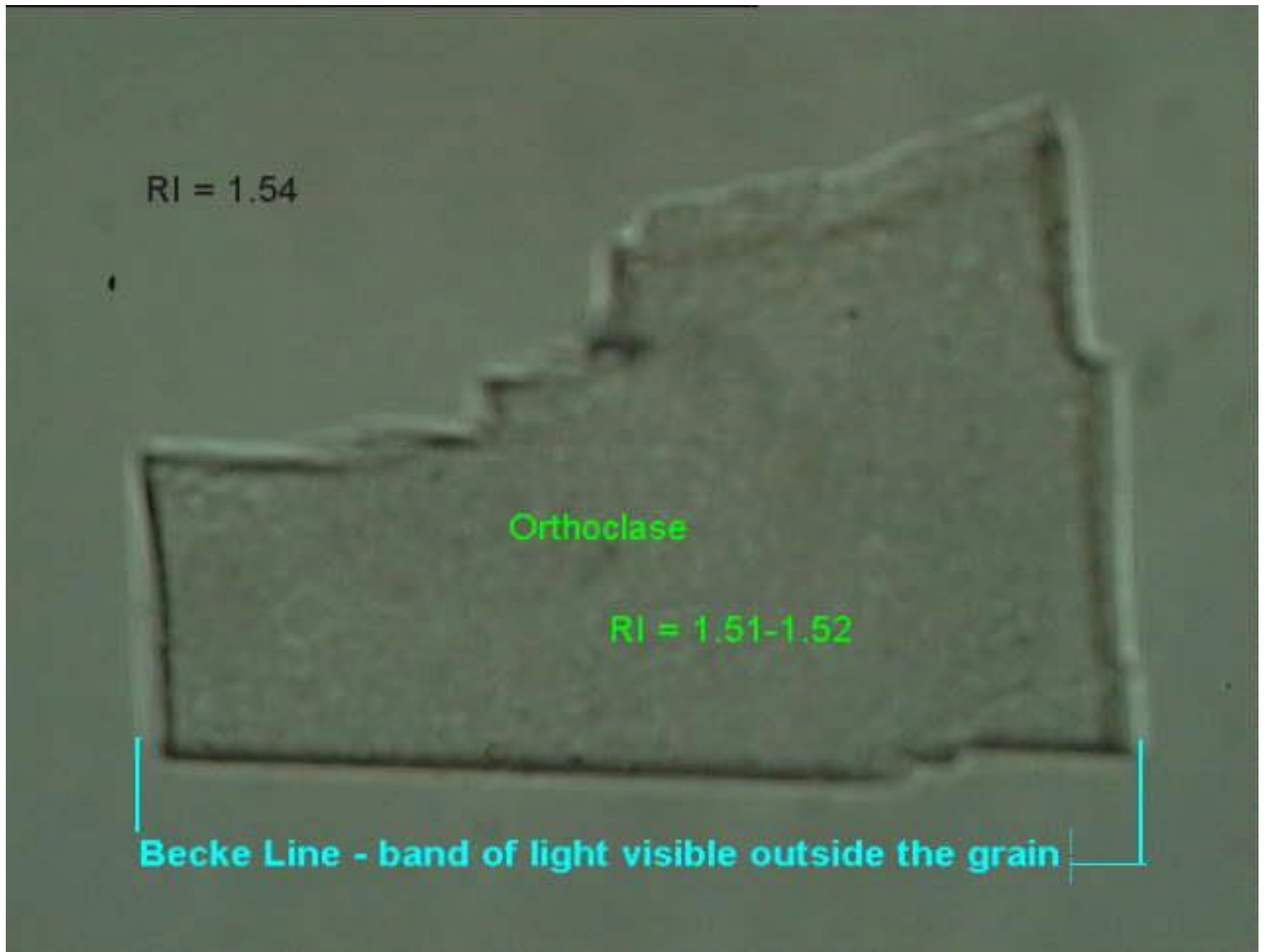
To compare glass fragments, a forensic scientist evaluates two important physical properties: density and refractive index.

Flotation Method

- The flotation method is a fairly precise and rapid method for comparing glass densities.
- In the flotation method, a glass particle is immersed in a liquid.
- The density of the liquid is carefully adjusted by the addition of small amounts of an appropriate liquid until the glass chip remains suspended in the liquid medium.
- At this point, the glass will have the same density as the liquid medium and can be compared to other relevant pieces of glass which will remain suspended, sink, or float.

