Fluorescein Techniques for Enhancing Bloody Fingerprints

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ABSTRACT: The use of Fluorescein in the detection of blood-transferred latent fingerprints using an Ethanol based solution of Fluorescein, and cyanoacrylate fuming.

KEYWORDS: latent fingerprints, criminalistics, fingerprint identification, bloody fingerprints, latent blood staining, Fluorescein, superglue, cyanoacrylate, alternate light source, photographing latent fingerprints.

INTRODUCTION:

In the course of criminal investigation, blood evidence is becoming more and more significant. With the advances in DNA analysis, Bloodstain Pattern Interpretation, and Fingerprint technologies, the collection, documentation and preservation of this liquid body tissue is becoming more important than ever. With the introduction of Fluorescein, a presumptive blood detection chemical, unexplored areas of criminal investigations are now becoming a gold mind of information. For example, areas where blood has been cleaned from a surface can now be made evident. Detecting a visible area of high velocity impact staining with the ability to document has not only become possible, but it can be done with minimal effort. Transferred footwear impressions can now be located with a very dilute layer of blood, and now blood transferred fingerprints can be obtained and photographed on surfaces that may very well be overlooked. All of this is possible and will not interfere with DNA testing.

By no means should Luminol, LCV, Amino Black or any other blood presumptive chemicals be put on the back shelf. All of these are highly effective chemicals and will always be needed in their own place and time. As a trained investigator, it will be up to your discretion to make this determination.

Fluorescin is the reduced form of *Fluorescein*. Fluorescein is soluble in alkali hydroxides and carbonates at room temperature and exhibits an intense green fluorescence. *(Sourcebook in Forensic Serology, Immunology, and Biochemistry, U.S. Department of Justice, National Institute of Justice, 6.6.13 Fluorescin.)*

With Fluorescein being a presumptive test for blood, there are several items that were previously tested that will result in false/positives. Some of the most common are brass and iron. When the target area is sprayed with the Fluorescein, the blood associated proteins, and iron ions found in the hemoglobin molecule will fluoresce when examined with an alternate light source (ALS). Some of the other items that were tested and resulted in a false/positive reaction

were tomato products such as catsup and tomato sauce, horseradish, motor oils and others. A list of additional items tested can be obtained from the author.

Safety Precautions:

Read the appropriate MSDS information on all chemicals. Zinc can be dangerous when it is wet. It can spontaneously combust causing a fire or explosion. Dispose of used zinc in a prescribed manner. Cyanoacrylate fuming (superglue fuming) can produce cyanide gases. Ensure that you are working in a well-ventilated area.

Materials and Methods:

The application of Fluorescein is a two step procedure consisting of a working solution and oversprays or rinse solution. This chemistry can be mixed in the lab or in the field with little effort.

Working Solution:

- **Fluorescein (Sigma 6377)**
- **Ethanol (Fisher A407-4)**
- **Zinc Dust (Fisher Z5-500)**
- **Glacial Acetic Acid (Fisher BP1185-500)**

The working solution is a combination of 0.021 grams of Fluorescein, 15 mLs Ethanol, 2.5 grams of powdered zinc & 0.8 mLs of Glacial Acetic Acid, mixed in a small glass vial. The solution will become colorless or near colorless soon after mixing, approximately 1/2 hour. Warming the vial with your hand will accelerate the process. Hydrogen is generated and may be vented occasionally by loosening the cap. This solution is further diluted with ethanol at a ratio of 1:50. This is the first spraying or working solution. This solution may be stored over fresh zinc, but yields optimum results when freshly prepared. The working solution should be drawn from the vial with an eyedropper or pipette. When drawing the working solution for the 1:50 dilution, make sure that you do not draw any of the zinc from the bottom of the container.

After the working solution has been diluted to the 1:50 ratio, place it in an atomizer spray bottle. It was found that the sprayer type was not that critical, as long as you can obtain a light, uniformed spray. Mark the outside of this bottle as "*working solution*".

Overspary:

- **Ethanol (Fisher A407-4)**
- **30% Hydrogen Peroxide (Fisher H325-500)**

The overspray or rinse solution is a combination of 5mLs of 30% Hydrogen Peroxide and 50mLs of Ethanol. This solution is not diluted any further. As with the working solution, place the overspray solution into a separate atomizer spray bottle and mark the outside of the bottle as "*overspray*".

Sensitivity Test:

In testing the sensitivity of the Fluorescein mixture, a piece of filter paper, with several increased dilutions of blood, was sprayed with the two solutions. The range of bloodstains on the filter paper ran from neat blood to a 1:1,000,000 ratio. The filter paper should first be examined with the Alternate Light Source for any inherent fluorescence.

