Now You See It, Now You Don't:

Harness the power of coaxial illumination and direct reflectance

Erik S. Malz, CLPE, CCSA

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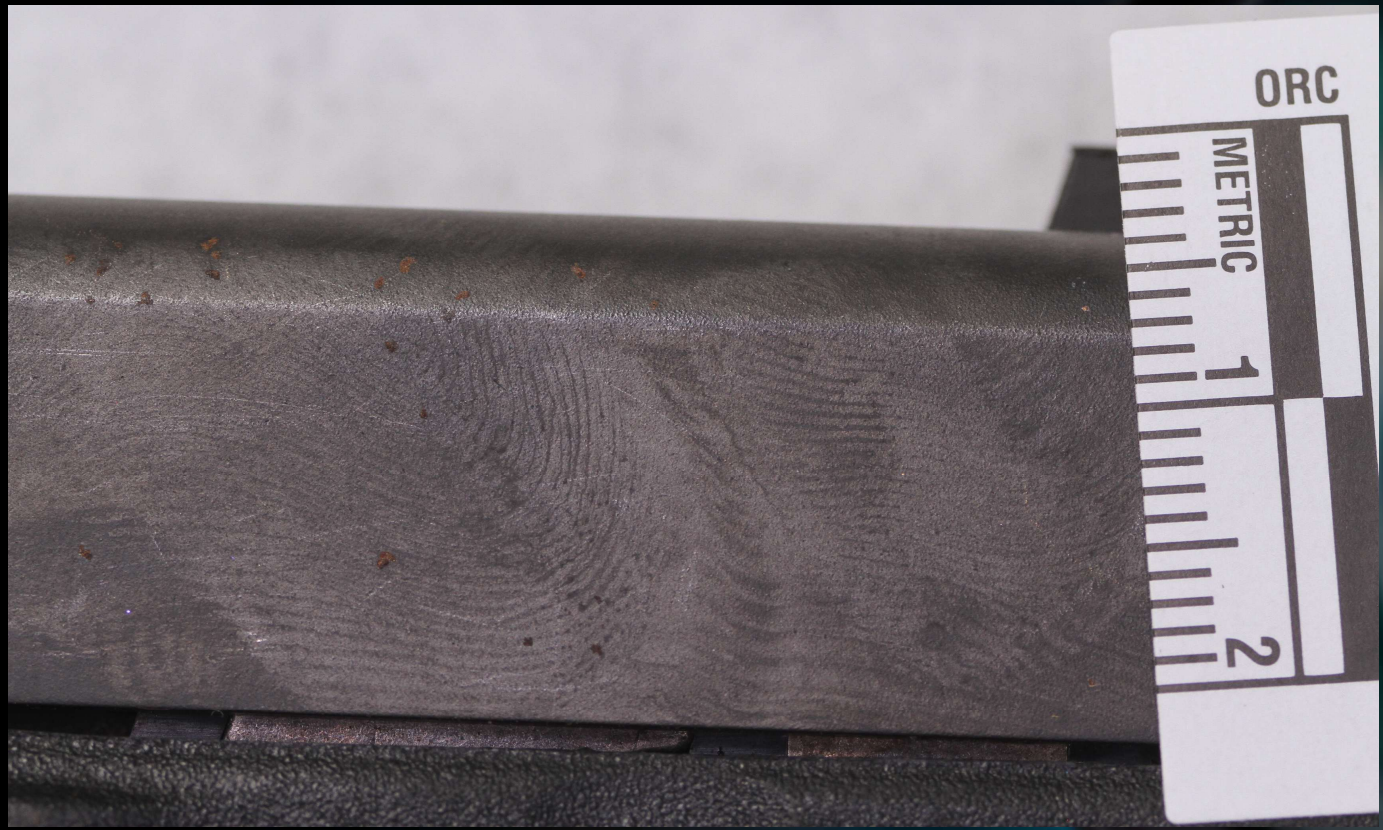
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Lecture Summary

- Interactions of light and matter and how those differences can be leveraged to create contrast.
- What scenarios direct reflectance and coaxial illumination can be useful (and when it is not).
- Direct reflectance (AKA soft specular illumination).
- Coaxial illumination: how to achieve, equipment needed, tips for success.
- How to use these powerful techniques to improve your laboratory photography and how they can be utilized in the field using limited resources.

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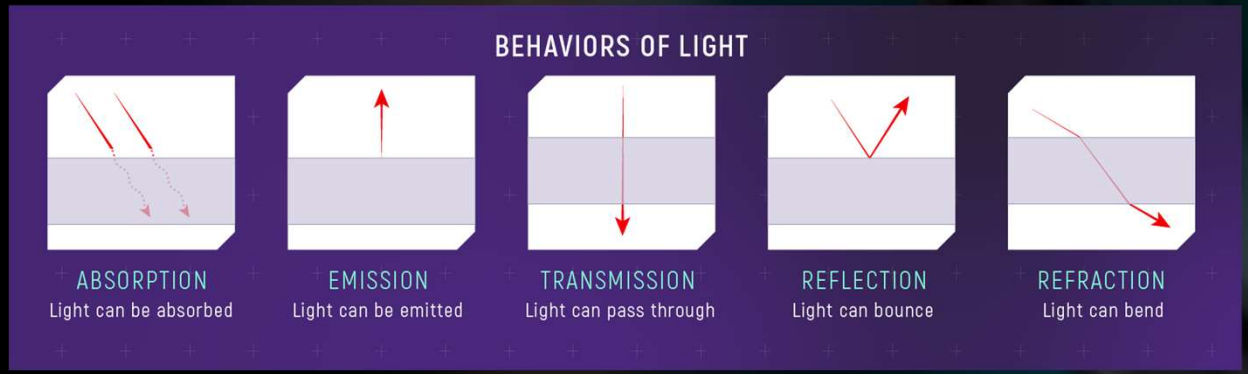
Interactions of Light and Matter

- Light will interact with the matter that makes up the world all around us in many different ways.
- Different materials will interact with different wavelengths of light in different ways.



Interactions of Light and Matter

The way light interacts with matter depends on the properties of both the material and the light:

- Absorption
- Reflection
- Transmission
- Refraction
- Scattering
- Emission

Interactions of Light and Matter

Light properties

- Intensity of light
- Wavelength of light
- Angle of incidence (angle of light at it relates to surface)

Material properties

- Color of material
- Makeup of material
- Texture of material

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A common problem

- Have you ever encountered evidence where latent (untreated) impressions were visible when the light is held at just the right angle, but quickly disappear when you try to photograph them?
- These prints are nearly impossible to properly photograph using traditional lighting techniques like oblique lighting or diffused lighting.
- Direct reflectance or coaxial illumination is often the solution!

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Why is this important?

- The ways that light interacts with different materials can be used to create contrast.
- Especially important for latent fingermarks are difficult to see or when processing method used creates low-contrast impressions.
- Latent impressions should be photographed pre-development, if visible.
- Photographs should be taken between each steps of the processing sequence.
- It is possible for prints to be destroyed/obscured during processing (examples to follow).

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Why it works?

- Both direct reflectance and coaxial lighting rely on the principles of reflection and scattering.
- Smooth and flat background substrates evenly reflect light from the source back towards the camera (or photographer).
- Most latent print matrices (oils, moisture, minerals, blood, and other contaminates) will scatter light in random directions, instead of reflecting it back to the camera.
- The difference in how light will interact with these two materials create contrast that can be made visible.

Direct Reflectance

- Direct reflectance is a specialized photographic technique in which the evidence is placed at an angle under the camera and the light source is angled so that it reflects off the surface.
- Also known as “soft specular illumination”.
- Direct reflectance will only work on flat surfaces.
- Curved evidence will not reflect light evenly.
- The evidence must also be smooth.
- Surfaces with texture will scatter the light instead of reflecting it.
- The smoother the surface, the better the technique will work.
- Direct reflectance will “drop out” or mute background colors or patterns. This technique works well on substrates with busy backgrounds.

