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# Student Instruction Manual for Black and White Film Processing and Printing

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89  
STUDENT INSTRUCTION MANUAL FOR  
BLACK AND WHITE FILM  
PROCESSING AND  
PRINTING

BY

STEPHEN MICHAEL DELAY

A thesis submitted  
in partial fulfillment of the requirements for the  
degree Master of Science, Major in  
Printing Management, South  
Dakota State University

1970

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STUDENT INSTRUCTION MANUAL FOR  
BLACK AND WHITE FILM  
PROCESSING AND  
PRINTING

This thesis is approved as a creditable and independent investigation by a candidate for the degree Master of Science, and is acceptable as meeting the thesis requirements for this degree, but without implying that the conclusions reached by the candidate are necessarily the ~~conclusions~~ of the major department.

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~~Thesis Adviser~~

Date

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~~Head, Department of Journalism  
and Mass Communication~~

Date

## FOREWORD

The mistakes that students make while shooting pictures, developing the film and printing the negative are numerous, but they are very logical mistakes. There is no luck or magic involved in photography. If a student follows the steps correctly and does everything as he should in the proper sequence, he will get good results. If he gets poor results, then something was omitted or done wrong.

Photography is very scientific and technical. It yields results directly proportionate to the amount and quality of effort put into the project by the photographer. No luck is involved.

The purpose of this paper is to show the student and instructor of photography what can go wrong performing the steps involved in producing a good black and white photo. Perhaps further studies in a similar format to this should be done covering other areas in photography, such as flash photography, portrait photography, graphic arts photography and the complicated area of color photography.



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## CHAPTER I

## INTRODUCTION

Statement of the Problem

For most subject matter the ideal classroom situation would allow a one-to-one relationship between instructor and student. In teaching basic photography this is especially true because of the great number of steps involved in producing a finished photograph and because each step must be done correctly to achieve good results.

Time won't permit the instructor to effectively follow each student through all the steps involved, and, ideally the student should be allowed to work at his or her own speed.

The one-to-one relationship therefore, isn't possible in most photography classes and, for that reason, something is needed to take the student through his laboratory work step-by-step.

The problem is that there is no step-by-step guide in either pamphlet or text form that is detailed enough, yet simple enough to give the student the necessary help. Also, there is very little material available with which the student can compare his results without consulting the instructor.

### Objectives of the Study

It is the primary objective of this study to create a step-by-step guide to be used by the student of basic photography in the performance of his laboratory requirements. It is hoped also that this guide will aid the instructor by offering complete instructions to the student and presenting graphically examples that can be used for comparison.

This guide could also be used as a lesson plan by the instructor when planning a course in basic photography. The text is arranged in a logical order with headings covering each basic step. By using this paper and supplementary material on other phases of photography, an effective course for the beginner could be designed.

### Review of the Literature

There are hundreds of books on photography available today covering every aspect of the science. A great many of these are simple collections of famous and not-so-famous photographers' works. The rest are technical manuals giving the how-tos of photography. Most of these books are too complicated for beginners and often contain pages of unnecessary information. At the other end of the scale are small pamphlets (usually produced by suppliers) giving instructions on a narrow aspect of photography. These are informative and useful as far as they go.

What is missing is a guide for the beginner that quickly takes him from getting the film into the camera through drying his finished print without force-feeding him with unnecessary details which may impede his learning of the basics. These "unnecessary details" are really fine points which should come after the student has become secure in the basic methods of photography.

One of the more commonly used textbooks, This is Photography by Thomas H. Miller and Wyatt Brummitt, contains all the information necessary for the student to take a picture and produce a print. However, the entire book must be read and understood in order for the student to find the specific directions for each step. For example, in Chapters five and six, films and film processing respectively are discussed with no mention until Chapter 12 and later of how to get images on this film. This book has the answers, but it doesn't present them in suitable order for getting the student started on his first picture.

Photography texts all seem the same as the one mentioned above. They are more like general information manuals or encyclopedias than instruction texts.

These texts are useful and necessary for the student photographer, but they should be used in conjunction with a manual that will give complete step-by-step instructions to the student when a one-to-one, teacher-student relationship is not available.

No literature review of books on photography would be complete without mentioning a newcomer to the field. The Life Special Books Division of Time, Incorporated has begun publishing a series of books on photography. The first two of these books are now available and will be followed by eight more.

Each book contains many illustrations and extremely high quality printing. Each contains a different aspect of photography and is written by staff writers with the aid of Time, Life and Sports Illustrated photographers. The first book deals with the camera only. It discusses all types and sizes of cameras and provides a good deal of historical data. The second book contains information on light and film, with much the same complete approach. These books are the most recent addition to the existing volumes on photography and are, perhaps, the closest to using the approach taken by this thesis. Again, of course, they are far more detailed than a laboratory manual needs to be to get beginning students started right.



## CHAPTER II

## METHODOLOGY

There are basically three film formats used by students in beginning photography--4" x 5" sheet and pack film as used in the Speed or Crown Graphic, 120 roll film as used in most 2 $\frac{1}{4}$ " square twin-lens reflex cameras, and 35mm film as used in miniature cameras.

One of the most popular cameras as a teaching device is the 120 roll film twin-lens reflex. It is used by a number of schools for four reasons: First, it is inexpensive to buy and maintain; second, it seems to be the most durable of any type in use; third, it has the features necessary to show the student all variables involved in taking pictures; and fourth, it yields a negative that is far more convenient than the 4" x 5" sheet-film negative--a negative that, under normal circumstances, will have far less grain than that of the 35mm format.

For the above reasons and for simplicity the 120 roll film twin-lens reflex camera will be used as the basic camera in this paper.

Although there are many manufacturers of the twin-lens reflex who produce quality equipment; a model D made in Japan by Yashica and priced at under \$50.00 has been chosen. This is one of the least expensive, and, perhaps one of the best twin-lens cameras on the market today.

All discussion in this paper will concern the twin-lens reflex and all demonstration negatives will have been produced on the same camera.

The laboratory or dark room consists of a film-developing area and a printing area. Both areas are "light tight" and safe-light equipped. There are temperature controls for both areas, but no humidity controls. Hot and cold water is piped into each with adequate sinks and work benches.

The film developing room has a "dry bench" for handling the negative prior to developing and a "wet bench" containing a developing tank, a stop-bath tank, a film-fixing (hypo) tank and a sink with a washing tank. A safe light (Kodak Wratten Series 3, dark green), a timer (Gra-Lab), a normal incandescent lamp, a thermometer, a towel for wiping hands and a sponge for clean-up complete the film-developing equipment in this room. An area outside the room is used to hang wet negatives for drying.

The printing room has a "dry bench" also. It is used as a stand for the enlarger (an Omega D-2 4 x 5 with a 150mm Schneider f4.5 lens) and a timer (Gra-Lab). The "wet bench" in the printing room has running water in a large stainless steel sink which holds trays for developer, stop bath and fix (hypo). Safe lights with 15-watt bulbs and Kodak Wratten OC filters are suspended four feet above the developing sink for proper lighting.

The printing area also contains a rocking-type wash tank, a tray with print-flattening solution and a Pako polished-drum print dryer.

Kodak Plus-X pan film (same as Kodak Verichrome pan film) has been chosen for all examples because it is commonly used in photography classes.

Kodak Polydol developer, Kodak Indicator stop bath and Kodak Rapid fix were used for film processing whereas Kodak Dektol, Kodak Acid stop, Kodak Rapid fix and Flexogloss (print-flattening solution) were used to process the Kodak Kodabromide enlarging paper chosen for examples.

All chemicals were fresh at all times. A strict temperature of 68 degrees F was maintained in each chemical. Errors in contamination of chemicals, shelf-life and manufacture were eliminated because these conditions are normally controlled by the instructor in the laboratory situation. It is assumed that these conditions are always optimum.

Where possible, an actual example of a student error was provided. In problems related to negatives, a negative exemplifying the error being discussed was mounted to accompany the text. When a printing problem is the subject, a finished print showing the problem was mounted with the text.

All negatives and prints for this purpose were prepared by setting up the conditions for making the mistake and reproducing the results as closely as possible. In some cases the problem was exaggerated to show the error more vividly.

## CHAPTER III

### PART I: THE NEGATIVE

#### Unexposed Film Storage and Handling

Starting with out-of-date film or film that has been improperly stored lessens the chance for successful picture-taking. Most people take for granted the effects of time, temperature and humidity on film.

