Fluorescing mud prints

Tale or reality

The visualization and securing of shoeprints made with wet or muddy outsoles, presented at the poster session of the 82nd Educational Conference of the IAI, Danvers/Massachusetts, 1997

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Introduction

A crime scene search during a time of year when rain is plentiful, is not unknown to we scene of crime officers. Rain, or water in general, can destroy or render almost useless important trace evidence.

That time we are also confronted with prints, that would not have posed any problems in securing had they have been placed when the weather was dry.

The traces to which I refer to, are known to us as “shoeprints placed with wet or muddy outsoles” on both non-absorbent materials (like glass fragments) as well as absorbing materials (like paper).

History

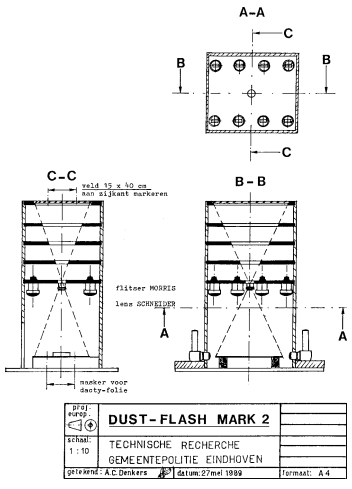
Shoeprints, found on the above mentioned materials, and made with dry outsoles (dust prints) are easily lifted with black gelatin lifters and photographed (for example with a Dustflash, see insert). When one has to deal with shoeprints places with wet or muddy outsoles, however, the lifted print was not always satisfactory. This is due to the fact that part of the print (mud/dirt) stays attached to the surface bearing the mark.
The results after photography of these lifted mud prints were poor and usually gave the impression that most of the information on the shoesole had been left on the material bearing the marks.
In many cases a solution to the problem was to photograph the original mud print as well as one could. This usually gave only moderate results; latent and partial latent parts of the print often remained invisible.

Chemical methods

Chemical methods, to increase the contrast between prints made with wet outsoles and the background and to make latent parts of those prints visible, are not or hardly used in the Netherlands. This is due to the lack of good means and the lack of knowledge in this area.
Investigations into useful chemicals to increase the contrast between print and background have allready taken place in several countries. This research was directed towards chemical reactions with elements, present in dirt or soil, and left behind in the print. One of the most important elements found in soil is iron, among others.

Dustflash

The Dustflash is a camera, designed by me in 1988, for the 1:1 reproduction with enhanced contrast, of shoeprints on black gelatin lifters or electrostatic film direct onto photographic paper. It has to built by one-self. See Technisch Informatie Bulletin, July 1989, p. 2-5 (Dutch). See for the PTU-model Sachsen, a from that camera derived model: Kriminalistik, 3/1997, p. 188-192 (German). The type of lighting in this camera enables the reproduction of even the finest details in the lift.



Till now the forensic researchers in the diverse countries have apparently not been able to come up with a chemical that will give spectacular results in the visualization of such shoeprints.

With these kind of prints on non-absorbing materials, cyanoacrylate is often used. The results of fuming prints, made with wet or muddy outsoles, with cyanoacrylate are varying. Due to contamination of the material bearing the mark, often deposition of cyanoacrylate results on parts where no print is found. For the same prints, found on absorbing material such as paper, the number of chemical methods is certainly as limited and the results moderate to poor.

Simplicity is often the solution to a problem

After having been confronted on numerous occasions with shoeprints made with wet or muddy outsoles on glass fragments or paper by burglars, I believe to have found the solution in this matter.
I did a large number of tests with prints made with wet/muddy outsoles on glass as well as paper. With paper it was evident to me that those prints would react well with DFO (1,8-diazafluoren-9-one). When I spoke to collegues about this, I understood that they had very poor results with these prints when treated with DFO. For me this was strange and unusal and it raised some questions.