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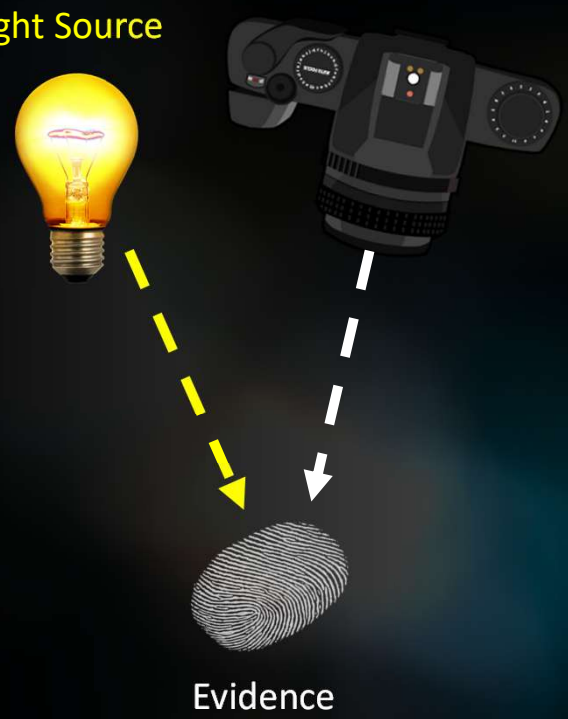
Direct Reflectance



Direct Reflectance

- The background surface will evenly reflect the light back to the camera, while the matrix of the impression will scatter the light.
- The result is a dark colored impression on a light-colored background.
- Due to the complex polymer structure created by cyanoacrylate fuming, impressions post-processing can also be photographed using direct reflectance.
- Because the technique relies on reflection, background colors or patterns will be muted or eliminated completely.

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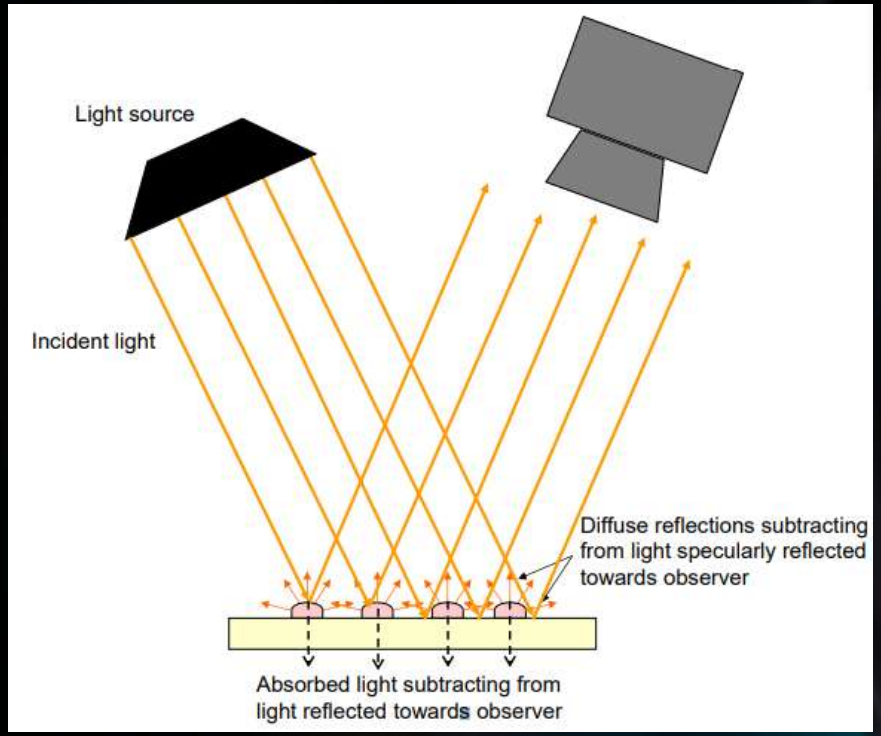
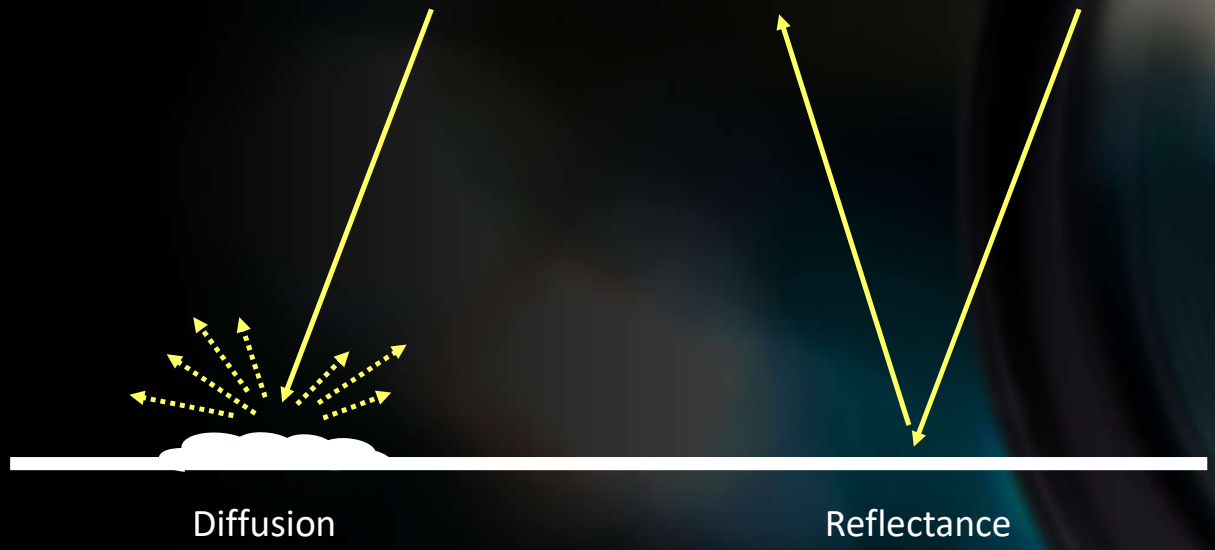
Direct Reflectance



Via the Fingerprint Source Book (U.K.)

Direct Reflectance



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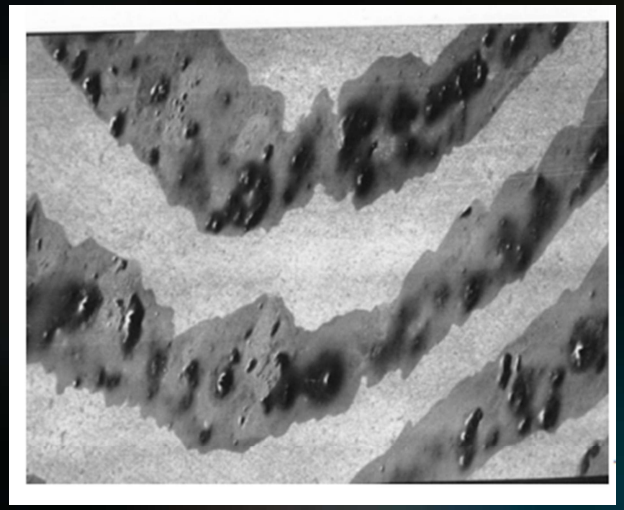
Direct Reflectance



Latent fingerprint residue under scanning electron microscope, via U.K. Home Office

Direct Reflectance

Cyanoacrylate polymer structure under microscope, via U.K. Home Office

Direct Reflectance

The technique will only work for flat, smooth surfaces.

The more reflective the surface is, the better the effect works.

Curved or textured surfaces will not evenly reflect the light to the camera.

Textured surfaces scatter light, instead of reflecting it.

Direct Reflectance

Using a traditional copy stand and light, the evidence must be placed at a slight angle on the copy stand, directly below the camera.