All film sold for general photography has a manufacturer's expiration date printed on the package. This date tells the approximate month and year when the film will start to deteriorate. The date assumes that the film has been stored in a cool, dry place because excessive heat (above 72 degrees F) and excess moisture will ruin the film long before aging will.

Deterioration means a decrease in film speed from the suggested rating and a tendency to become cloudy and mottled after development. These things are caused by any one or all three destructive elements: aging, temperature and humidity.

The problems depicted in Example 1 can be eliminated by first, buying only film that has not expired and second, storing film in a cool, dry place. It may be helpful at this time to note that many photographers store their film

in a refrigerator and a few go as far as to freeze the film.\*



#### EXAMPLE 1

#### OUT-OF-DATE FILM AFTER DEVELOPMENT

The expiration date of film can be greatly extended if the film is stored properly. Quite often photo-supply dealers will reduce the cost of out-of-date film that has been stored with care. This film will most likely yield favorable results if it isn't more than a year old. However, the most reliable and secure film is purchased and used before expiration and stored correctly before (and after)\*\* use.

---

\*N. B. After refrigeration, film should be allowed to warm ~~to~~ room temperature for approximately two hours before use.

\*\*N. B. The same principles of storage apply to exposed film after shooting and before development.



### Loading the Camera

Loading the twin-lens camera is simple. Beginners have only a few problems that are worth mentioning.

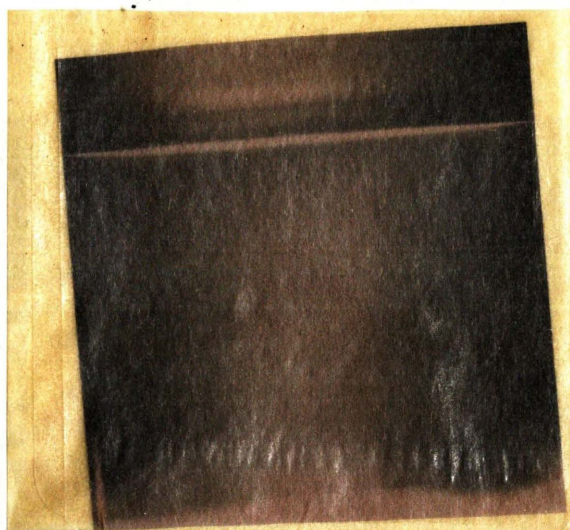
The inside of the camera should be free of dust and lint. Debris on the inside of the camera can fall onto the lens, thereby decreasing picture quality by diffusing the light rays passing through the lens or can fall on the film after the camera is loaded, thereby blocking part of the image. Any accumulation of dust inside the camera can also cause unnecessary wear to the moving parts of the camera. By lightly brushing and blowing out the camera with a mild air blast, these problems can be eliminated.

The basic problem that can occur while loading the camera is fogging the film on the edges, thus ruining a portion of the negative for use in recording the image.

The negative in Example 2 shows the effects of improper loading and film handling while loading. Notice the dark streaks or "edge fog" on each side of the negative.

The main cause of this is allowing the new roll of film to loosen or unwind partially while attempting to load it. Care should be taken to keep the film tightly rolled after removing the paper band that keeps the

film tight. It is necessary to unroll a portion of the paper backing (leader) to attach to the take-up reel, so extreme caution should be taken not to unroll more than is necessary.



EXAMPLE 2

EDGE FOG

Another problem which starts with loading the film is not centering the film leader end into the slot on the take-up reel (Plate A). If the film leader isn't centered exactly at this point, it will bind on one side of the reel, causing a light leak when the camera is unloaded after shooting. The damage done will be much like that shown in Example 2.

When loading is complete, the camera back should be swung into place and locked securely. Failure to



lock the camera back will result in fogged film. After the back is secure, the film should be advanced to the first picture.

### Exposing the Film

The objective of exposing the film should be

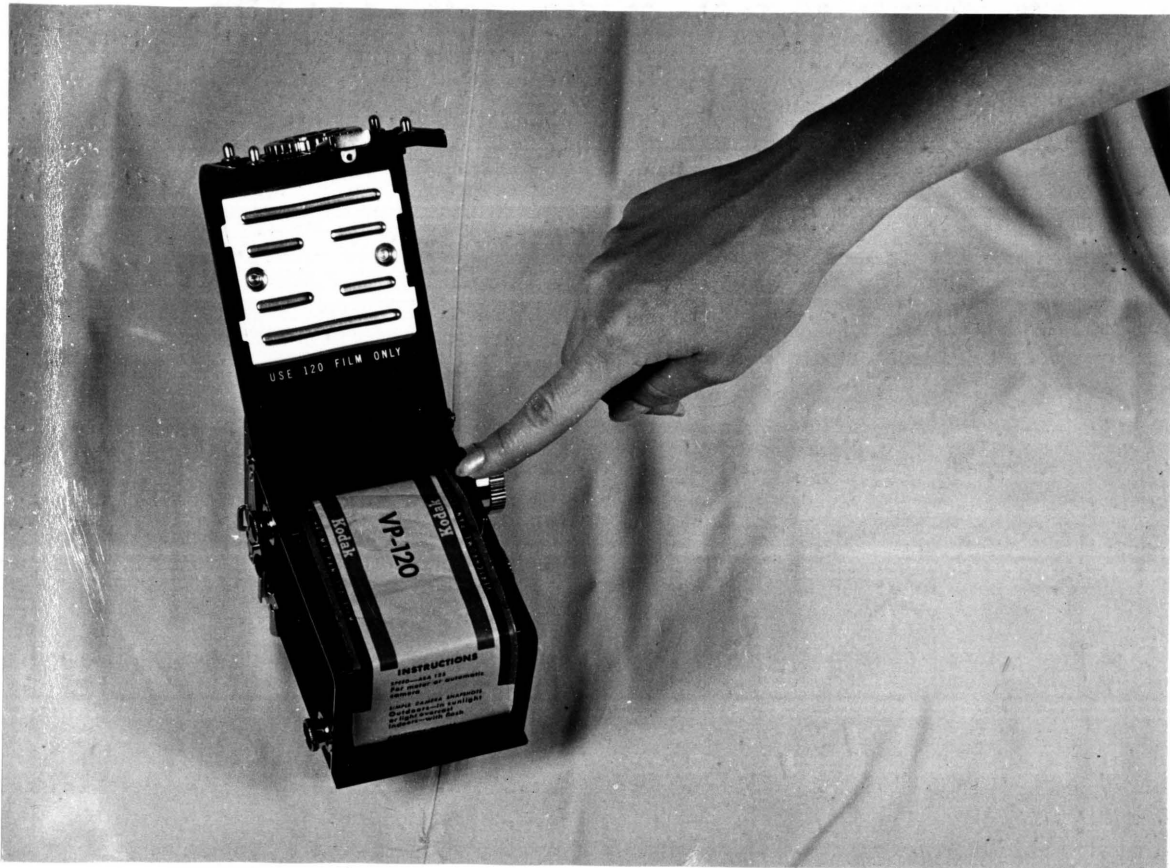


PLATE A

INSIDE OF YASHICA D CAMERA DURING LOADING

focusing the right amount of light for the right amount of time on the film to yield an accurate rendition in degrees of black and white on the negative. Most of the

mistakes which occur in photography classes are connected with these three variables: time of exposure, aperture and focus.

The focusing problem stems from two situations. The first and most frequent is the failure to remember to focus the camera on the subject. With so many things to remember, the new photographer often simply forgets to focus, only to be disappointed after developing his work and finding fuzzy images recorded on the film. Most photography lab cameras are equipped with a ground glass viewing screen that also serves as a frame for composing the picture. This is where the picture or subject should be checked for focus. The second situation occurs with people who need corrective lenses and have difficulty getting a subject into focus. The solution in this case is to wear proper eye glasses when taking a picture. Example 3 shows an out-of-focus negative.

There is absolutely nothing that can be done to "fix" a negative that is out-of-focus. If a negative is fuzzy, the print or contact from that negative will be fuzzy. The photographer will either have to live with unclear prints or discard the negative.

The second and third variables in exposure, lens opening (f stop) and shutter speed, are the most critical aspect of photography, and it is these two that give the student his biggest headaches.