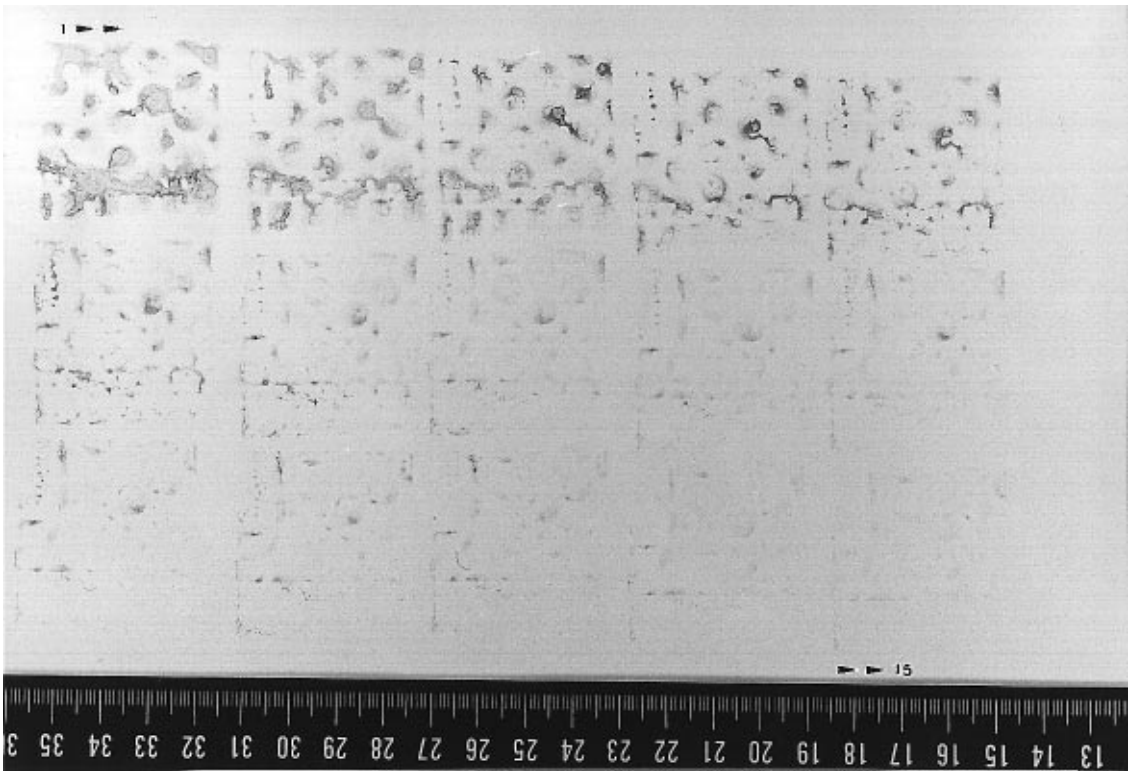
Activation of prints on absorbing materials

During the search for the difference in results between prints treated by me and the ones by my collegues, with DFO, the crucial point appeared to be the fact that I first lifted all prints found on paper with black gelatin lifters to have them subsequently photographed in the Dustflash as if it were prints in dust.

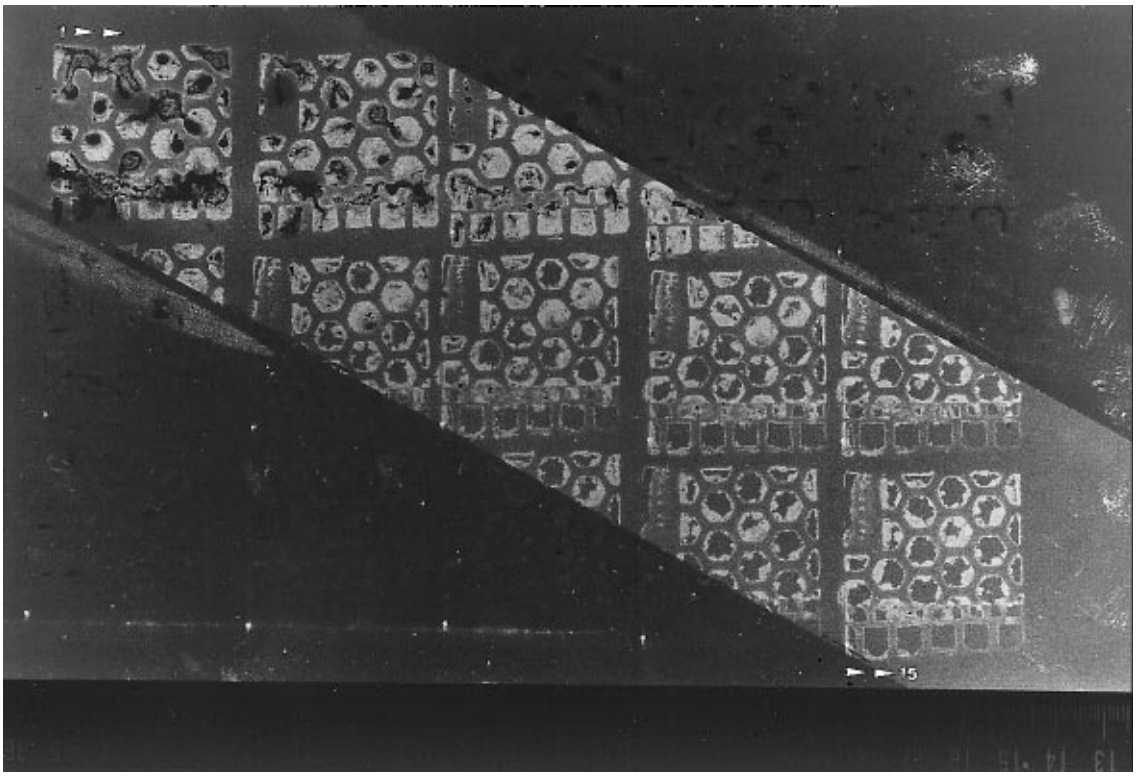
During the lifting of the (muddy) shoeprint the gelatin layer of the black lifter **activates both the visible as well as the latent parts of the shoeprint** on paper for the later treatment with DFO. The explanation for this activation is not quite clear, but is probably related to the presence of proteins in the gelatin layer of the black BVDA lifter.

