

Darkroom Film Development

This paper is about the practical application of darkroom film development. I will talk about the materials, the chemicals and the scientific background of them. As well as the types of techniques and darkroom manipulation methods. The intended audience of this paper are the people who are very interested in photography, especially film photography. This also includes people who use photoshop or use a darkroom to develop their own photos.

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1 INTRODUCTION

In today's times, the 21st century, photography and photo-editing have evolved from two centuries ago. Today people are able to edit and retouch their photos right at their finger tips. Before the invention of digital cameras and Adobe Photoshop, the process to develop photos was more strenuous and done in a darkroom.

1.1 History

Photography first started back in the 14th century with a camera obscura, which is also known as a pinhole image. The camera obscura idea came from a Arab Mathematician named Ibn al-Haytham. The camera obscura would have light come in through a little pinhole at the front of the camera project the image upside down in a dark box and onto the photographic paper [9].

As cameras started to advance, darkrooms started to be used in the 19th century through early to mid 20th century. Film cameras became more popular around this time and were used by photographers, such as Ansel Adams and Timothy H. O'Sullivan, used darkrooms to develop their images.



Fig. 1. This is a photograph by Ansel Adams. He took many film photos of landscapes and developed a majority of his work in a darkroom.

2 WHAT IS A DARKROOM?

A darkroom is a place where photographers and photo developers can go to develop an image. It is a room that is completely pitch black.

Meaning that there is no outside light coming into the room from windows, cracks and doors. Usually this room contains no windows and contains a safelight as it's only light source for humans. The best kind of lighting when in a darkroom is no light [1]. A darkroom must have six requirements. These requirements are a source of water, a light tight environment, proper ventilation, a dust-free environment, electricity, and enough space.[1]

2.1 What is a Safelight?

A safelight is a light that is a normal light bulb, but contains a red coloured filter. It is important for the light to emit a red colour because the common photographic paper and materials that photographers handle are orthochromatic. Meaning that the material is insensitive to the black and white electromagnetic waves that red emits. However, there are some panchromatic papers, such as Kodak Panalure, which are sensitive to all colors and require the use of a dark green filter.[1]



Fig. 2. This is an example of what a safe light bulb can look like. The bulb has a red tint, so when it emits light, the light is red.

3 WHAT EQUIPMENT DO PHOTOGRAPHERS USE?

There are the two most essential tools when performing darkroom photography. These two tools are the enlarger and the chemicals needed for a developer, stop bath, and fixer.

3.1 Enlarger

The vertical enlarger was invented in 1852 by Achille Quinet. This invention helps photographers size their photos onto their canvas or photographic paper to a size they are pleased

with and are able to set the exposure and focus of their photograph. To do this, the enlarger contain a lamp inside that illuminates the negative and projects the image onto the canvas evenly [2]. For colored images, there are filters that get placed inside the enlarger to project colored light onto the photo paper. There are also accessories that can be used with the enlarger for different effects. Photographers use the focus finder to adjust the sharpness of their photo. [2]

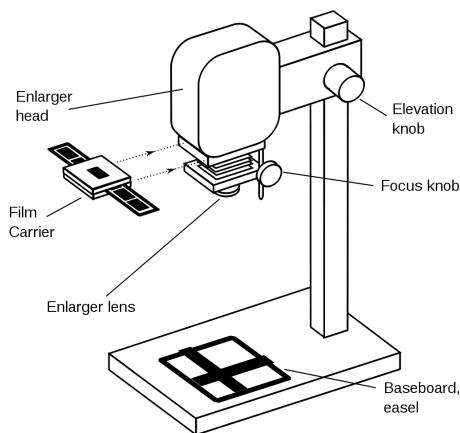


Fig. 3. This is what an enlarger typically looks like. The enlarger projects the image from the negative to the photographic paper.

4 CHEMICALS

To identify the three common chemicals that photographers use when developing film in a darkroom. Each chemical has a different effect on the outcome of the photo and different reactions with other chemicals so it is important to know the reactions and background of them. Photographers must use a developer, stop bath, and a fixer, in that order. Each of these chemicals have a different chemical reaction and affect the photograph differently. [1]

4.1 Developer

The developer develops the photograph on the photo paper. The chemicals that are commonly used as a developer are ascorbic acid, hydroquinone, metol, or phenidone. After the enlarger, the photo paper is placed

into the developer chemical, which then the "silver halide crystals are selectively reduced to metallic silver... The more metallic silver in an area of the film or paper, the darker it appears," [1]. Anchell claims that "There are many chemical agents that will reduce silver halide to metallic silver, but developing agents are a special kind of reducing agent because they only act on silver halide that has been exposed to light," [1].