### EXAMPLE 3

#### OUT-OF-FOCUS NEGATIVE

The negative requires a certain amount of light for the proper exposure (determined by the ASA or film speed). The shutter and lens opening (aperture) control incoming light and compensate for differences in light on the subject. The shutter speed, or the length of time the lens is open, is set in fractions of a second while the aperture of the lens is set in numbers called f stops which relate to the proportionate size of the hole through which the shutter will allow light to pass.

With every roll of film comes a sheet of paper giving instructions as to the use, handling and exposure of that particular type of film.

As shown in Table 1, various conditions or light situations require different settings of f stop and

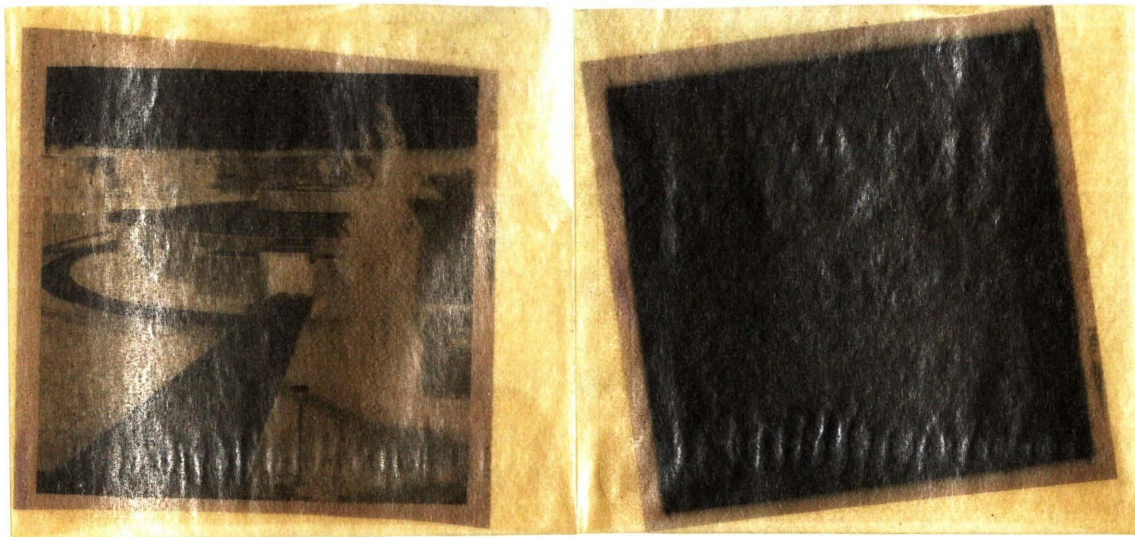
shutter speed to properly expose the film. The less light available, the larger the aperture (the smaller the  $f$  number, the larger the opening) and/or slower the shutter speed to allow the proper exposure to take place. Shutter speed and  $f$  stop have a direct relationship: as you increase one, you must decrease the other.

TABLE 1  
TRI-X FILM DATA

Outdoor Exposure Table for Average Subjects				
Shutter Speed 1/400 or 1/500 Second	Shutter Speed 1/200 or 1/250 Second			
Bright or Hazy Sun on Light Sand or Snow	Bright or Hazy Sun (Distinct Shadow)	Cloudy Bright (No Shadows)	Heavy Overcast	Open Shade**
f/22	f/22*	f/11	f/8	f/8
<p>* f/11 at 1/200 or 1/250 second for backlighted close-up subjects.</p> <p>** Subject shaded from the sun but lighted by a large area of sky.</p>				



Two things can go wrong with exposure at this point. The negative can either be underexposed by not letting enough light into the camera, or overexposed by letting in too much light. In Example 4 are an underexposed negative, an overexposed negative and a normal (correctly) exposed negative.



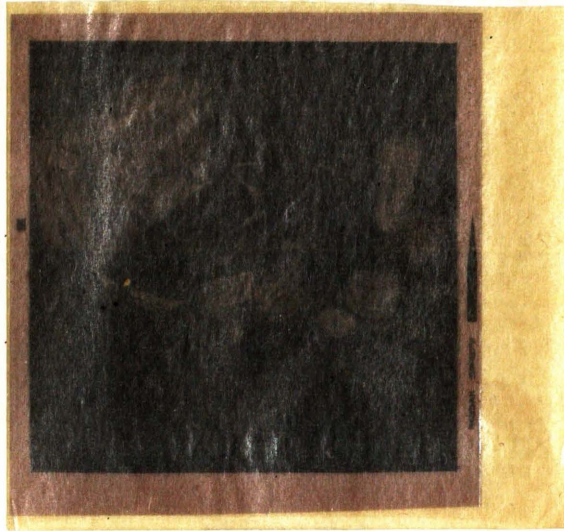
Underexposed

Overexposed

## EXAMPLE 4

## UNDEREXPOSED AND OVEREXPOSED NEGATIVES

The normal or correct exposure is the goal because such a negative will give the most accurate tonal values when printed. The underexposed negative will yield a print with detail missing in the shadow area. This is because the film couldn't receive enough light to record this area. Contrast is also lost with underexposure,



Normal Exposure

#### EXAMPLE 4

#### NORMALLY EXPOSED NEGATIVES

requiring compensation in print-making. The overexposed negative will be lacking detail in the highlight area. A slight overexposure is not extremely harmful. In fact, it is always better to overexpose to a certain extent than to underexpose.

#### Camera Movement

Camera movement while exposing the negative is a common problem for the beginning photographer. The resulting negative will look much like an out-of-focus negative; everything shown on the negative will be slightly blurred, yielding a blurry print, as in Example 5.





#### EXAMPLE 5

#### CAMERA-MOVEMENT NEGATIVE

The solution to this problem is to follow two basic rules: first, never hand-hold a camera when shooting at less than  $1/60$ th of a second shutter speed, and second, always be as steady as possible when shooting by standing firmly and squeezing the shutter release instead of snapping it.

#### Action Photography

Often blurry subjects appear in negatives when the photographer attempts to stop action with a shutter speed that is too slow. Action-stopping requires fast shutter speed and consequently a larger aperture unless the blurry effect is desired. The print in Example 6 shows what happens when a fast-moving subject is photographed with a shutter speed that is too slow.



#### EXAMPLE 6

#### BLURRED-SUBJECT NEGATIVE

Note the sharp image in the background and the blurry subject in the foreground. If the basic rules as shown in Table 2 are followed, little trouble will be encountered in action photography.



TABLE 2

## ACTION-STOPPING GUIDE

For Subjects such as	Distance from Camera	Shutter Speeds for Moving Subjects		
		Directly Head-On	At about 45°	At about 90°
Pedestrians, construction work, most ordinary activities	25 feet	1/125	1/250	1/500
	50 feet	1/60	1/125	1/250
	100 feet	1/30	1/60	1/125
Most sports and more energetic activities	25 feet	1/250	1/500	1/1000
	50 feet	1/125	1/250	1/500
	100 feet	1/60	1/125	1/250
Fast cars, trains, planes, and other swift motion	25 feet	1/500	1/1000	----
	50 feet	1/250	1/500	1/1000
	100 feet	1/125	1/250	1/500

Unloading the Camera

The results of improper unloading of the camera will be pictures ruined by fogging. The way to avoid this problem is never to open the back until the film is wound completely onto the take-up spool. Always take care not to allow the exposed roll of film to unravel before development. If these precautions are not taken, time and film have been wasted because there is little chance that any of the negatives will be usable.

### Processing the Negative

The darkroom for film developing must be light-tight. If there is a light leak, fog damage to the film may result. There must be a timing device which can be read or heard without turning on a light unless the light-tight tank and reel method of development is used.

For optimum results, the chemicals used should be at a constant temperature of 68 degrees F and of the correct type for the film. In most student labs a general-purpose developer is used with such factors as temperature and replenishment (periodic rejuvenation of the developer after use) strictly controlled by the instructor to eliminate student error in these areas. In most cases, development stopping and fixing times will be posted in accordance with the brand of developer being used.