A second advantage of the procedure of first lifting prints with a gelatin lifter is found in the removal of excess dirt/mud from the paper, resulting in an improvement of the results.
A third advantage is that with lifting one always gets a result from the trace in question. This is important to be assured of a result in case one cannot tell whether a print has been placed with a dry, wet or damp outsole.

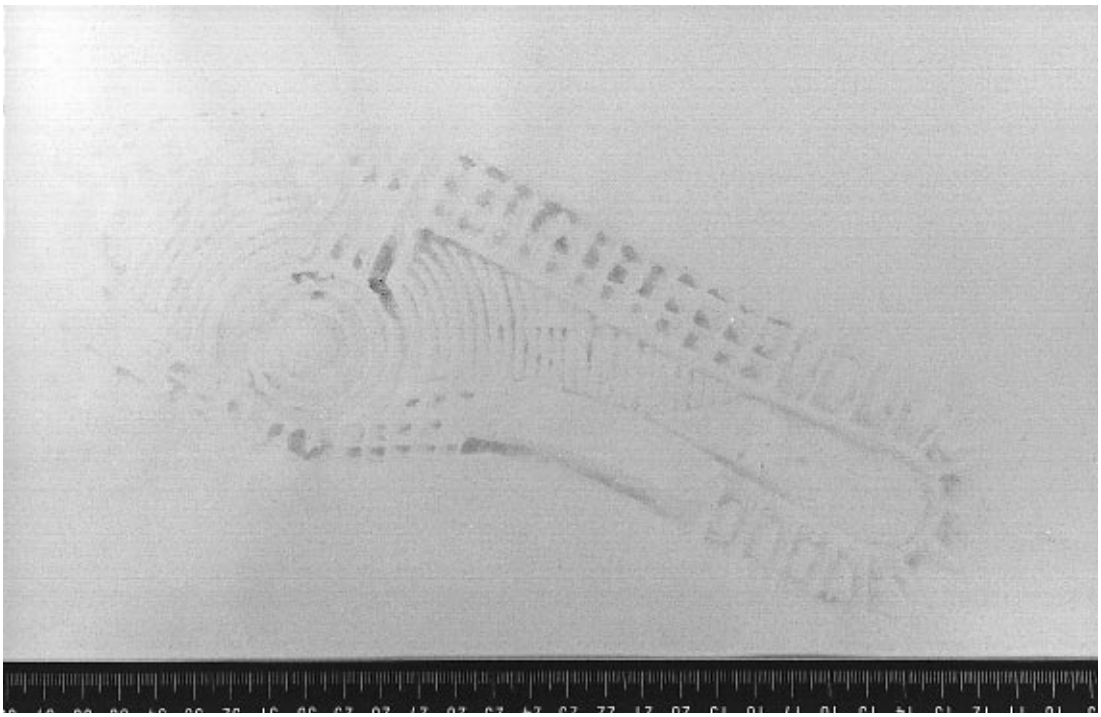
As proof of the thesis that the gelatin lifter activates the mud print on paper, I first made a number of shoeprints with a piece of outsole on paper and then put a strip of gelatin lifter diagonally over it. Thereby, a part of the prints was lifted with a black BVDA gelatin lifter. After that, the paper was treated with DFO.