4.2 Stop Bath

After putting the photo paper in the developer. The next step is the stop bath. The stop bath provides a buffer between the developer and the fixer. The stop bath first halts the development process. It stops the silver halides from turning into metallic silver. According to Anchell, photographers can either use an acid stop bath or a running-water stop bath.

If an acid stop bath is used then it will stop the development process in the shortest amount of time. However, it does come with some disadvantages. Anchell explains that "When the sodium carbonate...comes into contact with acid, carbon dioxide gas is released which can cause blistering in the emulsion of both film and paper," [1]. These are known as "pinholes". To prevent pinholes on the photograph, Anchell recommends that two methods:

- 1) Use developers that contain mild alkali, such as sodium metaborate or borax. Using this kind of developer with an acid stop bath will prevent the creating of carbon dioxide gas.
- 2) Use a mild acid stop bath or a very gently acting stop bath. This will cause less of a harsh reaction when reacting with the developer.

4.3 Fixer

After the stop bath, the photo paper then goes into the fixer, which then seals the image on the photo paper. Anchell describes the fixation process as the "removal... of unused silver halides, such as silver bromide, from the paper or film... This process involves a series of chemical reactions in which the silver bromide is converted into complex argentothiosulfates, which are then dissolved by contact with fresh fixer and finally washed out of the film or paper," [1]. According to Anchell, there are three types of fixers:

- 1) plain (neutral)
- 2) acid
- 3) alkali

There are different outcomes to these three types of fixers. The plain fixer is normally used before toning and can act as a "second bath" in a two-bath system. This type of fixer is not generally used as the "main" fixer because it can cause stains on the photograph and cause other problems.

The acid type fixer, the most used kind of fixer, is a weak organic acid type of solution. Acids that are used in this solution must be stable. Acids can be mixed in order to create a sulfuric acid.

The alkali fixers tend to be the most efficient and effective. They also have plenty of benefits when used. They have shorter washing times and they require less materials and baths in the process of developing a photo.

5 THE PROCESS

The process of film development stresses the importance of timing, light, and temperature. Michael Langford describes the process and the outcomes of photographs when timing, light, and temperature are changed in *The Darkroom Handbook*. Langford explains how it is all about technique and the different techniques to get certain outcomes. Black and white film "can be processed in about 45 minutes," [2]. However,

this all depends on "the type of developer you use, its temperature, and the amount of agitation given," [2].

5.1 Getting The Negative Ready

Before the development process starts, the negative must be prepped. Prepping the negative means that the photographer takes the film out of the film roll and uses a magnifying tool to choose the photo that they want to develop. Once they have chosen their negative, they cut it from the film strip and put the negative into a negative carrier. A negative carrier is a component that is apart of the enlarger where it can be removed and used to hold the negative. [4].

Once the negative is prepared, the photographer can now put it in the enlarger and adjust the exposure, aperture, and sharpness of the photo.



Fig. 4. Film negative inside the negative carrier getting ready to be placed inside the enlarger.

5.2 Exposure, Aperture, & Sharpness

After preparing the negative, the photographer can adjust the exposure, aperture, and sharpness to their liking.

Exposure is defined as the amount of light that hits your camera's sensors. To have a good amount of exposure, or "proper exposure", this means that the bright and dark areas of the photo received enough light that distinguishes the details [5]. Photographers are also able to underexpose their photos, meaning that

the dark areas of the photo did not get much light; or overexpose, meaning that the bright parts of the photo received too much light. Underexposing or overexposing loses the details of the image.

Aperture directly effects the exposure of a photo. Aperture is the opening of the lens on the enlarger. Photographers are able to control how much light passes through the lens. Having a large aperture allows more light into the enlarger. This can cause an image to be overexposed. A smaller aperture allows less light to pass through the enlarger. Therefore, this results in a underexposed photo. A medium aperture will let in a normal amount of light which will result in a proper exposure [6].

The sharpness of a photo refers to the clarity and contrast of an image. Photographers adjusted the sharpness of an image by using a focus finder.



Fig. 5. Photo developer looks through a focus finder to adjust the sharpness of the photo.

They used this and the enlarger together to get their desired setting. To use a focus finder, the photographer or photo developer would place it onto the canvas of the enlarger. They then would look through the focus finder and adjust a knob on the enlarger to fix the sharpness. The focus finder magnifies the image. As the photographers look through it, they can see how blurry or clear the image is and adjust accordingly [7].