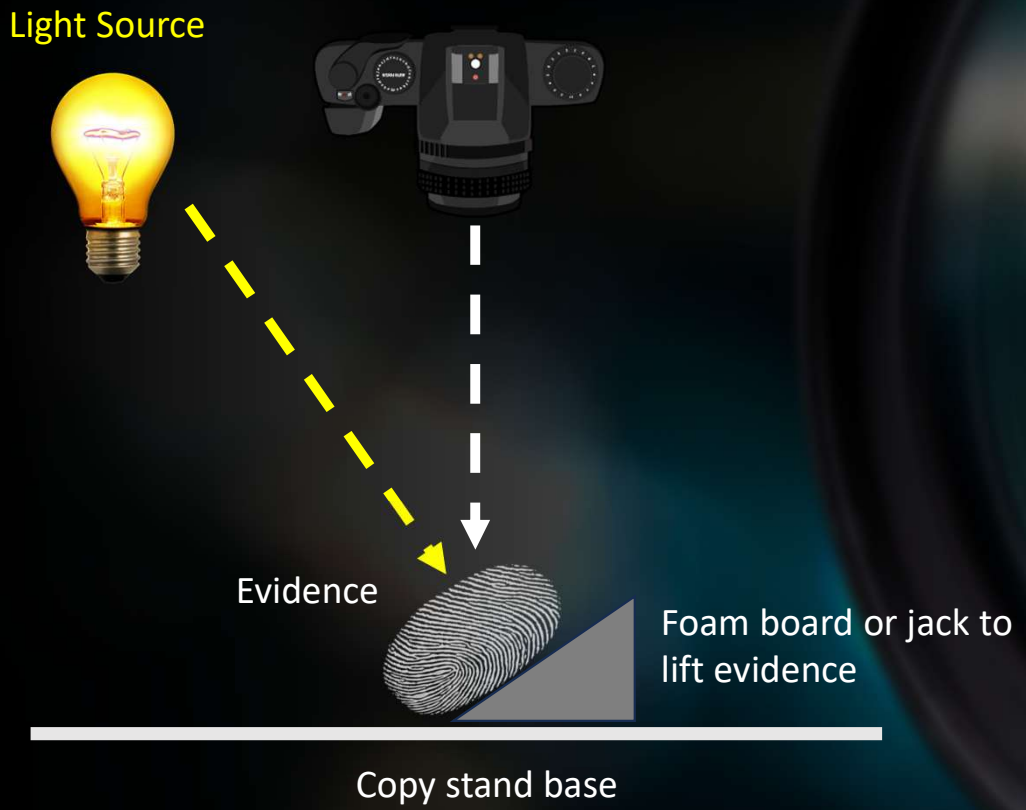
A light is placed at a high angle and moved until an even reflection is achieved.

A single source of light should be used.

Direct Reflectance

- Evidence should be placed on the copy stand base directly under the camera.
- Place two scales (or one L-scale) along two axes of the impression.
- Evidence is tilted at approximately a 10-degree angle using foam board or other material.
- Light source is placed at a high angle next to the camera, on the same side as the evidence is angled.
- Adjust angle of evidence or light source as needed.

Direct Reflectance

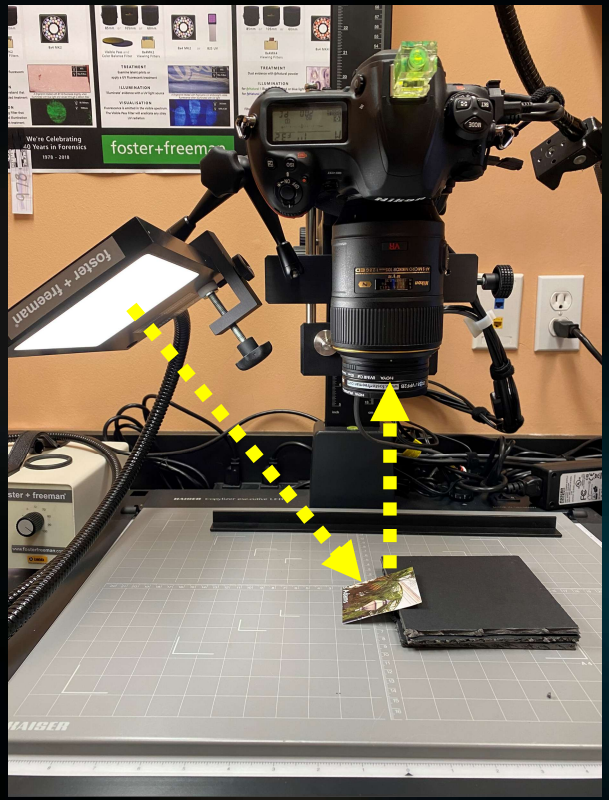


Direct Reflectance

Light Source

Evidence

Direct Reflectance



Direct Reflectance

Ridges appear dark because the matrix scatters light in different directions, instead of back to the camera.

Background appears light due to even reflection of the light off the substrate to the camera.

Unprocessed latent print on glossy paper

Direct Reflectance

- Use a very diffused and even light.
- A light source which has adjustable output is best.
- Handhold the light to get the correct angle of incidence before securing it with an arm.
- The best angle for the evidence is directly related to the angle of the light.
- Use manual exposure and manual focus settings.
- Use an appropriate aperture to gain depth of field.
- Eliminate competing light from overhead lights, windows, and other light sources.
- Try to get the impression right in the middle of the “hot spot” of the light.
- Once the correct angle is achieved, the impression will appear dark on a light background.

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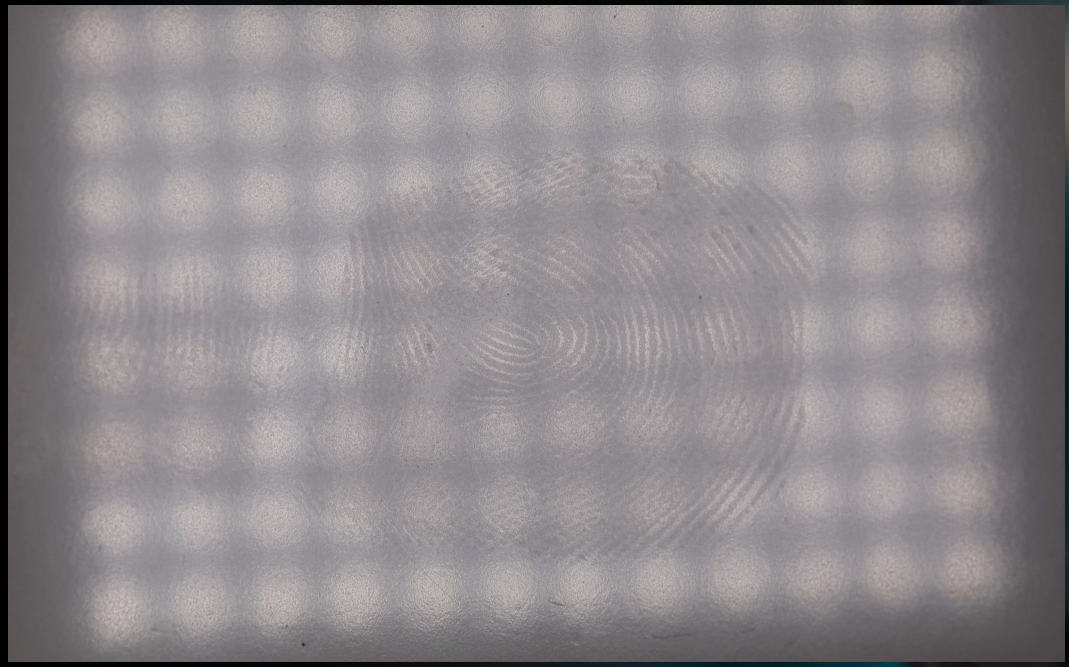
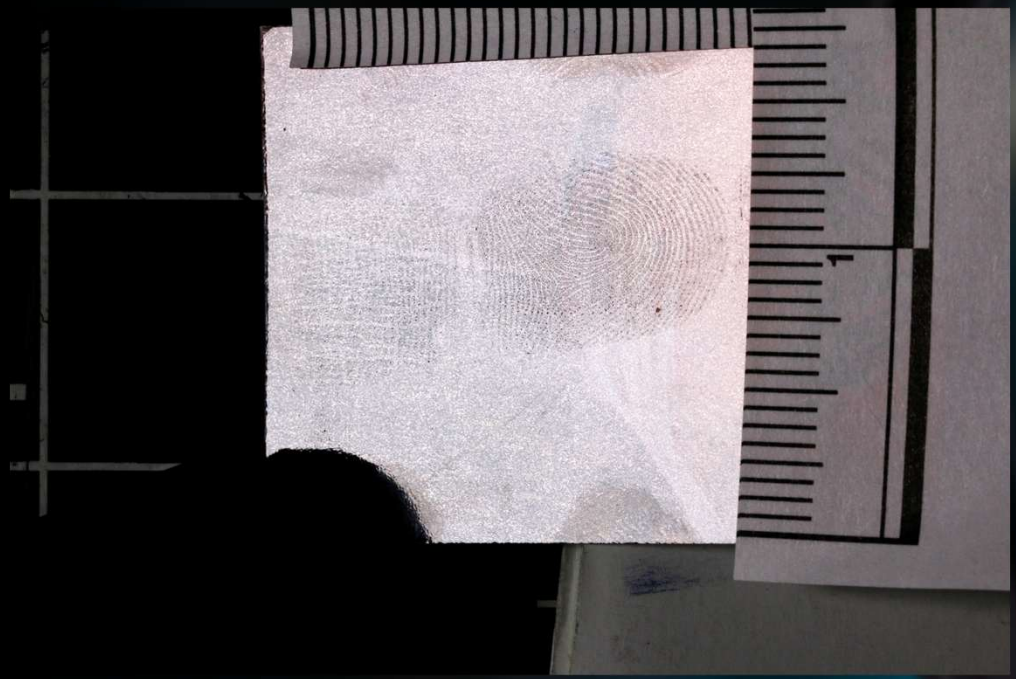
Direct Reflectance