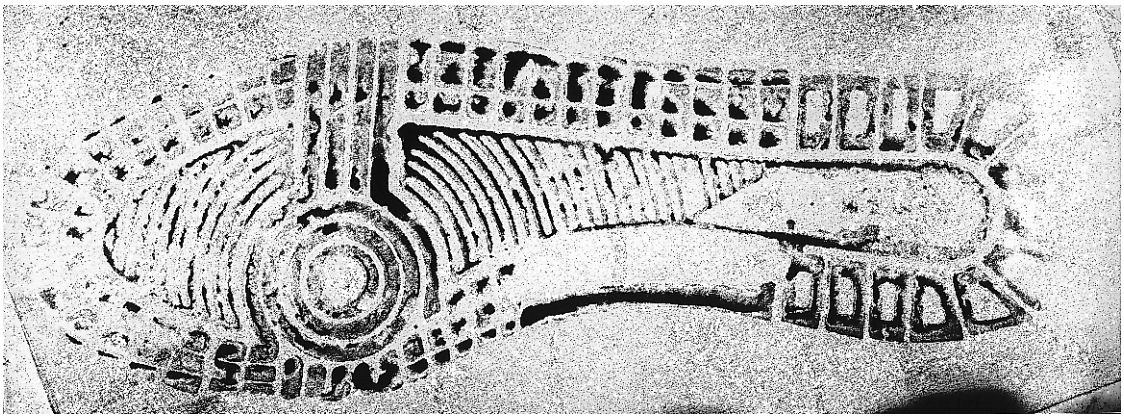
Photograph 1. Fifteen shoeprints, made in succession with a piece of outsole that was placed in mud initially. The amount of mud decreases from print to print.



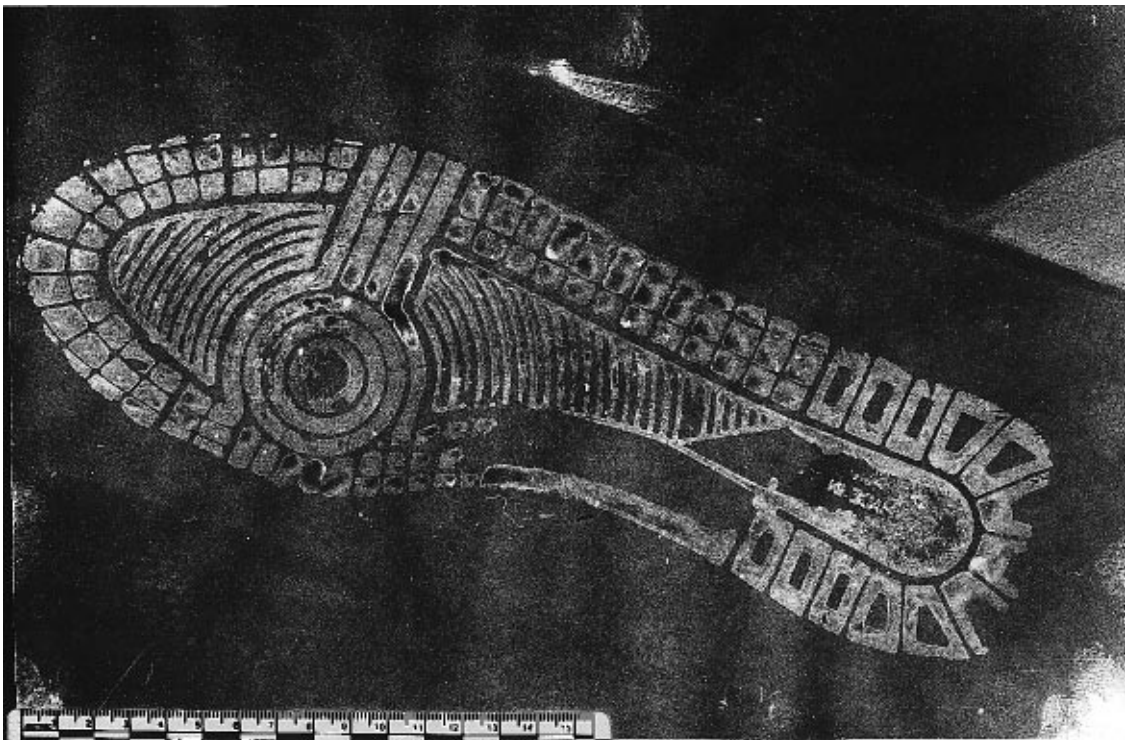
Photograph 2. The testprints on paper as on photograph 1, after treatment with DFO.