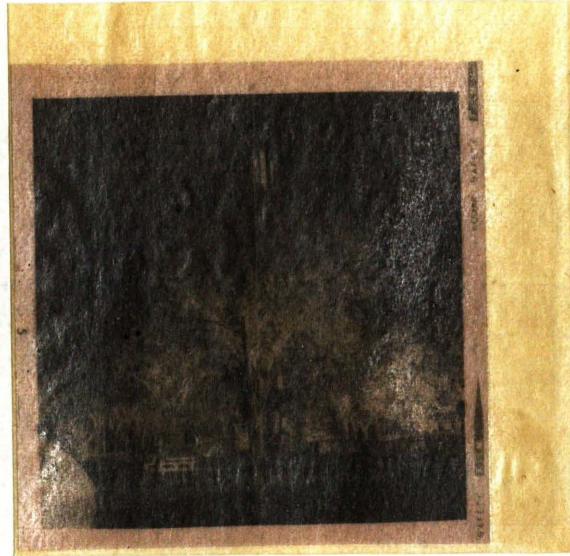
The steps in developing black and white negative film are simple. First, the film must be completely immersed in developer for a specific amount of time and must be agitated. Second, the film must be completely immersed in a chemical bath to stop development. Third, the film must be immersed in a fixing bath (sometimes referred to as hypo) to make the negatives permanent and to clear away an opaque coating on the film. All that remains is washing the negative, to remove remaining chemical residue, and drying.

Now that the steps in film processing are known, the film must be put into these various chemicals without damage. There are two methods used successfully. The first consists of winding the film onto a reel and placing it in a fillable, light-proof tank so that chemicals may be poured in and out during processing. The second is the hand method of processing, requiring the rolling and unrolling of the film by hand in tanks during development. The first method is far superior because it lessens the chance of scratching the negatives by rough handling and it allows the film to be processed with the lights on because the film and reel have been placed into a light-tight tank.

There are four major types of problems that will arise in the development of film. The first and perhaps most common one is physical damage to the negative in the form of scratches, film tears and crescent-shaped nicks picked up during processing. This kind of negative damage can be seen clearly in the negative in Example 7.

Scratches will appear as black or dark grey lines on the print. The reason for this is that the scratches actually remove part of the emulsion, allowing white light to pass through the negative onto the paper.

Another error made frequently is in developing time. If negatives are left in the developer longer than specified, they will become overdeveloped and dense, thereby sacrificing detail and sharpness. If the negative is



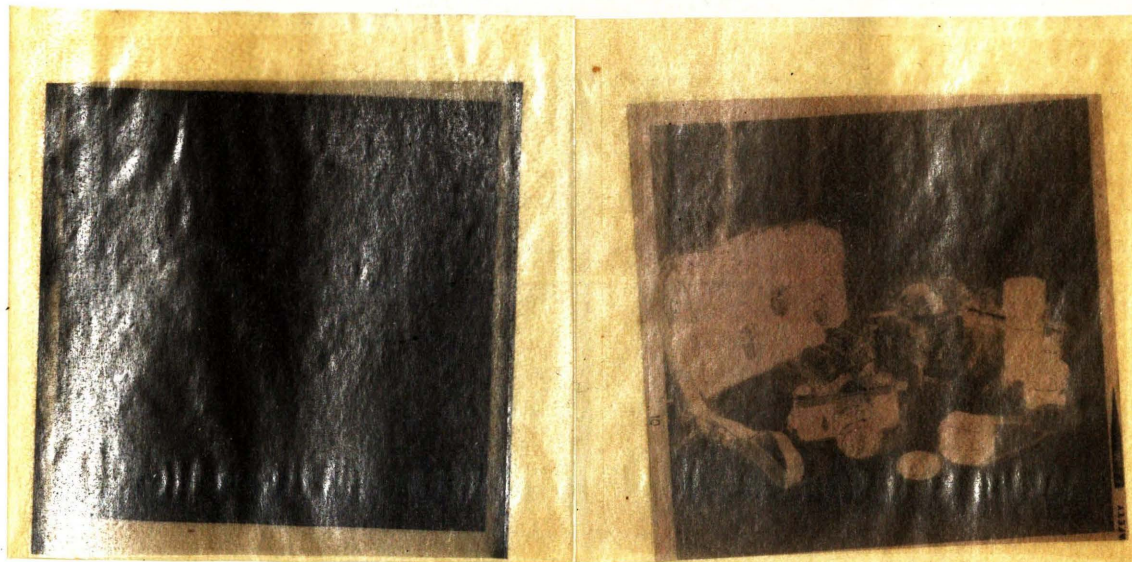
EXAMPLE 7

## SCRATCHED NEGATIVE

highly overdeveloped, it will darken completely and be unprintable. Taking the negative out of the developer before the total developing time has elapsed will result in an underdeveloped negative, and detail will be lost in the shadow areas. If the negative is highly underdeveloped, it will be almost clear (too thin) and unprintable. Example 8 shows overdeveloped, underdeveloped and normal negatives.

The third problem is less obvious than the other two. It results from failure to agitate the film during development. The contrast in the film will appear mottled and dull, as in Example 9.





Overdeveloped

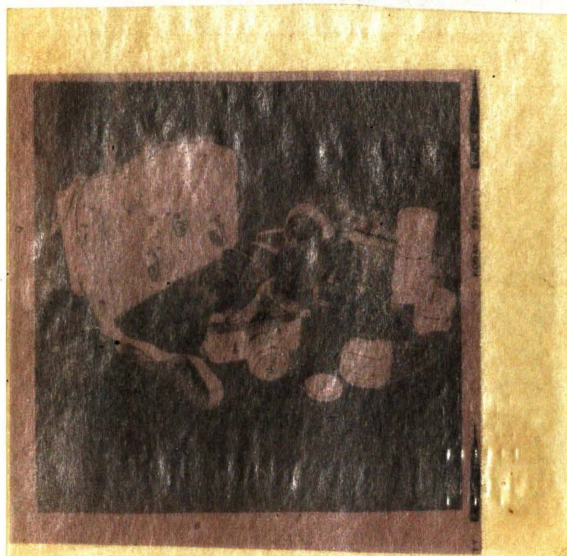
Underdeveloped



Normal

EXAMPLE 8

OVERDEVELOPED, UNDERDEVELOPED AND NORMALLY  
DEVELOPED NEGATIVES



#### EXAMPLE 9

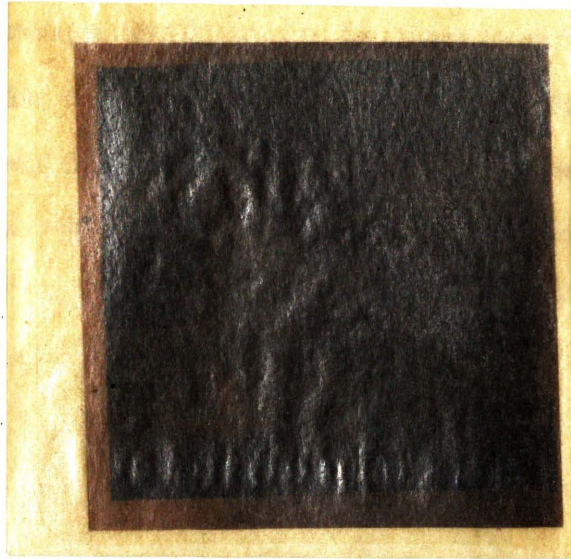
#### UNAGITATED NEGATIVE

The fourth problem occurs when the film isn't allowed to stay in the fixing bath long enough. This will result in a cloudy negative that has portions of the image fading, as shown in Example 10.

All of the aforementioned errors can be eliminated by careful darkroom handling and by paying strict attention to processing times. The damage in most cases, depending upon the degree of the damage, is permanent and there is little that can be done to salvage the negative.

The steps after development include washing and drying the negative. According to most film manufacturers, negatives should wash for a minimum of 20 minutes at a wash-water temperature of approximately 68 degrees F. Decreasing the wash time will decrease the life of the





#### EXAMPLE 10

#### INSUFFICIENTLY FIXED NEGATIVE

negative because of residual fixing solution of the film. The effects of this are not immediately noticeable in a print, but it is none-the-less important for negatives that are to be saved for any period of time.

Wash-water temperature should never exceed 75 degrees F because at temperatures above this the emulsion of the film may soften to the point of coming off the film base and rinsing down the drain.\* Wash-water temperature should also be kept warmer than 65 degrees F unless the wash time is greatly increased.

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\* This holds true for almost all cases except where the developing process changes the characteristics of the film to allow greater wash temperatures as in the case of Patterson Chemical Company's P.Q.D. process that allows 150 degrees F wash temperature.

After thorough washing it is recommended that the film be placed in a "wetting solution," such as Kodak's Photo-flo 200, which helps to eliminate water spots and to speed drying. Example 11 shows a badly water spotted negative.