Light is not diffused enough causing hot spots at each LED on the light panel

Direct Reflectance



Correct application of direct reflectance.
Reflection from light source is even.

Direct Reflectance

- It can often be very difficult to get the correct angle of the evidence and the light source.
- The quality of the light matters. Light should be diffused, even, and bright.
- Tilting the evidence introduces several problems.
- Depth of field should be taken into consideration.
- Maximize depth of field by using a shorter focal length and increasing aperture.
- Perspective distortion is introduced due to the angle of the evidence.

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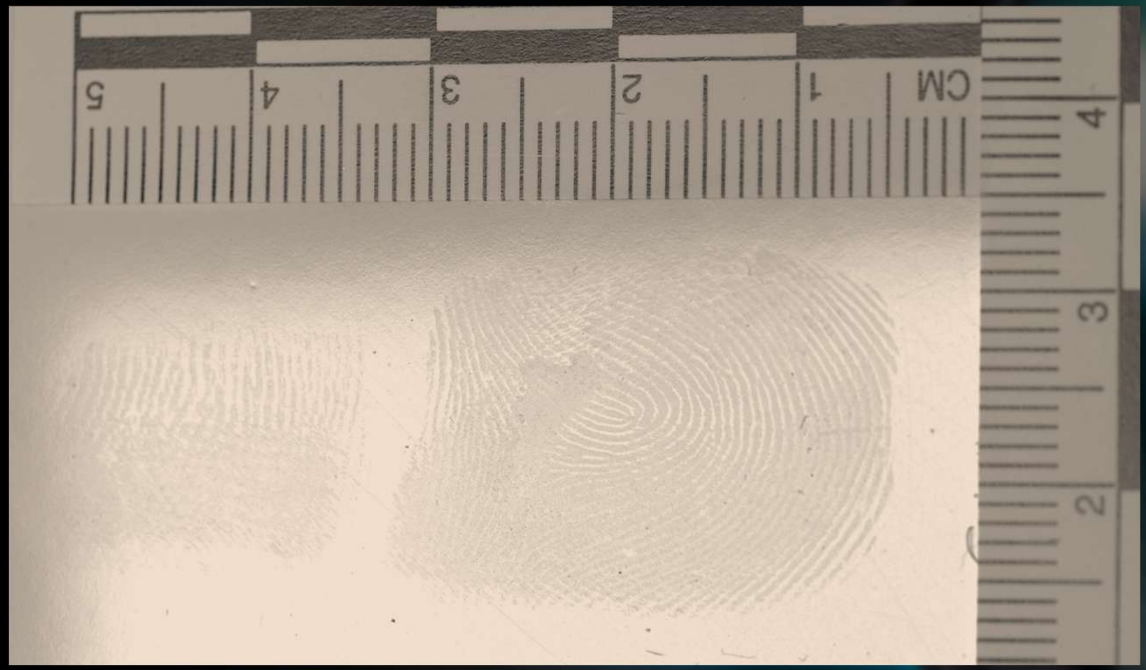
Direct Reflectance



Perspective distortion caused by the evidence being at an angle makes the portion of the print furthest from the camera appear smaller than the portion closer to the camera.

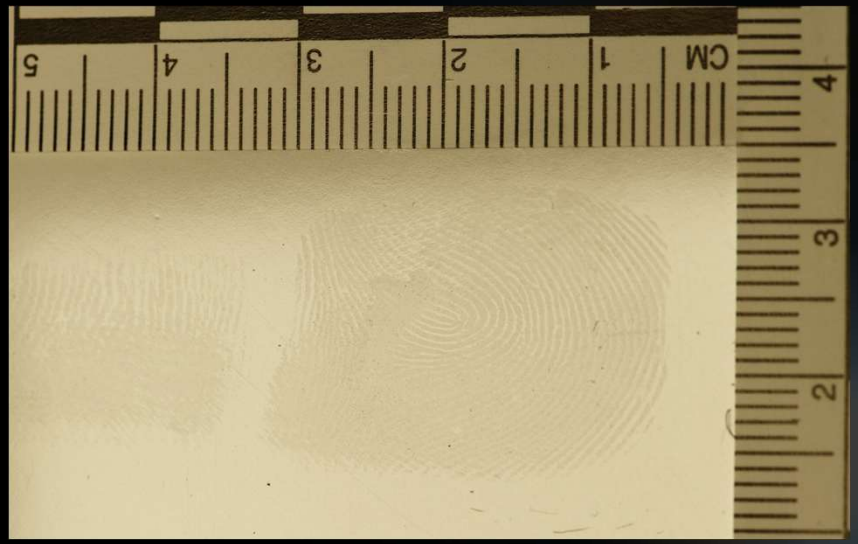
Direct Reflectance

- Perspective distortion makes a portion of the print (further from the camera) appear smaller than other portions.
- This can sometimes cause issues during comparison, especially when entering prints into AFIS.
- Perspective distortion can be corrected in Photoshop.
- Angle should be minimized as much as possible when capturing the impression.
- Two scales should be used (or one L-scale). One side should be along the axis angling away from the camera.

Direct Reflectance

A tilt-shift lens can also be employed to reduce distortion and achieve greater depth of field than what would be expected from a traditional macro lens.