Photograph 3. Shoe print on white paper before lifting with a black gelatin lifter.



Photograph 4. The lifted shoeprint from photograph 3, photographed as a dustprint.



Photograph 5. The fluorescing shoeprint from photograph 3 and 4 after treatment of the paper with DFO.

Procedure muddy shoeprints with DFO

- Photograph the untreated shoeprint on paper
- Lift the dirt/mud print with a black BVDA gelatin lifter.
- Photograph the lift (for example in a Dustflash)
- Treat the paper with DFO (same procedure as with fingerprints), heating the paper for 10 minutes at 90° C.
- Photograph the fluorescing DFO treated shoeprint. Excitation wavelength around 535 nm, use a narrow band (35 nm) barrier filter of around 600 nm in front of the camera lens. Use either black and white or color film.

Remark:

The above mentioned procedure for treatment of shoeprints with DFO works best with papers that also show good results when treating for fingerprints. There are coated/shiny papers which are known to give poor results when treated for fingerprints with DFO. The results with (muddy) shoeprints on these kinds of paper might be negative also.

Shoeprints in dirt or mud on glass

The best solution, in my view, for treatment of shoeprints made with wet and dirty or muddy outsoles on glass or other non-absorbing surfaces, I believe to have found in a very simple treatment. I got the idea for this method after extensive experimentation with prints on glass (among others) with chemical means like cyanoacrylate, gentian violet, Sudan Black failed time and again or resulted in less agreeable results.

Basis of the idea

Traces in dirt or mud on for example glass, have the property of fixing themselves to the underground on drying. Because of this, fixation of the print is not necessary, which should facilitate a direct staining of the print with an appropriate dye without disturbing it.

Safranine O: a suitable dye

The chemical Safranine O, is a strong dye that has (among other uses) found application in the medical world for the staining of bacteria in microscopy. At certain dilutions, the dye has fluorescent properties when excited with green light. This cationic azine dye of the formula $C_{20}H_{19}ClN_4$, has found use in the forensic field as a cyanoacrylate stain.

Treatment with Safranine O

I first lifted the dirt/mud print with a black gelatin lifter and then photographed the lift in the Dustflash. After that the shoeprint that had adhered to the glass during drying, a solution of 1 gram Safranine O in 1 liter of water was poured over it. After allowing the Safranin O to stay in contact with the print for 2 minutes, I washed it extensively under running water until there was hardly any noticeable staining of the wash water. Subsequently, the water present on the glass fragment was blown away with compressed air and the print allowed to dry.

After that, the print was lifted with a white gelatin lifter (BVDA). After applying the lifter, it has to stay in contact for 2 minutes, to allow the dye to be absorbed from the print. The fluorescencing lift was photographed next,using green light (around 535 nm) and a narrow bandwith barrier filter (600 nm, with a 35 nm bandpass).
The resulting pictures after this procedure were astounding. The quality of the print after this procedure is very good. Even parts of the prints that normally would have remained latent, now became visible.

Water and prints = water and fire!

One could expect that shoeprint, made in dirt or mud on a non-absorbing surface such as glass, dried, treated with Safranin O solution and extensively washed under running tapwater would be disturbed and/or destroyed. However, as long as one doesn't touch the wet print, it will stay intact. An analogy is found in washing window panes. If the windows are rinsed with water from a hose and one doesn't use a sponge, after drying one will find that the dirt will have stayed where it was.

Nonetheless, care should always be taken with a treatment, especially when the material on which the print is found has been treated with a dirt repelling layer or has the property that it easily releases dirt or stains.