EXAMPLE 11

#### WATER-SPOTTED NEGATIVE

The negative is now ready to be dried. This can be done in a drying cabinet designed specifically for fast-drying film or the negative can be left hanging in the open to air dry. In either case it is an absolute necessity that the atmosphere be as dust-free as possible and that the negatives not be in contact with any surface other than a weighted device at one end (such as a clothes pin) to help prevent curl and a clip at the other end from which to suspend the wet negative.



When drying is complete, the negatives should be cut into convenient strips of two, three or four frames and stored in a protective envelope of some kind. There are several different sizes of glassine envelopes commercially available for this. The envelope prevents scratches on the negative from handling and allows the negatives to be filed conveniently.

This part of the study has dealt with the major problems that students seem to encounter when making photographic negatives with a roll-film camera of the twin-lens reflex variety. It is hoped that the examples and brief explanations accompanying them will be of use in trouble-shooting this part of the photographic process.

If one piece of advice could be given to sum up the solutions to all the aforementioned problems, it would be "don't cut corners." Follow all directions to the letter; don't skip any steps; and don't try to get by with poor darkroom techniques. If a mistake is made at this point, the photographer is starting at a big disadvantage in the subsequent steps of actually making the print from the negative.

## PART II: THE PRINT

### Printing

Print-making is enjoyable to most photographers because it allows for creativity beyond the camera. Many poor negatives can be salvaged and many special effects can be achieved in printing. This part of the paper will be concerned with problems encountered while producing prints from student negatives.

Everything in print-making begins with the darkroom. The darkroom must be light-tight and reasonably clean. Excessive amounts of dust will lead to a great many printing problems. Light-leaks in the darkroom will cause obvious problems by exposing the light-sensitive emulsion of the photographic paper to be used.

The darkroom should contain a safe light with the proper filter (Kodak OC) and proper bulb size (15 watt). The safe light should be mounted or hung at least four feet from any photographic paper. It should illuminate the working area and timing device.

The chemicals to be used in developing the exposed photographic paper should be kept at 68 degrees F. An area should be provided for trays containing the developer, stop bath and fixing bath (hypo).

Because it is assumed that this paper deals with

problems encountered in a student darkroom where such variables as chemical mixing and chemical life are controlled by the instructor, there will be no mention of problems along this line except to say that it is essential in making good prints that chemicals be mixed properly and maintained at the proper temperature.

### The Enlarger

The main tool in print-making or enlarging, as it is called, is the enlarger. The examples used in this paper have been produced on an Omega enlarger, model D-2, which will accept negatives from 4" x 5" to 35mm size.

The enlarger consists of a light source, a set of condensers to focus the light through the negative, a negative carrier to hold the negative and a lens with an adjustable diaphragm to control the amount of light (Plate B).

The enlarger is attached to a vertical support which in turn is attached to a base called the copy board. The easel rests on the copy board and holds the photosensitive enlarging paper in place for exposure (Plate B).

Check to make sure that the copy board, the lens and the negative are all parallel to each other. If they are not, distortion will appear in the print.

Before using the enlarger, it should be checked for dust and dirt. The surfaces of the lens (both sides) and

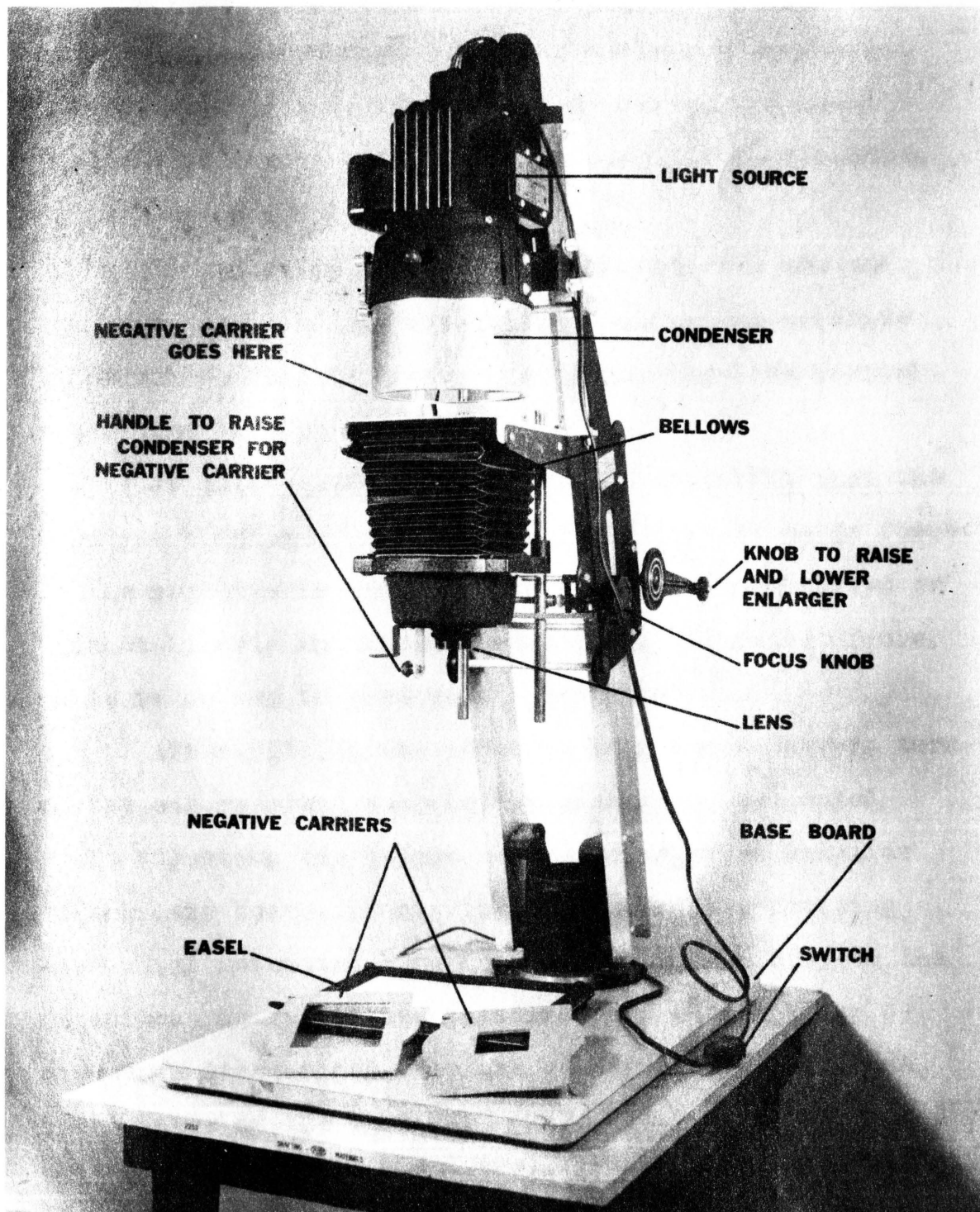


PLATE B

THE ENLARGER

the condenser (top and bottom) are likely to pick up dust and should be kept clean and dust-free to insure high quality in the print. In most cases, the manufacturer of the enlarger supplies complete instructions for maintenance and cleaning.

If all is in order in the darkroom and the enlarger is clean and in proper adjustment, the negative to be printed may be inserted into the negative carrier and placed into the enlarger.

At this point it is absolutely essential that the negative be free of dust and lint and that it be in focus. If the negative is dusty or dirty, it can be rewashed or brushed lightly and blown clean. If it is out-of-focus, there is no way to produce a sharp print.

After placing the negative into the enlarger, turn on the enlarger and compose the picture on the easel while adjusting the height of the enlarger in relation to the copy board. Focus the image with the focusing knob which moves the lens up and down in relation to the negative. To facilitate this process, the lens may be opened to its maximum aperture by turning a ring around the outside of the lens.

At this point several decisions can be made concerning the negative. First, is it sharp enough (in focus enough) to print? If it is, the next move is to determine if the negative has been exposed and developed properly. If the negative is too thin (very little image and quite

clear), it may not be printable. If the image on the negative has a range of tones from black to white or almost clear, with many grey tones in between, it will print nicely. The final decision will be which contrast grade of paper should be used to get the best results.

Enlarging paper comes in grades from one through six. A normal negative--one with a complete range of grey tones from black to white--will require a number two paper (see normally developed negative in Example 8 and normally exposed negative in Example 4). A thin negative, one with less contrast, i.e., one with few grey tones and no solid black areas, will require a higher numbered paper. The lack of contrast in the negative may be so great that even a number six paper won't produce a print (see underexposed negative in Example 4 and underdeveloped negative in Example 8).