Direct Reflectance



Before perspective correction

After perspective correction

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Direct Reflectance

Latent print on revolver frame

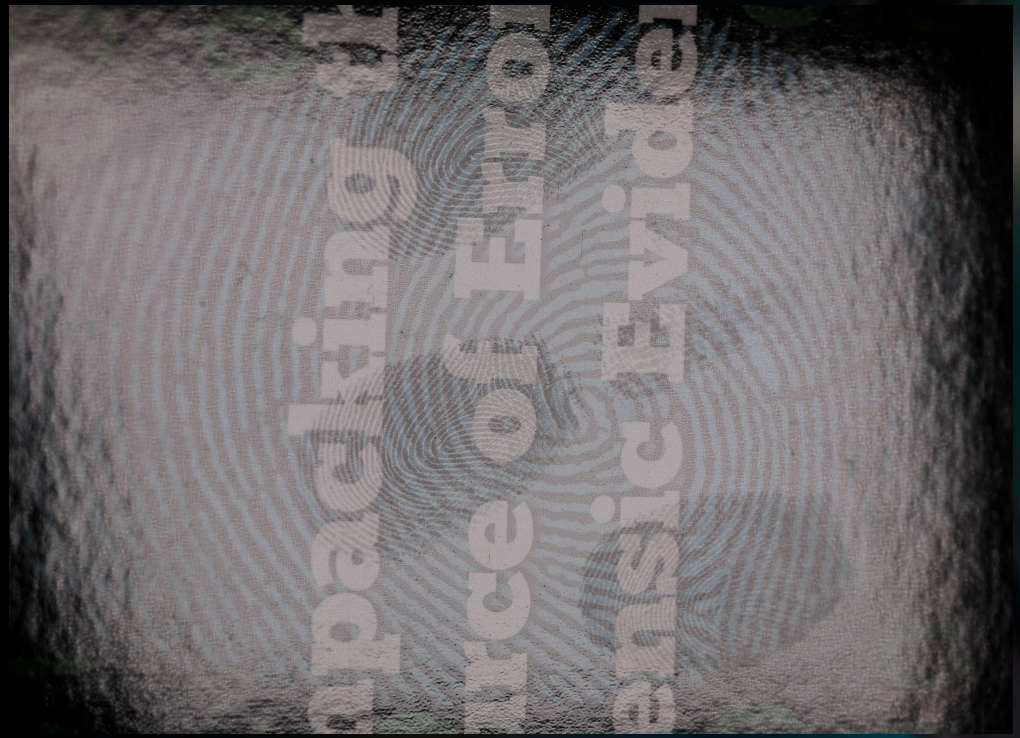
Direct Reflectance

Latent print on revolver frame

Direct Reflectance

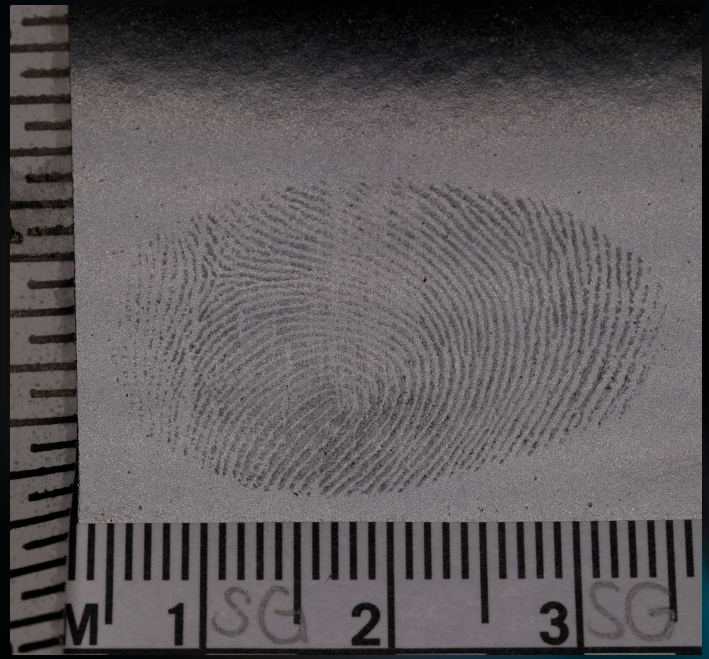
Latent print on knife blade

Direct Reflectance



Latent prints on magazine cover

Direct Reflectance

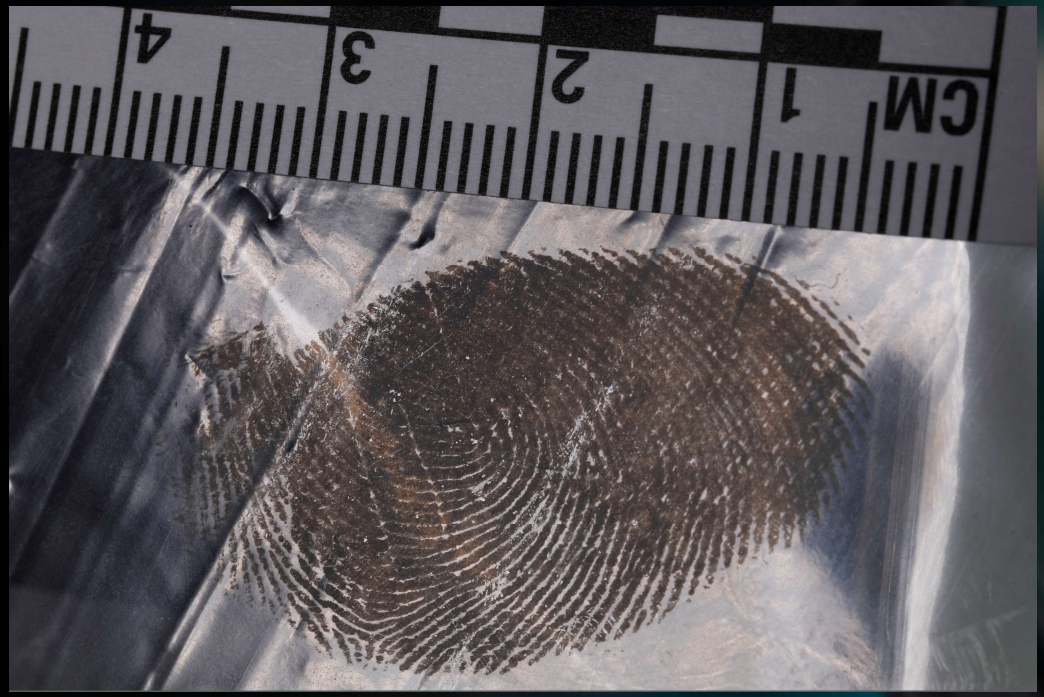


Print developed with black fingerprint powder on black cardstock

Direct Reflectance

Print developed with CA glue

Direct Reflectance



Print developed with CA glue on plastic zip bag

Coaxial Illumination

Coaxial illumination is a variation on soft specular lighting.

A semi silvered mirror or piece of glass is placed at an angle between the camera and evidence.

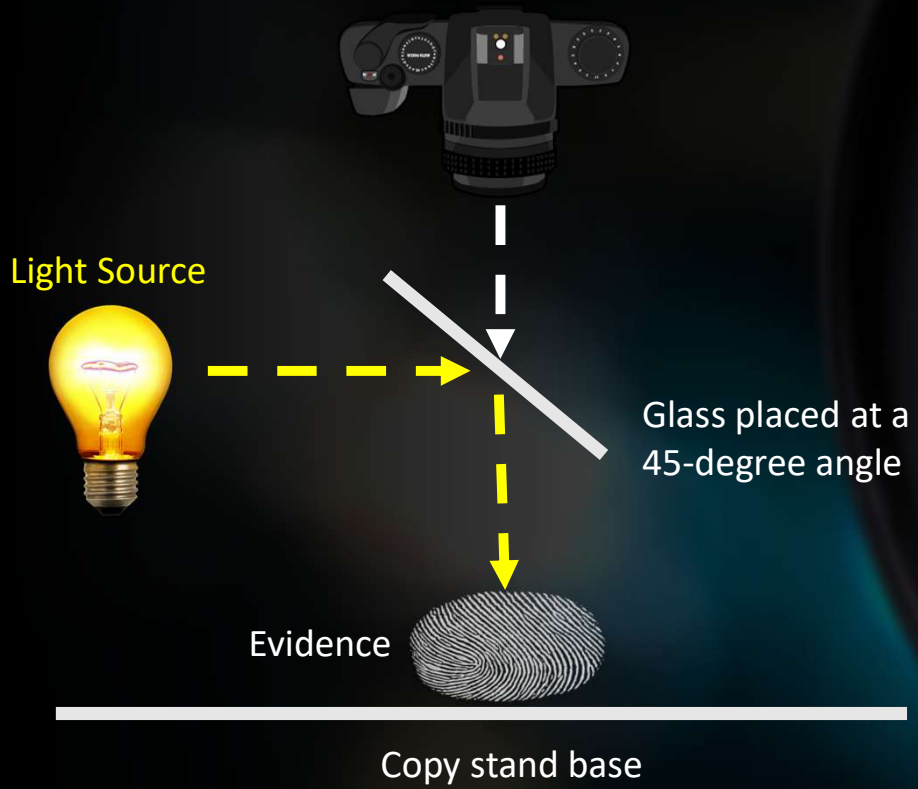
The glass will reflect the light directly down towards the evidence.

Coaxial Illumination

Relies on the same principles of reflectance and scattering of the light as direct reflectance.

Evidence may be placed flat on the copy stand eliminating perspective distortion and photographs that require correction.