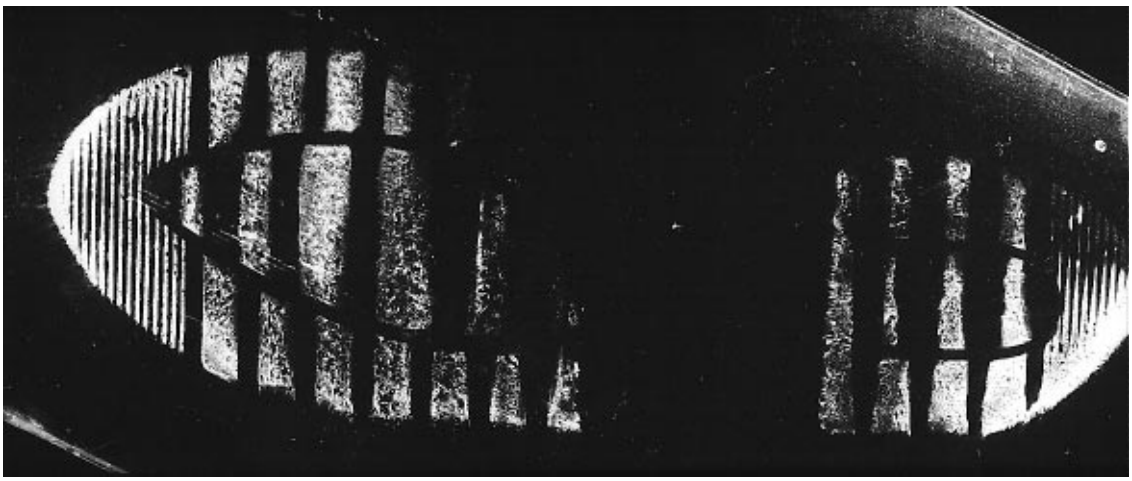
Working procedure Safranin treatment

- Photograph the shoeprint on the material bearing the mark.
- Lift the print with a black gelatin lifter.
- Photograph the lifted shoeprint (for example in a Dustflash).
- Pour the Safranin O solution over the shoeprint on the non-absorbing surface.
- Leave the Safranin solution in contact with the print for about two minutes.
- Rinse the shoeprint under slow running tap water. To avoid possible chalk stains, rinse a last time with distilled or demineralized water.
- Remove water droplets with a blow dryer or pressurized air and let dry.
- Apply a white gelatin lifter on the print, without inclusion of air bubbles and leave the lifter on the print for at least several minutes.
- Remove the lifter and photograph the fluorescence of the lifted print within a time period of 30 minutes maximum. Use green light (around 535 nm) and a narrow band barrier filter in front of the camera lens.

Prints treated with Safranine O

Photograph 6. A plexiglass board on which a shoeprint is found, made with a muddy outsole.

Photograph 7. The shoeprint after having been lifted with a black gelatin lifter and photographed in the Dustflash.



Photograph 8. The same shoeprint after having been treated with Safranin O and lifted with a white gelatin lifter. The picture shows the fluorescence (mirror image due to lifting).

Remarks:
By lifting the Safranine treated print for a second, or even third time with a white gelatin lifter, the quality of the lift might even improve, compared to the first lift.

When using the bandpass barrier filter of 600 nm with 35 nm bandpass, it can be adviseable to use a camera lens with a longer focal distance (100 mm). This will increase the contrast of the fluorescing image.

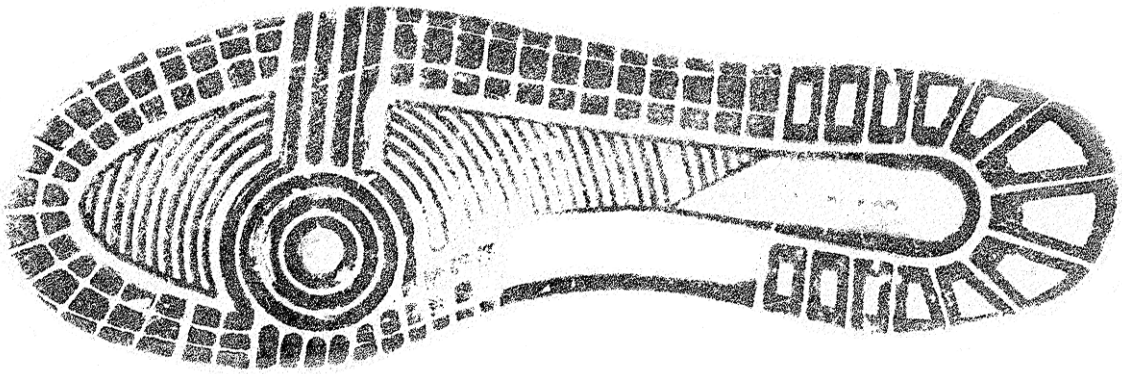
Technical details of the photographs

Camera: Pentax LX, automatic with 1:1.4/100 mm lens.
Exposure time DFO treated prints: 180 seconds at diaphragm f8
Exposure time Safranine/white gelatin lifter: 30 seconds at diaphragm f8
Used film: Ilford XP2 (camera set at 21 DIN/100 ISO)
Fuji HG400 (camera set at 24 DIN/200 ISO)