In the student darkroom, only number two and number three paper should be used because good negatives are easily obtainable by reshooting or starting over. The higher contrast grades (four, five and six) are needed only when mistakes are made in exposing or developing negatives of the professional or serious amateur and the possibility of reshooting is slim.

The number one contrast grade is for a very thick negative, i.e., one that is very dark. This grade is almost never used because number two paper will handle most thick negatives effectively.



### Exposing the Print

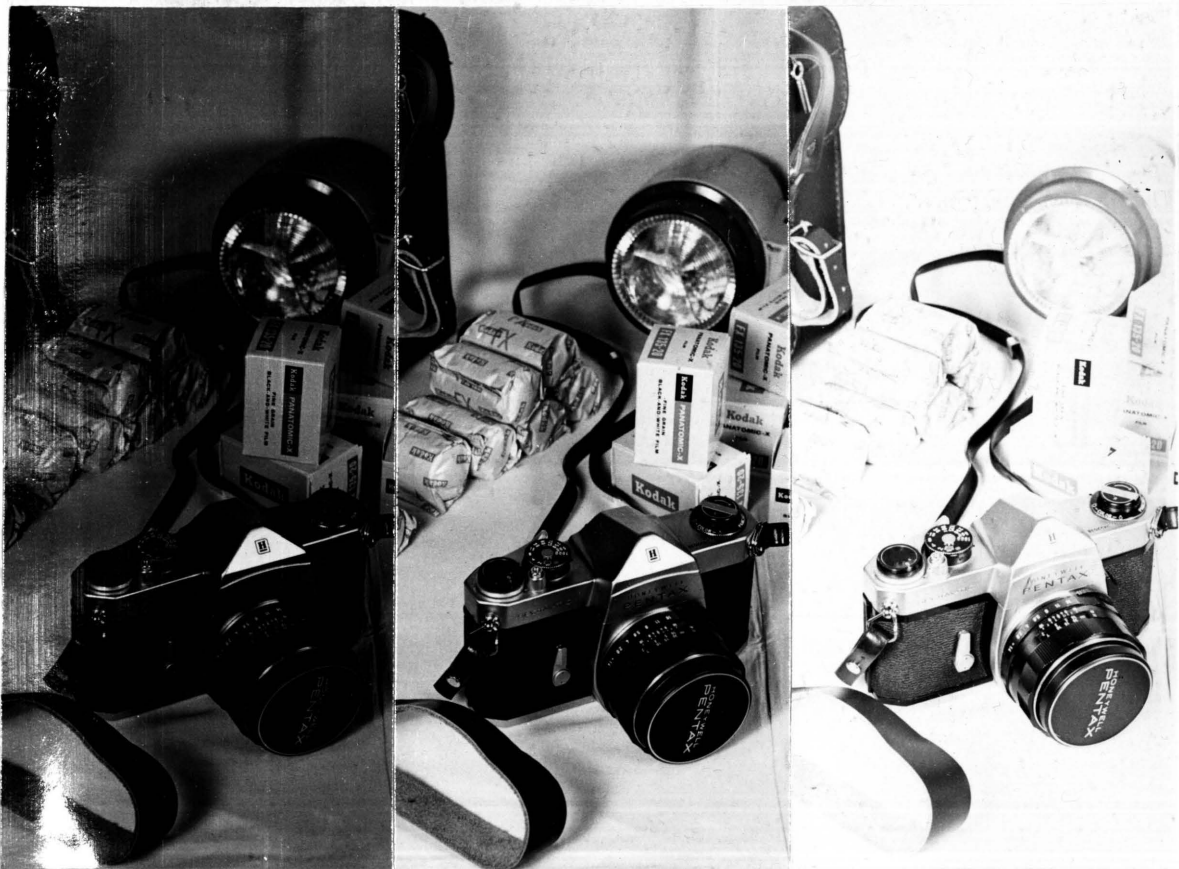
The next step is exposure of the enlarging paper. The enlarger, at this point, works much like a camera, with only minor differences. The time of exposure is controlled by turning on the light in the enlarger. The aperture ring on the lens controls the amount of light that will fall on the enlarging paper, which acts like the film and records the image that appears after development.

The first step in exposure is to check focus and position of the easel. If all is in order, stop down the aperture ring on the lens to f8 or f5.6. (If the lens has click stops, stop it down about three clicks.) This allows for a longer exposure for more accurate timing than if the lens were left wide open. Next cut a piece of enlarging paper into strips for trial exposure. The test strips must be cut from the same grade of paper being used. One at a time, expose three of these strips by placing them on the easel and turning on the enlarger. The first strip could have a five-second exposure, the second strip a ten-second exposure and the third a fifteen-second exposure.

Next place all of these strips in the developing tray at once, submerging them in the developer completely and agitating the tray continuously. After about a minute and a half, development should be complete. Check each strip carefully and determine which one shows the



best exposure (best image with good contrast). If none are good and they all appear underexposed, then increase each time by approximately five seconds. If all are too dark, stop the lens down and repeat the process until an exposure time that will yield a good print is obtained. Example 12 shows a print that is correctly exposed in contrast to one that is overexposed and one that is underexposed.



Overexposed

Normal

Underexposed

## EXAMPLE 12

OVEREXPOSED, UNDEREXPOSED AND NORMALLY  
EXPOSED PRINTS

If the print seems to lack contrast and appears flat or dull, the wrong grade of paper was used for the negative. Example 13 shows a negative with less than normal contrast printed on number two paper and on number three paper. Note that number three paper yields the better print.



Number two

Number three

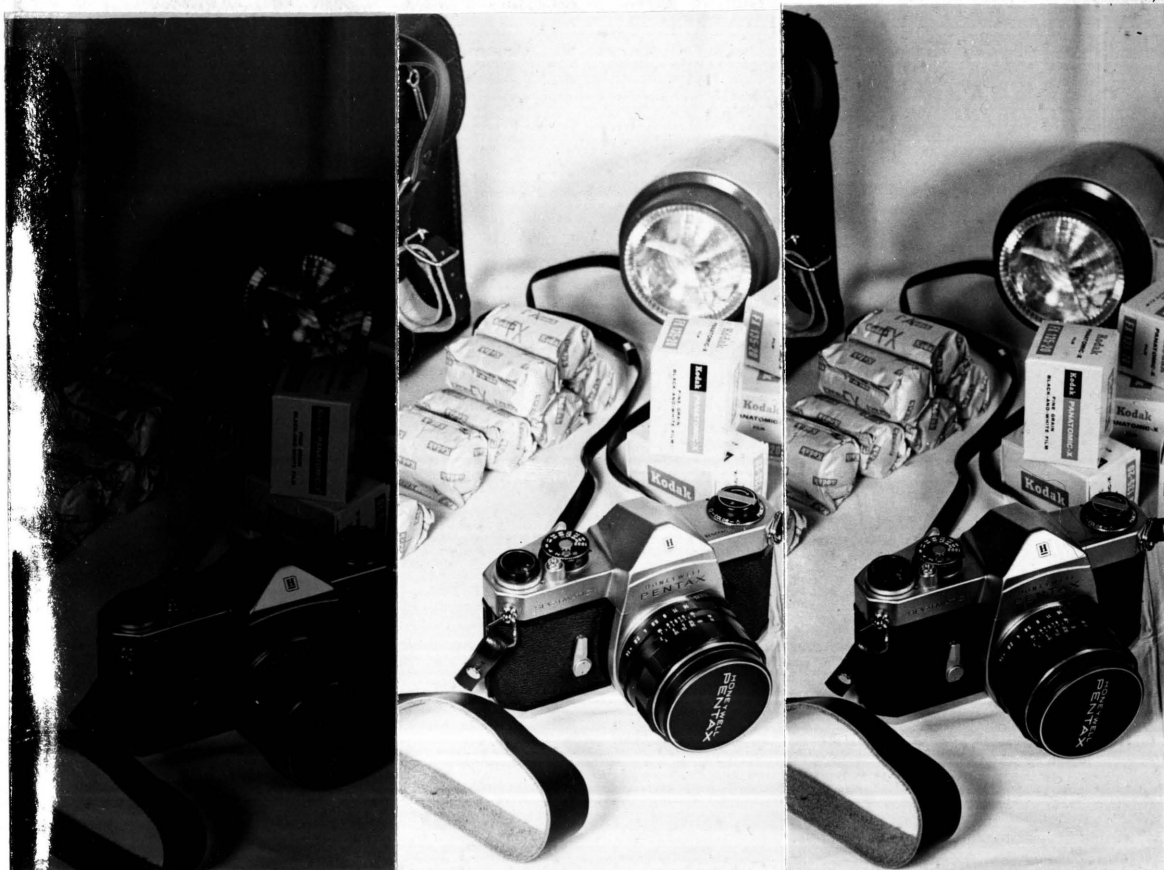
## EXAMPLE 13

THIN NEGATIVE PRINTED ON NUMBER TWO AND  
NUMBER THREE CONTRAST PAPER

### Developing the Print

Now that the print has been exposed correctly, using the proper grade of paper, there are several steps in developing, stopping and fixing the print that can cause trouble.