Alternate Light Source:

There are a variety of Alternate Light Sources (ALS) on the market today, and some may be more suitable than others, but as long as you are in the light range frequency of 450 - 485mn you should obtain optimal results. All safety precautions should be exercised when using the ALS, and proper eye protection shall be worn by all persons present when the ALS is in operation. Never shine the light directly in to a persons eyes.

Different wavelengths and barrier filters can be used depending on the substrata to be illuminated. It is recommended that a yellow (515) barrier filter be used for eyewear as well as on your camera and/or video camera.

Experimental:

A layer of neat blood was applied to the ridge surface of a finger and rolled across various substrates approximately 6 - 15 times depending on the surface space available. During the rolling process, no additional blood was added to the finger surface. After the third and fourth roll, the blood became latent or near latent. The surface area was then permitted to air dry for approximately one hour.

The items were then placed in a superglue-fuming chamber to be processed. Prior to the fuming of the items, a test print was placed on the side of the chamber wall to insure that the items inside were not over processed. Placing a low temperature heat source into the chamber (a coffee cup warmer was used) to performed the fuming. If you are in an area with low humidity, you may also want to place a small glass of heated water inside the chamber. The water can be heated in the microwave for approximately 30 seconds.

A small aluminum dish was placed on the heat source and several drops of superglue were placed inside the dish. Cover the chamber as airtight as possible and plug in the heat source. As soon as you can see your test print on the side of the chamber, unplug the heater, and vent the superglue fumes. Be sure that you vent the fumes in a vent hood or in a very well ventilated area. (See safety procedures)

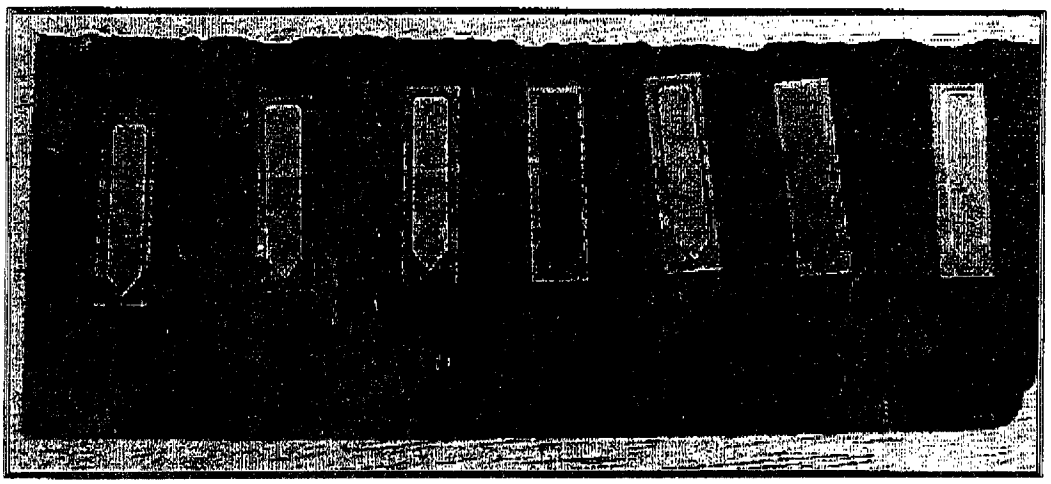
After the surface had gone through the fuming process, which takes approximately 10 to 15 minutes, the substrates should be allowed to cure for approximately 10 minutes. Apply a light coat of the Fluorescein working solution to the surface and allowed too dry. Using a hair dryer on low setting (no heat) can accelerate the drying time. Once the surface is dry, apply a coat of the overspray solution to the surface and again you can dry it with a hair dryer on the low setting.

With your alternate light source and the appropriate filters, you should be able to obtain excellent ridge detail. In the testing that was performed, it appeared that the weaker prints, prints 4 through 8 provided the best results, but identifiable prints were still obtainable up to the 11th transfer. (Each surface will yield different results).

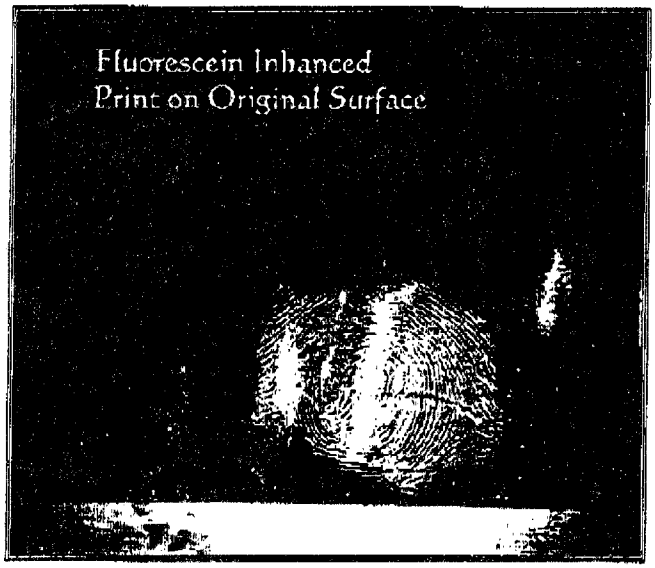
The prints that were obtained using this Fluorescein method were still visible after 6 weeks from the time that they were originally treated. However, the weaker prints appeared to have faded slightly over time.