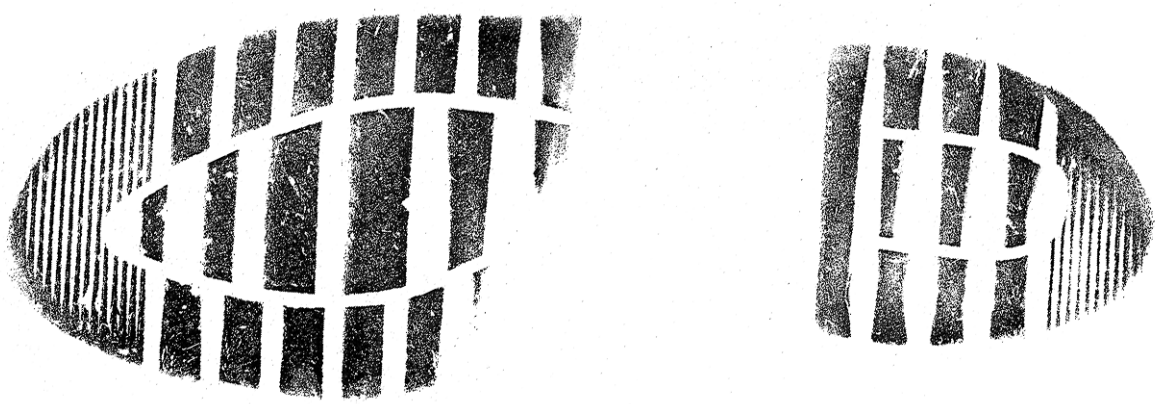
Illumination: Crimescope CS-16 at 535 nm, barrier filter: 600 nm BP 35 nm. A diffuser was used in front of the light guide.

Used materials:

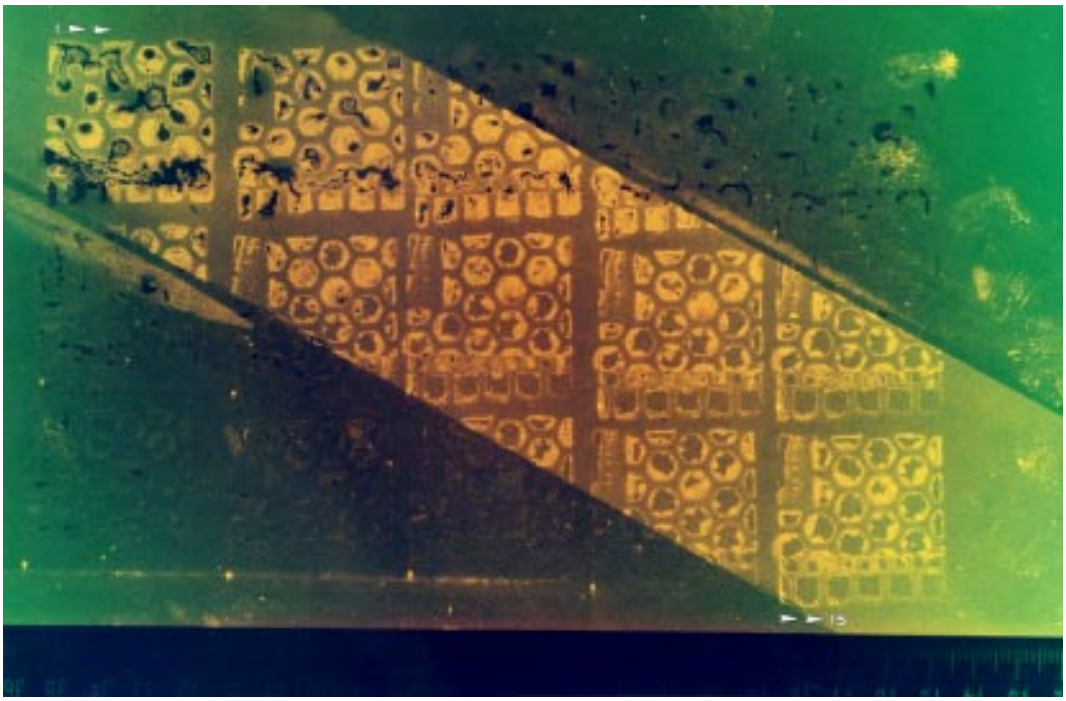
Safranine O, Merck (article number 1.15948.0025).
Recipe of Safranin solution: dissolve 1 gram in liter distilled or demineralized water.
DFO solutions: BVDA International b.v. (DFO in petroleum ether/xylene/acetone/isopropanol/methanol/acetic acid)
Black and white gelatin lifters: BVDA International b.v.