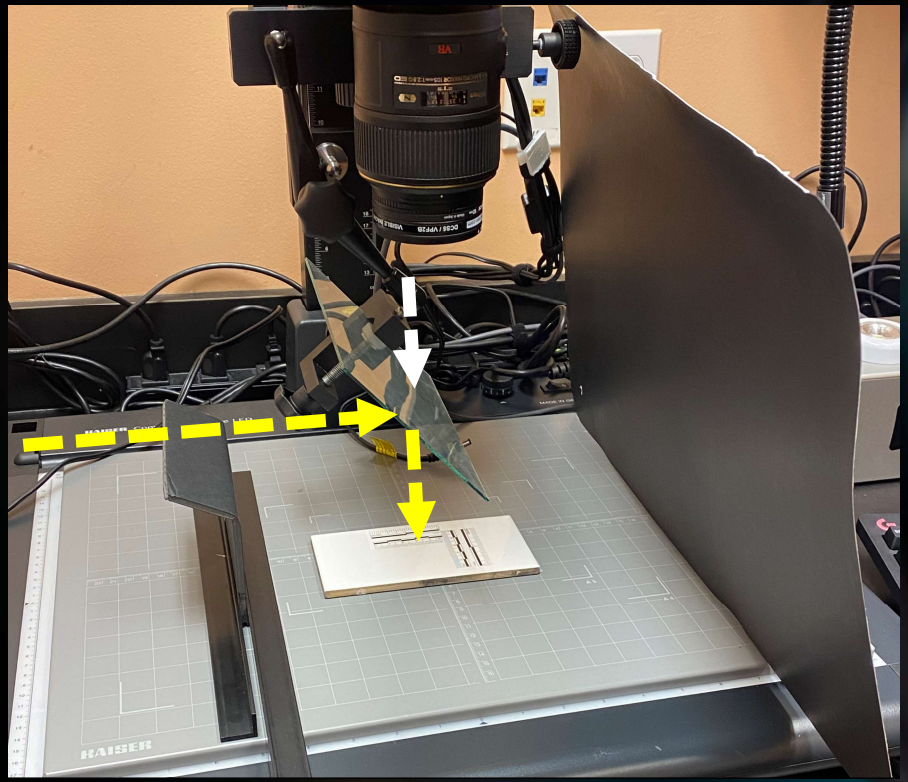
Coaxial Illumination



Coaxial Illumination

Traditional coaxial illumination

Coaxial Illumination



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Coaxial Illumination

- Use macro lens with longer focal length in order to fill the frame, while also having plenty of space to place reflector.
- Reflector can be fashioned from a thin sheet of picture frame glass.
- Light source should be even and bright.
- Place light source further from reflector than you would think is appropriate.

Coaxial Illumination

- Any light except the light bouncing off the reflector should be eliminated.
- Turn off all lab lights (dark environment).
- Opaque baffle placed low between light source and reflector blocks all light traveling directly from light source to evidence.
- Black card or fabric will “catch” the light that passes through the glass reflectors to prevent it bouncing off walls and back towards evidence.

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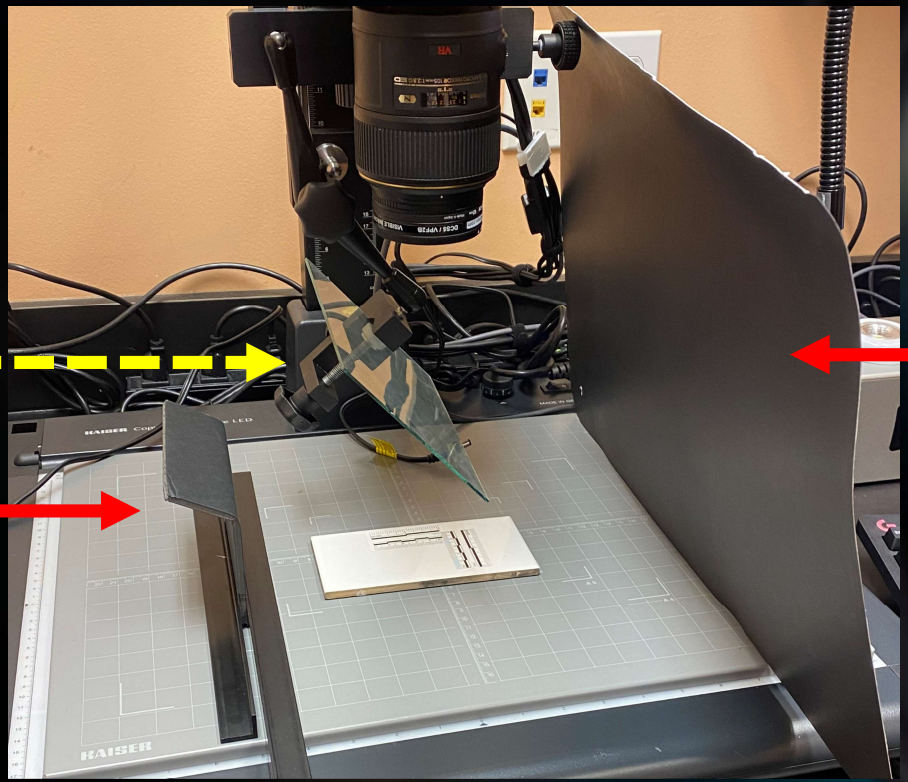
Coaxial Illumination

Direction of light

Baffle to prevent light from striking surface directly from light source



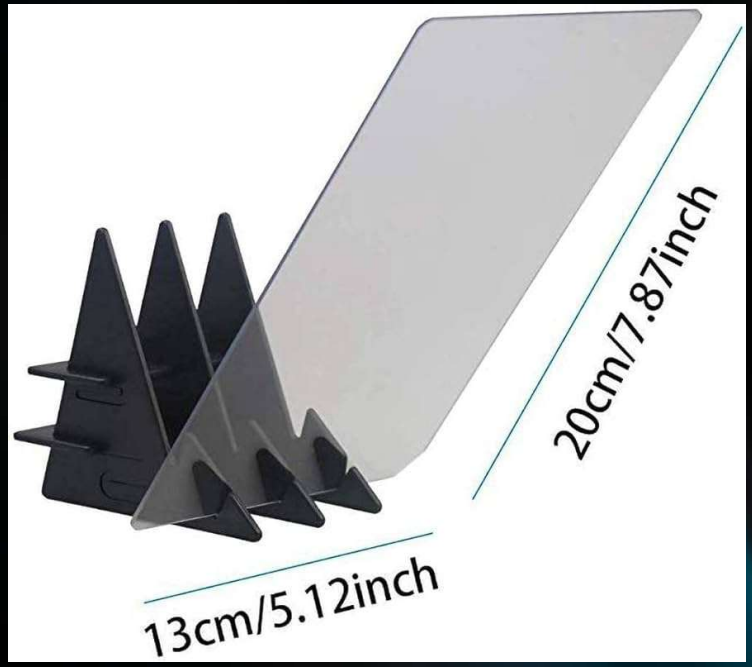
Black card or fabric sheet to catch light passing through glass and prevent it from bouncing off lab walls

Traditional coaxial illumination

Coaxial Illumination

Unprocessed latent print on ceramic tile taken using traditional coaxial illumination

Coaxial Illumination



“Portable drawing board sketching tool” – via Amazon

Coaxial Illumination

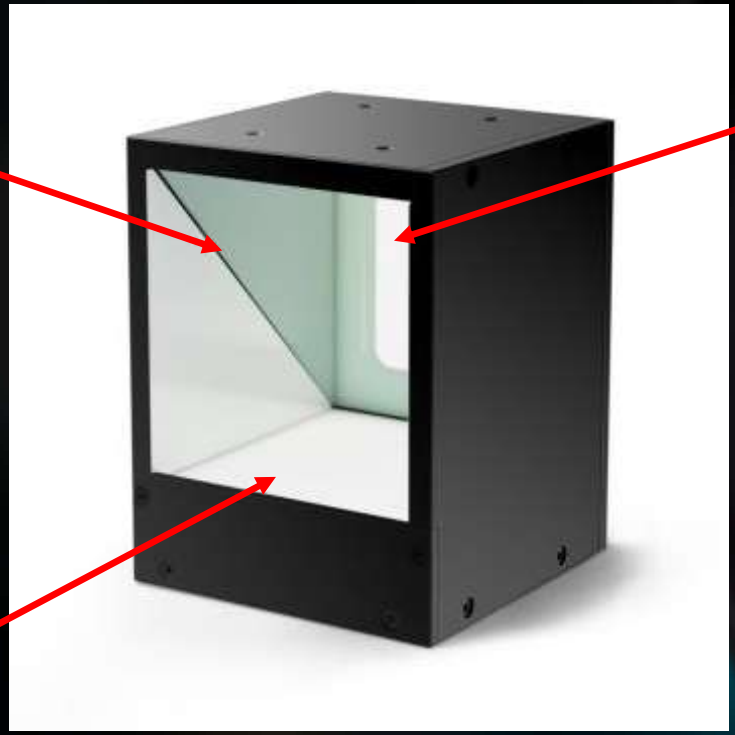
A coaxial light box simplifies the process of creating coaxial illumination.