Experiment #1

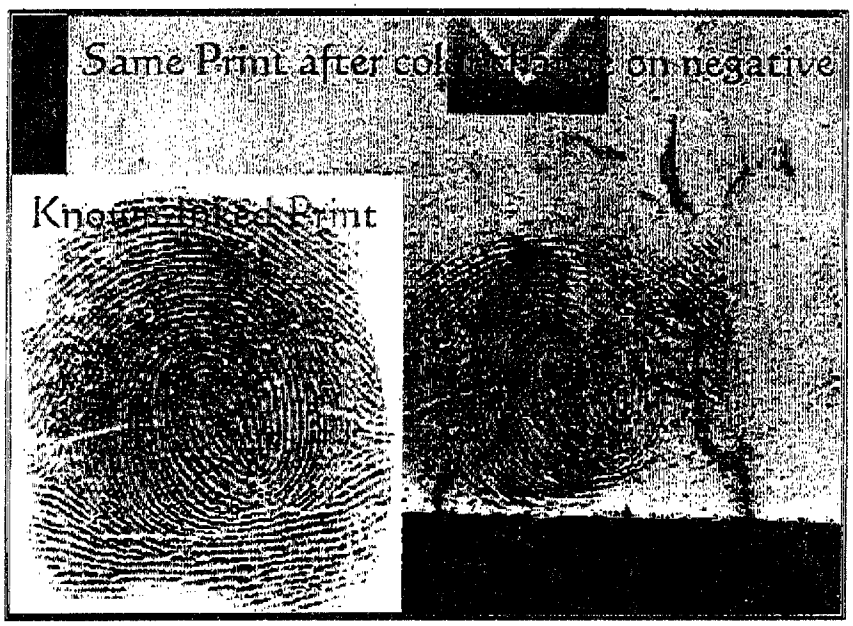
This is the known inked fingerprint that was used to place the blood samples on to the substrates that were used during this experimentation.



Surface #1: this surface is a section of black floor tile. Only seven transfers were made on this tile, with the last Being to the far right.

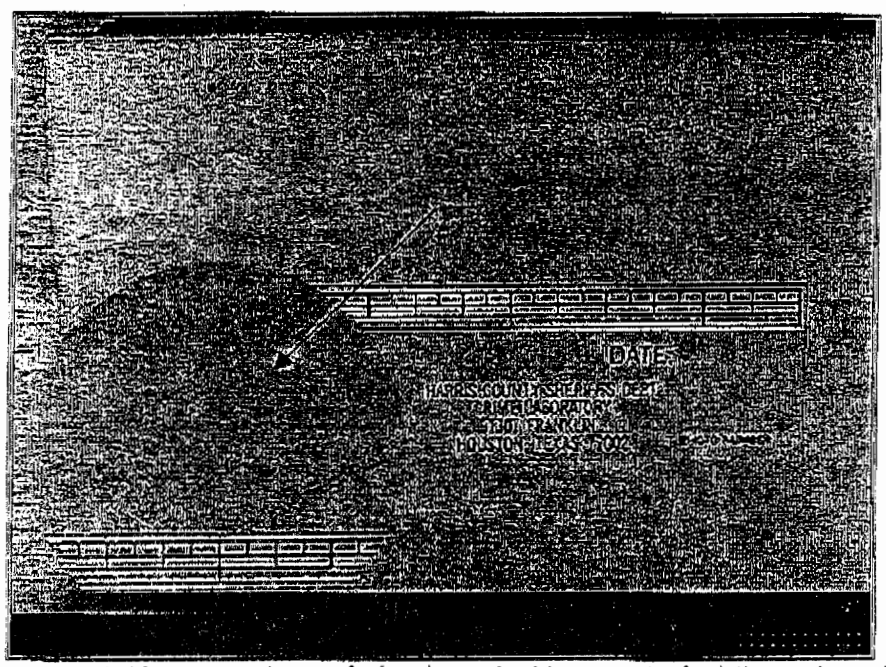


After the surface was superglued and sprayed with Fluorescein and the overspray, it was examined with the ALS at 485nm, and yielded the above results as you can see, there. is good ridge detail, but on the darker surfaces, it was necessary to do a color reversal of the print which is shown below.



A side-by-side comparison of the known inked print and the color Reversed Fluorescein prints show that an easy identification can Be made.