Immersion Method

- ▶ The immersion method is best used to determine a glass fragment's refractive index.
- ▶ This method involves immersing a glass particle in a liquid medium whose refractive index is varied until it is equal to that of the glass particle.
- ▶ At this point, known as the match point, the Becke line disappears and minimum contrast between liquid and particle is observed.
- ▶ The Becke line is a bright halo near the border of a particle that is immersed in a liquid of a different refractive index.



Glass Refractive Index Measurement (GRIM)

- ▶ GRIM3 is an advanced tool that uses the refractive index temperature variation method
 - The glass is immersed in oil
 - The refractive index of the oil changes with temperature
 - The glass is visible when the refractive indexes are different
 - As the oil is heated to the same refractive index of the glass, the point at which the glass is no longer visible
 - A computer attached detects this change and, from the temperature of the oil, calculates the refractive index of the glass

Analyzing Cracks

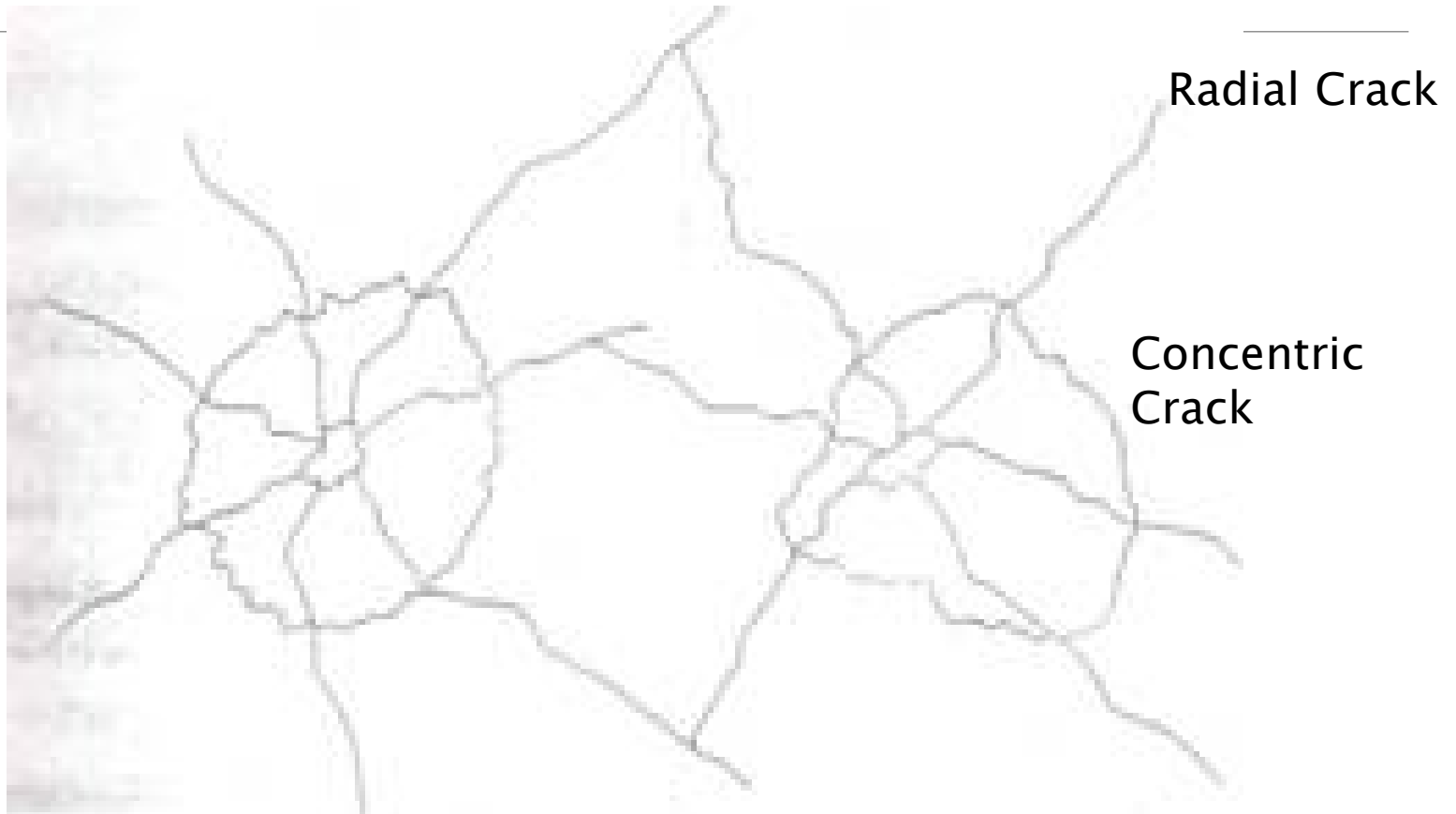
- The penetration of window glass by a projectile, whether it is a bullet or a stone, produces cracks which radiate outward (radial fractures) and encircle the hole (concentric fractures).
- By analyzing the radial and concentric fracture patterns in glass, the forensic scientist can determine the direction of impact.