The box contains a light source (or light guide) and a semi-silvered mirror placed at a 45-degree angle that will reflect light towards the evidence.

The box is placed between the evidence and the camera lens.

Coaxial Illumination

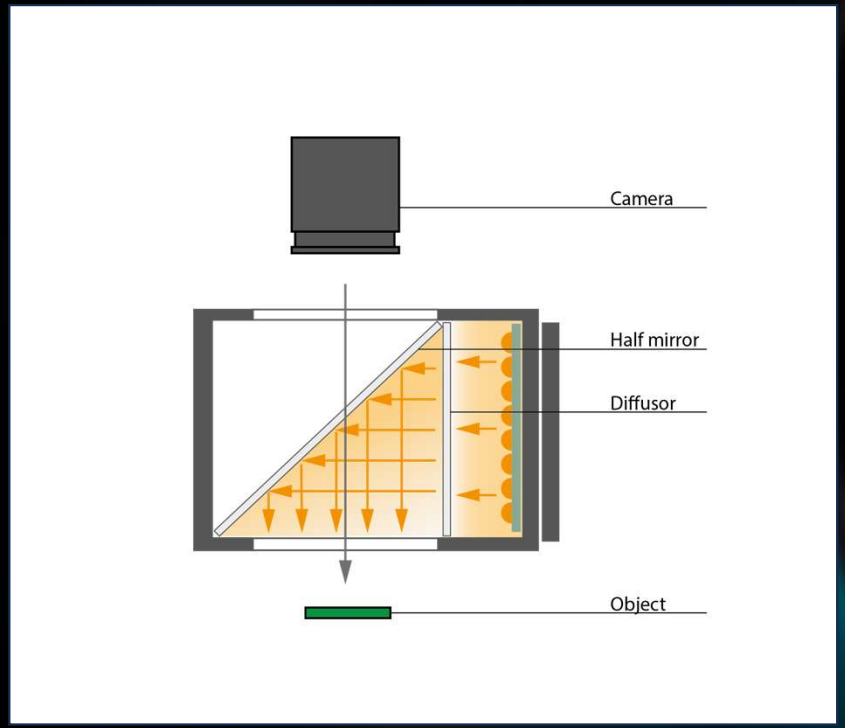
One-way mirror at 45-degrees



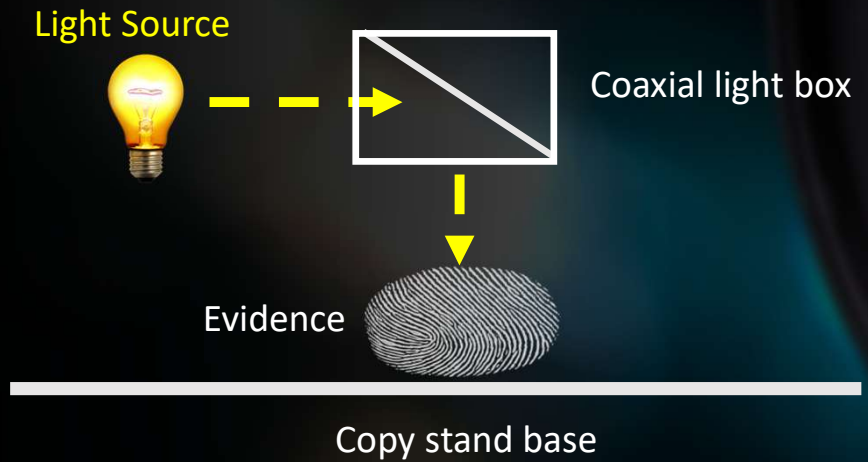
Opening for camera lens

Diffused light source

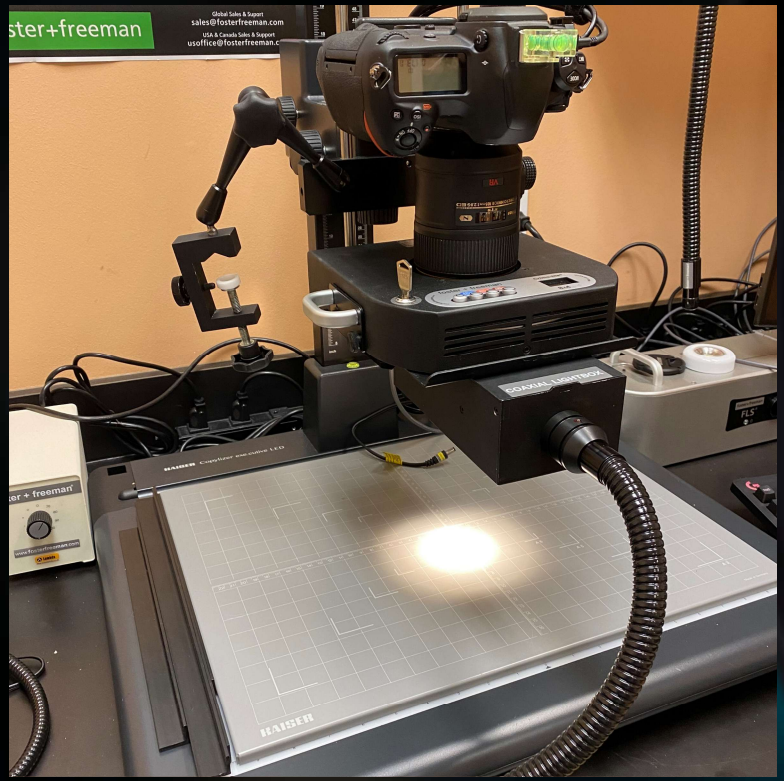
Coaxial Illumination



Coaxial Illumination

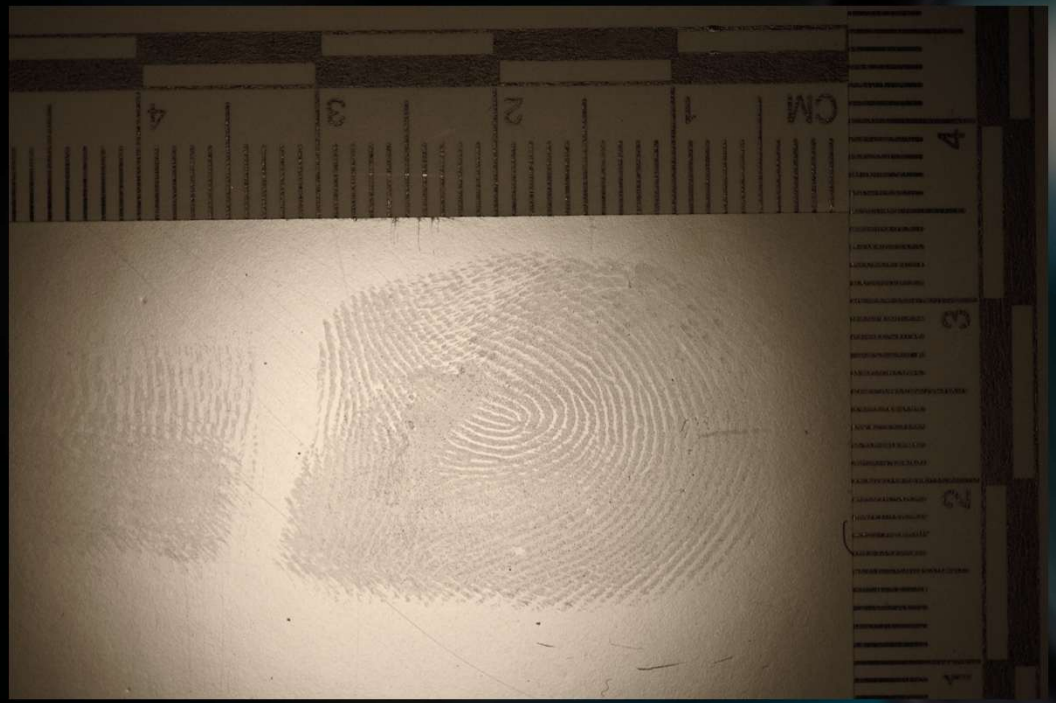


Coaxial Illumination



Coaxial light box with DCS-5 camera

Coaxial Illumination



Latent print on white subway tile

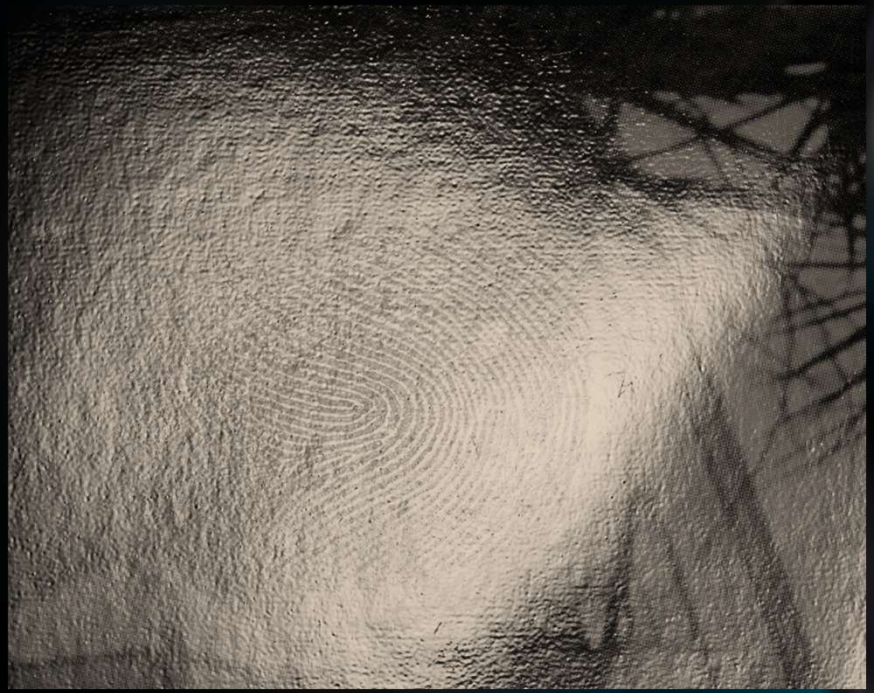
Coaxial Illumination

Latent print on mirror

Coaxial Illumination

Latent print on butter knife

Coaxial Illumination

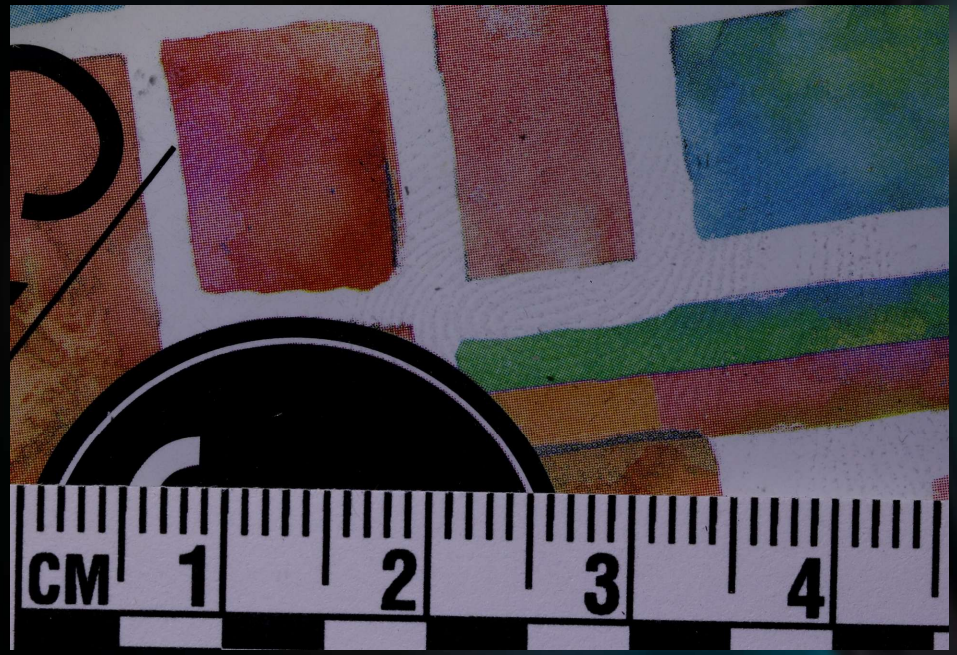


Latent print on glossy photo paper

Coaxial Illumination

Latent print on cell phone screen

Coaxial Illumination



(Untreated) latent print on picture frame glass –