The first would be under- or overdeveloping the print. Example 14 shows an underdeveloped print (note that part of the image hasn't appeared), a normal or correctly developed print and an overdeveloped print (note how the print has become dark and the usually white, highlight areas have started to grey).



EXAMPLE 14

OVERDEVELOPED, UNDERDEVELOPED AND  
NORMALLY DEVELOPED PRINT

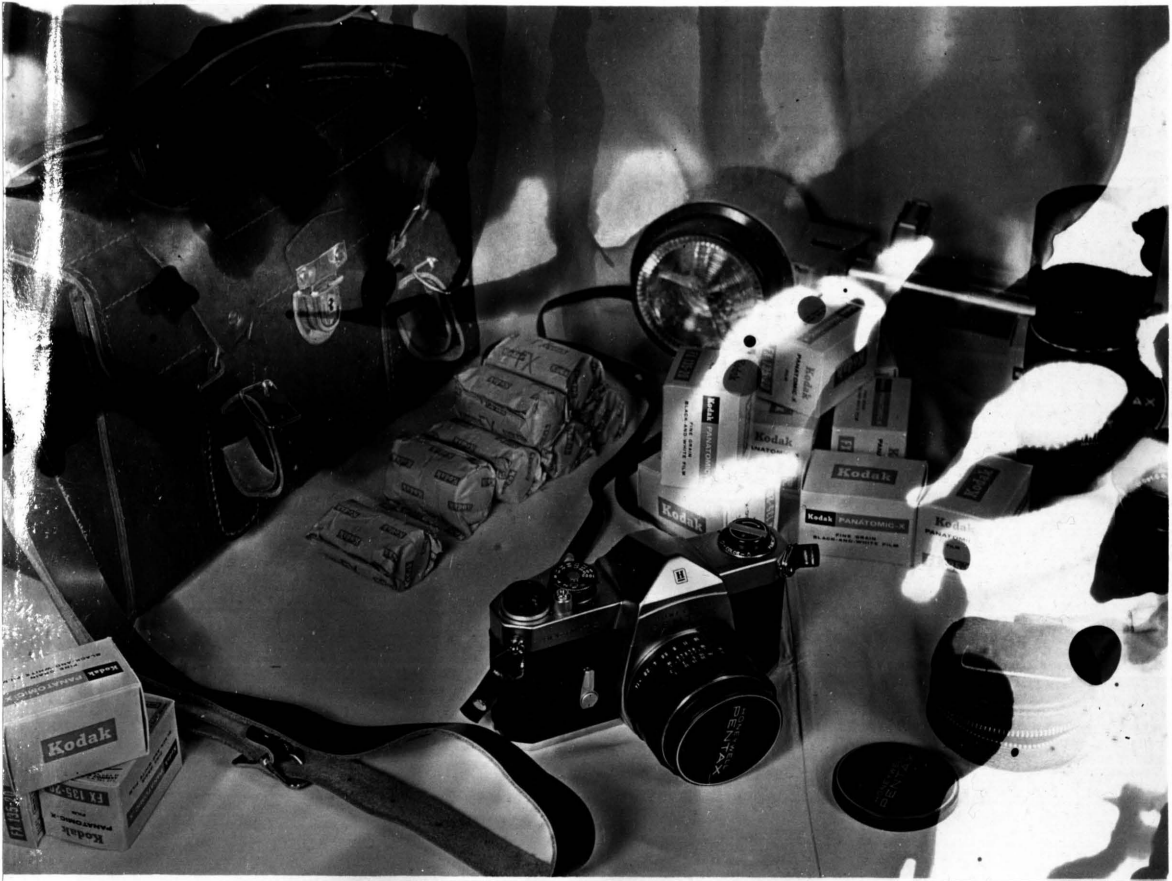
When placing the print in the developer and the stop bath, it is essential that the print be submerged completely and quickly to insure even development and even stopping of development. A line as seen in Example 15 could appear if care isn't taken in submerging the print.



EXAMPLE 15

#### UNEVENLY DEVELOPED PRINT

Continuous agitation is necessary throughout development. If the print isn't agitated, it becomes grey and mottled, as in Example 16.



### EXAMPLE 16

#### PRINT DEVELOPED WITHOUT AGITATION

During development, rough handling with print tongs (used to handle print while in chemicals) can lead to scratches on the print. These scratches seldom can be removed. Example 17 shows print scratches from rough handling during development.

The final step in developing the print is fixing. The print should be soaked in a fixing solution for at least ten minutes. This varies depending on the manufacturer's recommendation. After fixing, the print





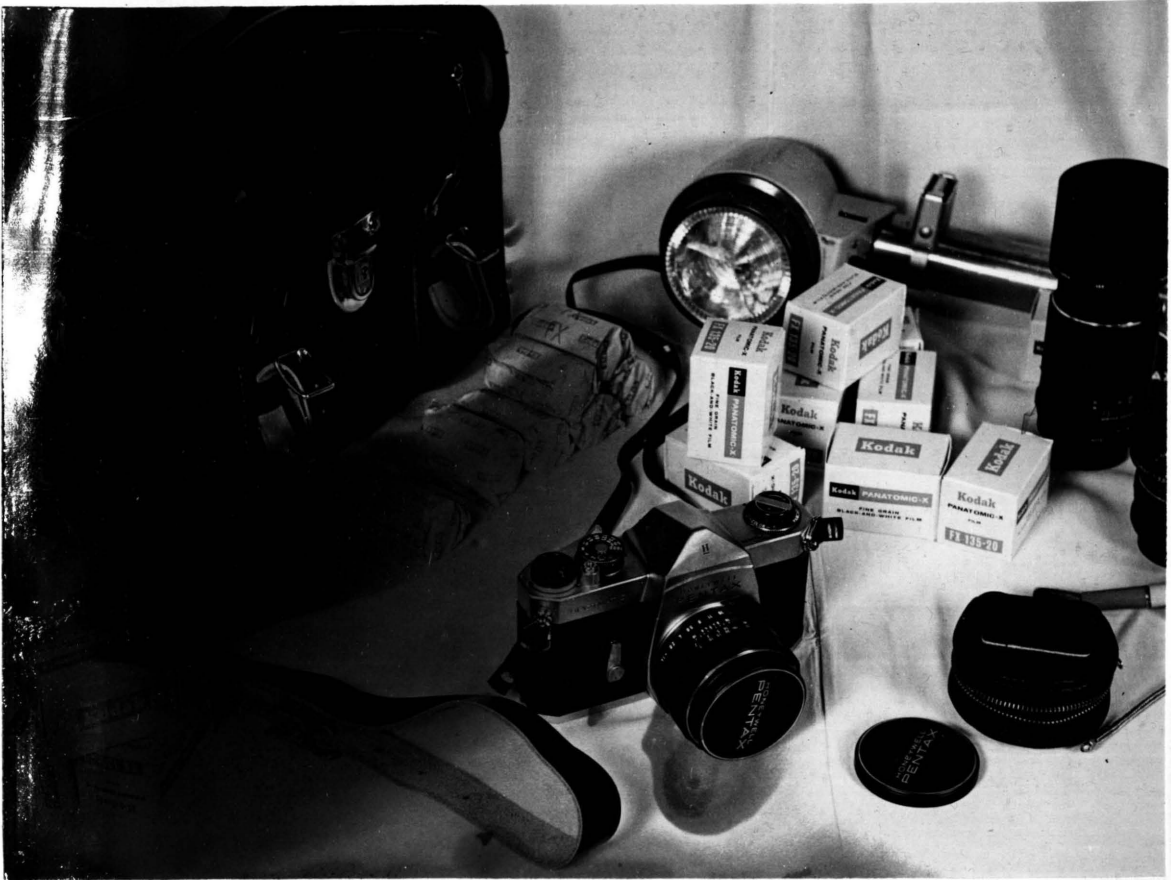
### EXAMPLE 17

#### SCRATCHED PRINT

can be handled in normal room light for subsequent operations. If the print isn't fixed long enough and it is brought into normal light, it will turn dark and fade, destroying the print. Sometimes, however, the print will not show this until after it is washed and dried. Example 18 shows a print that hasn't been fixed properly.