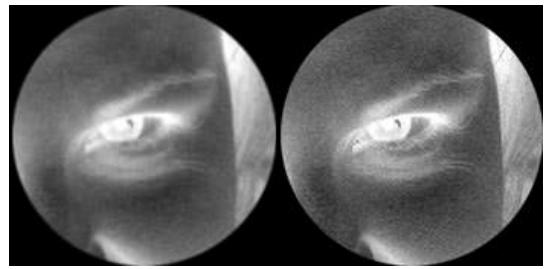


Fig. 6. The left circle shows an image that is not very sharpened. A less sharpened image shows very soft features. The image is not as defined. The circle on the right shows an image where the sharpness is on the higher side. The image is more defined and features stand out more.

5.3 Test Run

After getting the desired settings for the photo, the photo developer will then do a test run. A test run is an image where each part of the photo paper is exposed under the enlarger in five second intervals.



Fig. 7. The test run above shows:
From left to right: 5 seconds, 10 seconds, 15 seconds, 20 seconds, 25 seconds under enlarger

The less time under the enlarger, the lighter the photo will appear. This means that for a lighter photo, photo developers would want five to ten seconds under the enlarger. The more time under the enlarger, the darker the photo will look. This leads to an overexposed photo. To achieve an overexposed photo, the photographer would need to expose the photo under the enlarger for more than 20 seconds.

5.4 Developer, Stop Bath, & Fixer

After exposing the photo paper under the enlarger, the photo developer then wants to move the photograph to the developer bath for 60 seconds, then to the stop bath for 10 seconds, and then to the fixer for 30 seconds. During these chemical baths, the photographer must provide agitation to the photos.

5.5 Agitation

Providing agitation means that the photo developer must gently shake the tray back and forth in order for the photo paper to get evenly covered with the chemicals. If agitation is not provided, then the photo will not develop evenly or could form bubbles that prevent development in certain areas of the photo.



Fig. 8. The photo developer shakes the tray back and forth in a gentle manner in order to make sure that all of the photographic paper is covered in the chemical.

5.5.1 Colored Photos

However, if a photographer is trying to print a photograph with color, this process has to be in complete darkness. Colored photographs need to be produced completely in the dark due to the photographic paper that is being used. Colored images use a different type of paper than the paper used for black and white photos. Hence the paper used is sensitive to all kinds of light due to having ilfochrome, which "is a dye destruction" that is used on photographic paper for colored images. Dye destruction is the method that allows the colors to be rich on the photographic paper when the image appears. [8]

5.6 Water Bath & Hang To Dry

Once out of the fixer, the photo developer then wants to put the image into a water bath. The purpose of the water bath is to filter out the chemicals from the image. In order to do this, the photo developer does not need to provide agitation, but will need to replace the water a few times. This will fully rid the photo of chemicals. Once the image is filtered, can be hung up to dry. It will take eight to ten hours for the photo to fully dry. After the image dries, the photo developer can go back and add effects to the photo, known as darkroom techniques and manipulations.

6 DARKROOM MANIPULATION

Darkroom manipulation is a method of editing photographs after they have been developed. After a photo is done developing, the photo developer can manipulate the photo by adjusting the exposure of some parts of the image (exposure control) or can do certain effects, such as the Sabattier Effect.

6.1 Exposure Control

Exposure control is about controlling how much light is exposed to the photo paper and specific areas of the paper we want to expose for either a longer or shorter period of time. Methods used are called dodging and burning.

6.1.1 Dodging

Dodging is a technique that makes certain parts of the image lighter. The photo developer uses a dodging tool and places it over parts of the photo that they want to make lighter. This action is done under the enlarger.

The reason why light is blocked is because when a photo is under the enlarger for long periods of time, the photo will become darker. This is due to the silver halide crystals turning into metallic silver in the area from being exposed to light. Therefore, when dodging, the photo developer wants to reduce the amount of metallic silver in the areas on the photo that they are trying to lighten.



Fig. 9. The dodging tool is usually a piece of wire with black tape at the end. The photo developer will hold the wire, which acts as a little handle, and position the end with the black tape over parts of the photo that they want to lighten.

6.1.2 Burning

Burning is a technique that makes certain part of the image darker. To do this, the photo developer cups their hands over the opening of the enlarger where the light comes through and directs the light to parts of the photo that they want to darken.



Fig. 10. The photo developer his hands around the opening of the light and aims it to parts of the photo he wants to darken.

There needs to be more light when darkening the photo due to the silver halide crystals producing more metallic silver in areas of the photo where there is more light exposure.



Fig. 11. The photo on the left is an image without any dodging or burning. The photo on the right is an image where burning is applied to the shadows and dark parts of the photo and dodging is applied to parts of the sky and highlights of the photo.

6.2 Sabattier Effect

Langford describes the sabattier effect as a "unique positive/negative effect [that] could be obtained by reexposing to light and redeveloping an exposed and partially developed negative or print," [3].



Fig. 12. The Sabattier Effect on an image.