Before coaxial illumination

Coaxial Illumination

(Untreated) latent print on picture frame glass – Coaxial illumination

Field Application

Direct reflectance and coaxial illumination are not just reserved for photography conducted in a laboratory.

Can be performed in the field even with limited resources.

Helpful for photographing latent prints on windows, mirrors, counters, and some painted surfaces prior to processing and collection.

Portable, self-contained coaxial light boxes are also available for field use.

Tripod and light source to provide even illumination is necessary.

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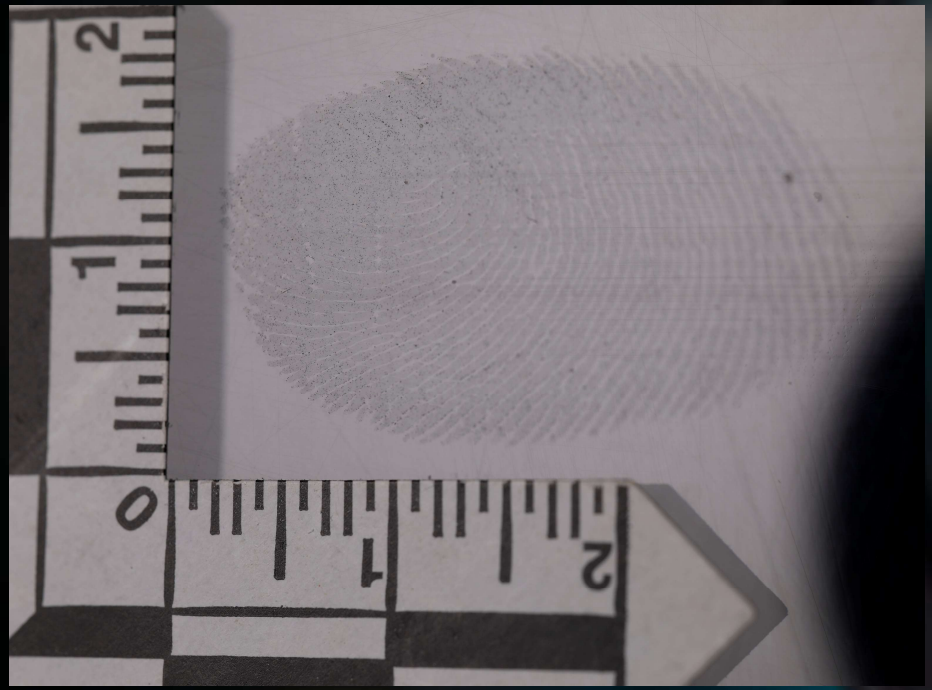
Field Application

Camera and tripod setup for photographing unprocessed latent print on window

Field Application



Unprocessed latent print on window

Field Application

Foster+Freeman Crimelite Auto with attachable coaxial light box for field application

Questions?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