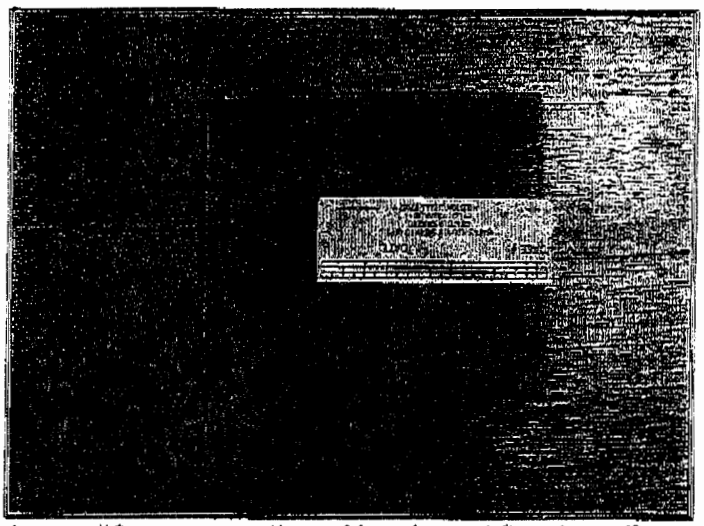
Experiment #2



Experiment #2 was a piece of pine board with a coat of white satin paint. The area of the board that was photographed was the ninth print deposited. The orange tinted area is the Fluorescein, but as you can see in the exploded area, There is no ridge detail visible.

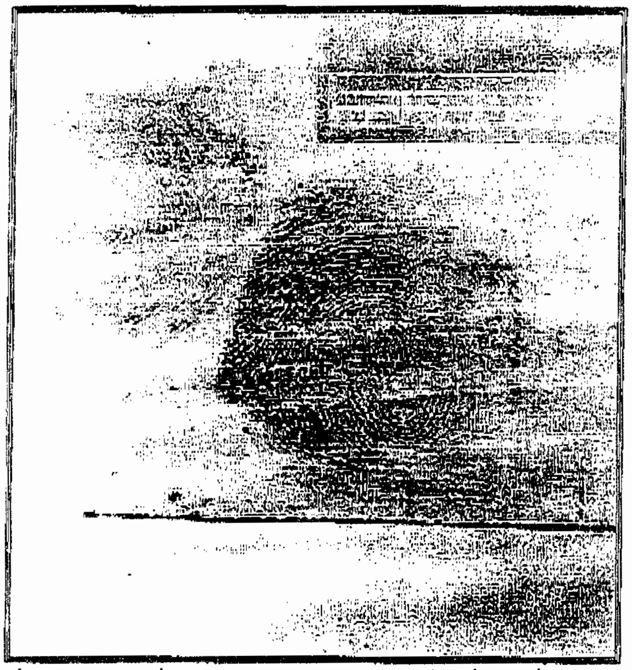
In photographing the white painted board, it was not Necessary to do a color reversal on the negative.

Experiment #3



Experiment #3 was a section of hardwood flooring. Due to the Surface area, only eight prints were placed on the surface.

The two prints that are visible here were prints 6 and 7 that Were placed on the above piece of hardwood floor.



A color reversal was necessary to obtain color correct
Ridge detail.

Photography:

The Fluorescein enhanced fingerprints were photographed using a 4 X 5 camera with a yellow (515) barrier filter. An OmniChrome 1000 ALS, set at 485nm was used while photographing the example photographs. The film used in photographing the latent fingerprints examples was Kodak technical pan film, 25 ASA, CAT 800 4640. The speed on the camera was set at the "Time Release" position in order to keep the shutter open for a timed exposure, and the F-stop was set at 5.8. Exposure time varied between 10 and 15 seconds but may vary depending on the background of the substrate, the intensity of your ALS and the intensity of the fluorescence on your target surface. The lighter backgrounds were photographed with less time to prevent the light background color from blending with the fluorescing latent fingerprint. It was found that the color reversal of the negatives was only necessary on the darker backgrounds. When examining and photographing your surfaces, it is not necessary to have the room completely dark, but it helps keep the consistency of the photographs if the room is kept darker.

Conclusion:

Prior experimentation in producing an identifiable blood transferred latent fingerprint using Fluorescein mixed in an Aqueous based format, resulted in little or no identifiable ridge detail. The solutions typically beaded on the acrylic-based surfaces such as plastic and painted items. The surface background began to fluoresce soon after the applications of chemicals and the chemicals did not effectively adhere to the ridge detail to produce an identifiable print. With the described Ethanol based Fluorescein solution, the background did not fluoresce and the ridge detail continued to fluoresce without the reapplication of chemicals. This in turn will allow the latent fingerprint technician ample time to properly document the evidence.

Address request for reprints or additional information can be received via email by contacting:

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