To recreate this effect, the negative chosen must have a slightly high contrast. The process for this is then followed by a developer, water rinse, and then into another solution that contains 1:10 developer, then fixer, fixer remover, and a water rinse. A safelight is okay to use during this process.

6.3 Processing Control

Processing control is when we select different parts of a photograph and decide the placement of the developer and how long we want the developer to process the image [3].

6.4 Toning With Bleach

Using bleach helped lighten the image. Stone claims that when an image is too dark or over exposed, a bleach mixture after fixing and rinsing helps lighten the image and helps make highlights stand out.

Sometimes photo developers will paint the bleach in certain areas to brighten it. This is another way to lighten the photo instead of doing to dodging method.



Fig. 13. The photo on the left is before the bleach is applied to the photo. The photo on the right shows the results of toning with bleach. The bleach makes more of the photo stand out. Like the center of the photo and the detailing on the walls of the cave.

6.5 Color Filters

To give photos some colored tints, photo developers are able to place color filters over in a compartment on the enlarger that holds the plastic filter in place while light shines and the image is projected onto the photographic paper.



Fig. 14. These are examples of some of the colors that the filters come in. They are tinted sheets of plastic and give the photo a tint.

6.6 Masking

Photo developers use another piece of cardboard or paper to cover a part of the photo that they do not want to edit. There can be multiple masks used. If masking is done correctly, then the sharpness of the image will be improved. Masking allows for the shadows and blacks to appear more correct and adds texture.



Fig. 15. Here this photo developer is creating a burning mask. Where the sky is covered so the mountains in the image have the burning technique applied to it.

6.7 Cropping

Photographers can also crop images using a tool that can be placed over the image on the canvas of the enlarger. It contains sliders to adjust the size of the photo and what parts to crop out.

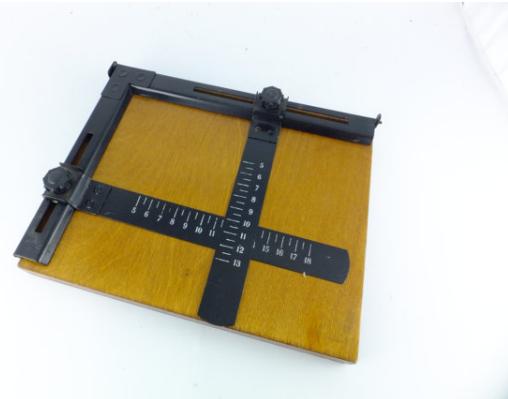


Fig. 16. This is the crop tool. It has sliders to adjust to the size of the photo and crops out what the photographer wants. On Adobe Photoshop, the symbol to crop resembles this tool.

7 TODAY'S DARKROOM: DIGITAL CAMERAS, LIGHTROOM, AND PHOTOSHOP

Today, many people do not use darkrooms to develop or edit their photos because technology has advanced and has allowed people to do it straight from their computer. The invention of Digital cameras have allowed photographers to see their work right away instead of waiting until the film is ready and cannot see it until the very end of the developing process. This made it more convenient and efficient for

photographers' line of work as they can retake a delete photos that they do not think came out well.

As for editing, Lightroom and photoshop became useful inventions that require no darkroom use. However, these computer applications are heavily based on the techniques that photo developers use and darkroom manipulation.

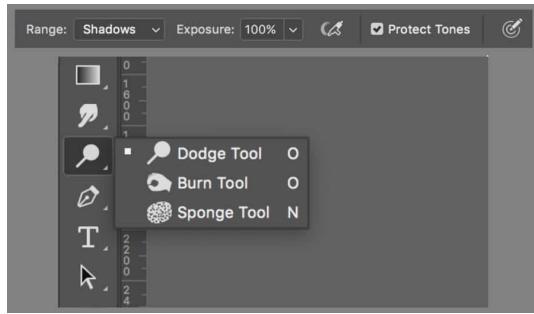


Fig. 17. Photoshop uses icons that resemble the methods that are used in darkroom photography. In this picture, we can see that the dodge icon resembles the wire and black tape at the end and for burn, it is a cusped hand.

Lightroom only allows for editing of the lighting and filters/tints of a photo and acts more like a digital photography studio. Where as photoshop allows the user to do more with their photo and acts as a digital darkroom.

8 CONCLUSION

Darkroom film development paved the way for modern photo editing. Apps like photoshop and lightroom take many of the same techniques such as exposure control, processing control and processed them digitally. Technology has come a long way, especially for photography. Darkrooms are not as common as they were back then, but they are still around. Darkroom photography is not a lost art as there are photographers, old and young, who are still interested in this practice. Many young photographers tend to try darkroom photography due to film photography being popular with the younger generation. This is popular because film photography and darkroom development gives a sense of nostalgia.

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