#### Washing the Print

The idea behind washing the print is to remove



### EXAMPLE 18

#### INSUFFICIENTLY FIXED PRINT

all of the excess fix from the print. Any fix left on the print will eventually cause the print to fade, discolor or become mottled.

Ideally, after fixing, a five-minute soak in a hypo (fix) clearing agent should be used. This chemical bath removes excess fix before washing, therefore reducing washing time and ensuring long-lasting prints. If hypo clearing agent is used, only a 10- to 15-minute wash is necessary instead of the normal half hour recommended time.

The theory of most washers for prints is to float away fix while agitating the prints gently. There are many different kinds of washers that accomplish this very well.

Normal tap water about 68 degrees F should be used. It should never be above 75 degrees F and any temperature below 68 degrees F will necessitate a longer wash time. Example 19 shows the result of insufficient washing of a print. Note the faded appearance of the normally white paper.



EXAMPLE 19  
UNWASHED PRINT

### Drying the Print

The thoroughly washed print should now be soaked in a wetting solution which consists of a mild detergent mixed with water. The wetting solution insures a smoother, shinier gloss on gloss prints and aids in flattening mat and gloss prints. Failure to use a wetting solution will not affect the finished product greatly, but handling may be more difficult because of the tendency of the print to curl.

The method of drying prints depends upon the equipment available and the type of paper used for the print.

If a mat or dull finish is desired and a heat-type dryer is not available, the print should be rolled up in photo blotting paper after draining excess water and/or wetting solution. A heat-type dryer has a smooth, highly polished metal surface, either flat or drum-shaped, covered by a cloth. The metal surface heats and the cloth holds the print snug against the heated metal surface during drying.

The common method of loading the dryer for mat finishing the print is to drain excess moisture and smooth the wet print onto the metal surface with the back of the print against the metal and the picture surface in contact with the cloth. The cloth texture is thus imparted to the picture surface. The dryer should be preheated to a temperature recommended by the manufacturer.

When a gloss print is desired, assuming gloss paper has been used, the print should be drained and placed wet, face down on the glossy metal surface. The print should then be pressed smoothly onto the metal, using a rubber roller designed for this purpose. Next the cloth should be brought into contact with the metal and prints to hold them in place while drying. The print is dry when it can be removed without peeling from the dryer.

The automatic drum dryer works essentially the same as the dryer mentioned above. The only difference is that the metal surface is cylindrical and revolves with the cloth in constant contact. The prints need only to be drained and fed face up onto a cloth belt that will take them around the drum and drop them conveniently in a basket when dry. This takes one revolution. The most common type of automatic drum dryer is pictured in Plate B.

The most common problem with drying glossy prints is having the prints stick to the dryer. This happens for either of two reasons: the student is impatient and tries to remove the prints before they are dry, or the metal surface is dirty and needs cleaning with ferrotype plate cleaner and polish. When the prints stick and are pulled prematurely from the dryer's surface, they often tear or crack. They almost always have little gloss. The cure is simple: wait until the prints loosen themselves.

One other problem may occur when glossing prints--



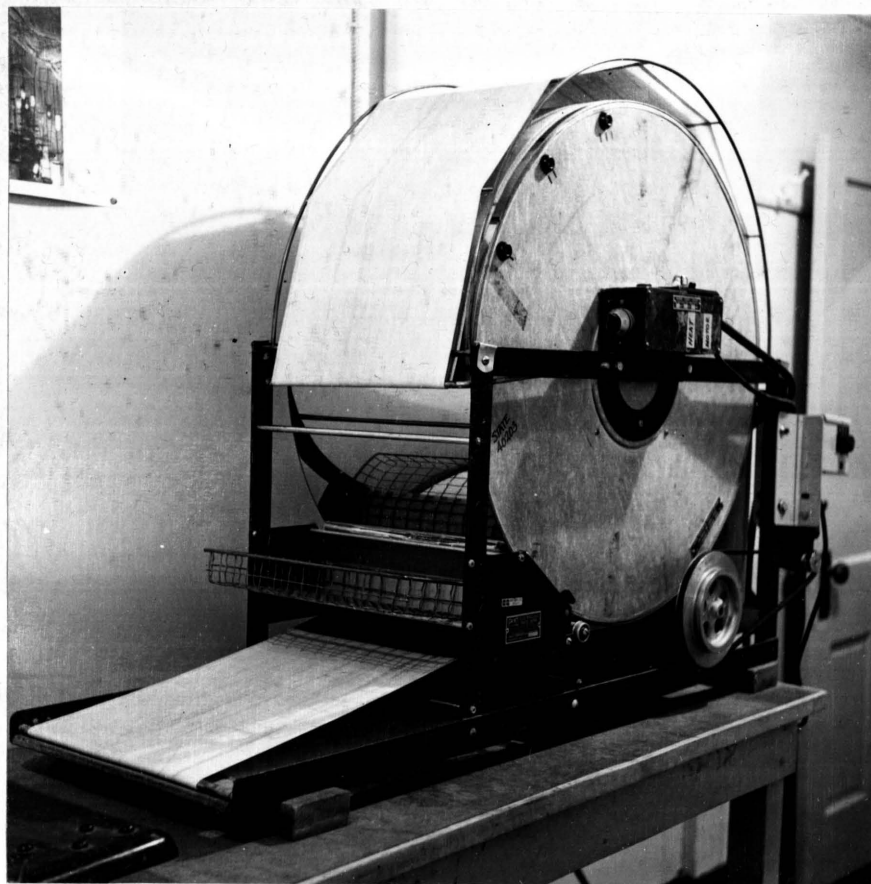


PLATE C

## DRUM DRYER

a mottled gloss may appear on the surface after drying. This is caused by putting the prints on the drying surface when they are too dry. A certain amount of moisture is necessary for a good gloss. If the prints are too dry before drying, they will look like Example 20.

Other drying problems do occur but are not important. If minor problems do arise, the print can be rewetted in the wetting solution and dried again.

As in the first part of this chapter, examples have



## EXAMPLE 20

## IMPROPERLY GLOSSED PRINT

been inserted where possible to demonstrate the problems which may arise while producing prints from negatives.

The quality of the print produced depends directly on the quality of the negative and the photographer's ability to follow the basic steps involved without cutting corners. When producing a print, the same care should be taken in printing as is given to producing a good negative.

## BIBLIOGRAPHY

## Books

- The Camera, (New York: Time-Life Books, 1970).
- Elementary Photographic Chemistry, (Rochester, N. Y.: Eastman Kodak Company, 1936).
- Light and Film, (New York: Time-Life Books, 1970).
- Mees, C. E. K. The Fundamentals of Photography, (Rochester, N. Y.: Eastman Kodak Company, 1938).
- Miller, Thomas H. and Wyatt Brummitt. This is Photography, (Garden City, N. Y.: Garden City Publishing Company, Inc., 1947).
- Neblette, C. B. Photography, (New York: D. Van Nostrand Company, Inc., 1935).
- Neblette, C. B. and others. Elementary Photography, (New York: The MacMillan Company, 1936).
- Rothstein, Arthur. Photojournalism, (New York: American Photographic Book Publishing Company, Inc., 1965).

## Pamphlets

- Basic Developing Printing Enlarging, (Rochester, N. Y.: Eastman Kodak Company, 1962).
- Camera Technique, (Rochester, N. Y.: Eastman Kodak Company, 1965).
- Color as Seen and Photographed, (Rochester, N. Y.: Eastman Kodak Company, 1966).
- Filters, (Rochester, N. Y.: Eastman Kodak Company, 1969).
- Flash Pictures, (Rochester, N. Y.: Eastman Kodak Company, 1965).
- Kodak Color Films, (Rochester, N. Y.: Eastman Kodak Company, 1968).

Kodak Master Darkroom Dataguide, (Rochester, N. Y.:  
Eastman Kodak Company, 1967).

Photography in the School, (Rochester, N. Y.: Eastman  
Kodak Company, 1965).