Analyzing Cracks

- ▶ A high-velocity projectile such as a bullet often leaves a hole that is wider at the exit side, and hence its examination is important in determining the direction of impact.
- ▶ The direction of impact can also be accomplished by applying the 3R Rule: *Radial cracks form a Right angle on the Reverse side of the force.*
- ▶ The sequence of impacts when there have been successive penetrations of glass, is frequently possible to determine because a fracture always terminates at an existing line of fracture.

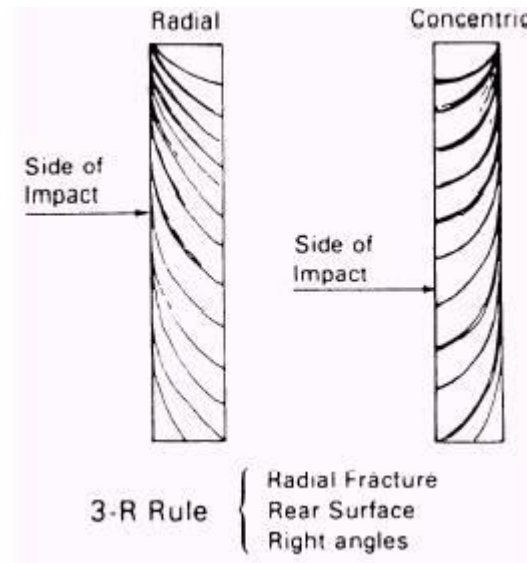


Two Bullet holes in Glass



<http://www.santoshraut.com/forensic/glass.fractures.htm>
And Fig 14-19 in Forensic Science by Saferstein

Determine which type of fracture you are looking at then apply the 3-R rule



<http://www.tpub.com/maa/189.htm>

Collection of Glass

If even the remotest possibility exists that glass fragments may be pieced together, every effort must be made to collect all the glass found.

When an individual fit is thought improbable, the evidence collector must submit all glass evidence found in the possession of the suspect along with a representative sample of broken glass remaining at the crime scene.

Collection of Glass

The glass fragments should be packaged in solid containers to avoid further breakage.

If the suspect's shoes and/or clothing are to be examined for the presence of glass fragments, they should be individually wrapped in paper and transmitted to the laboratory.

Soil

- ▶ The value of soil as evidence rests with its prevalence at crime scenes and its transferability between the scene and the criminal.
- ▶ Most soils can be differentiated by their gross appearance.
- ▶ A side-by-side visual comparison of the color and texture of soil specimens is easy to perform and provides a sensitive property for distinguishing soils that originate from different locations.

Comparison of Soil

- In many forensic laboratories, forensic geologists will characterize and compare the mineral content of soils.
- Considering the vast variety of minerals and rocks and the possible presence of artificial debris in soil, the forensic geologist is presented with many points of comparison between two or more specimens.
- Metagenomics – microbial fingerprints

Collection of Soil

- ▶ Standard /reference soils are to be collected at various intervals within a 100-yard radius of the crime scene, as well as the site of the crime, for comparison to the questioned soil.
- ▶ Soil found on the suspect, such as adhering to a shoe or garments, must not be removed.
- ▶ Instead, each object should be individually wrapped in paper, and transmitted to the laboratory.

Review

- ▶ Review of last trace evidence lecture
 - Mitochondrial DNA
- ▶ Hair DNA and a Russian Grand Duchess
 - Russian revolutions, relatedness of the royal families, mtDNA
- ▶ Other major types of trace evidence
 - Paint – automobile, pyrolysis and GC, PDQ
 - Glass – different types, density and refractive index
 - Soil – distinguished based on colour, texture, mineral content etc
- ▶ Methods of collection