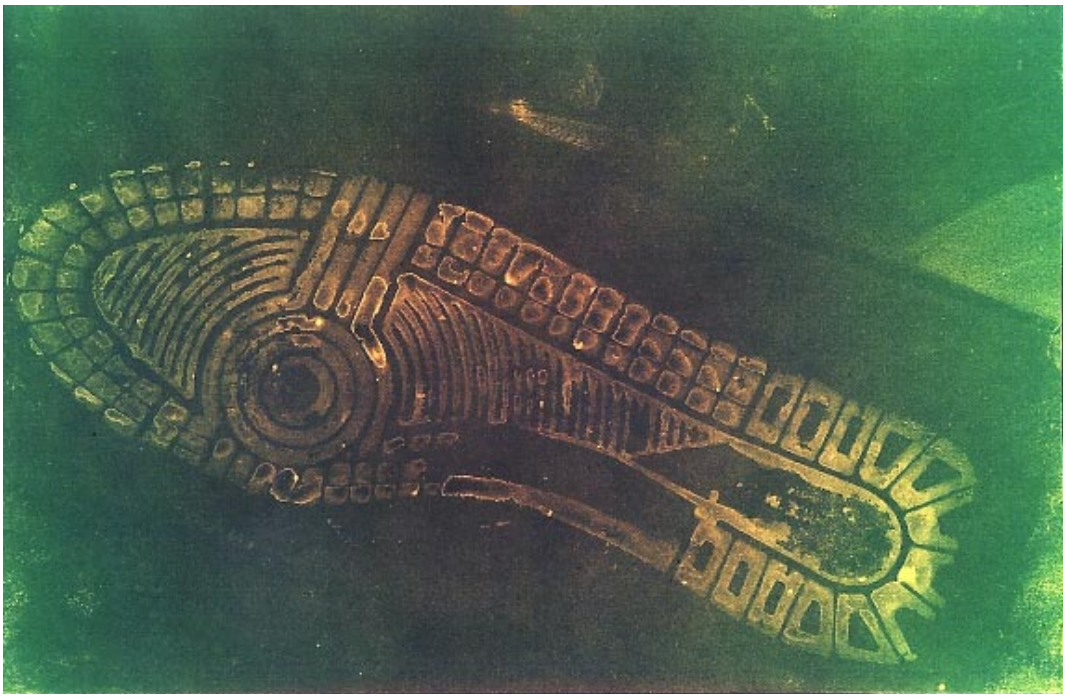
Comparison print of the shoe in photograph 3, 4, and 5



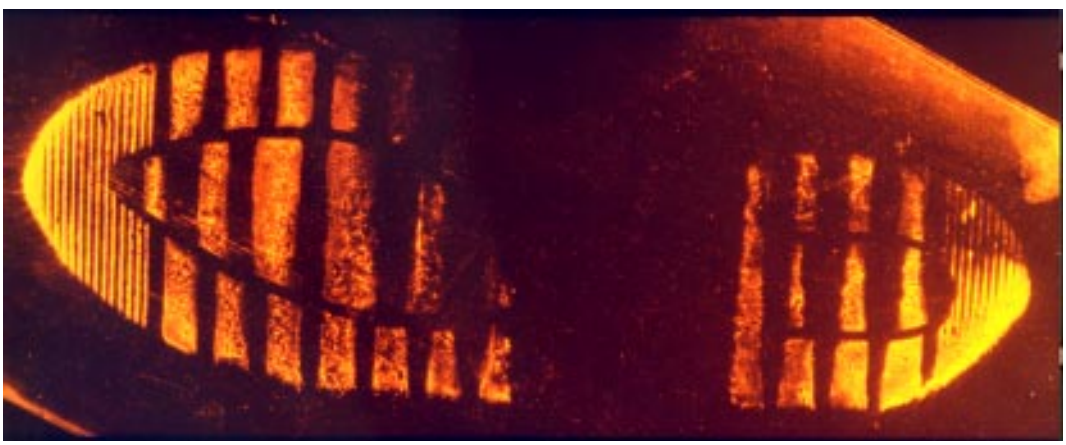
Comparison print of the shoe in photograph 7 and 8



Photograph 2, in color



Photograph 5, in color



Photograph 8, in color