1953

The hypersensitization of sixteen millimeter black and white motion picture film by pre-exposure to light

BOSTON UNIVERSITY

School of Public Relations

Thesis

THE HYPERSENSITIZATION OF SIXTEEN MILLIMETER BLACK AND WHITE MOTION PICTURE FILM BY PRE-EXPOSURE TO LIGHT

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(B.S., Boston University, 1952)

Submitted in partial fulfillment of the requirements for the degree of Master of Science

1953

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CHAPTER I

THE PROBLEM AND DEFINITIONS OF TERMS USED

For many years there have been constant improvements in the manufacture and use of motion picture film. Scientific advancements further progress in the photographic field but certain problems will be present for some time. As Sheppard points out:

> "There are two subjects of perennial interest to seriously minded photographers. One consists in attempting to improve the sensitized material furnished by photographic manufacturers, by processes generally termed "hypersensitizing," the other amounts to attempts to rectifying the consequences of inadequate exposure to light of said material--or of such material lacking sufficient sensitivity for the available light." [1]

I. THE PROBLEM

Statement of the problem. It was the purpose of this study: (1) to attempt a method of hypersensitizing sixteen millimeter black and white reversal and negative film by pre-exposure to light; (2) to show the results obtainable from such experiments; and (3) to point out the conditions under which it can be successfully employed and how much benefit can be expected.

1 S. E. Sheppard, W. Vanselow, R. F. Quirk, Journal of the Franklin Institute, 1945, Number 6, Hypersensitizing and Latensification: A Preliminary Survey, Volume 240, P. 439.

Importance of the study. There has been considerable study in supersensitizing film plates and roll film. The results of such studies have been favorable. Upon review of literature concerned with the supersensitizing of motion picture reversal film, it was found relatively few data had been published. Inquiries were made at the Eastman Kodak Research Laboratories[2] and the publishers of the American Cinematographer Magazine. It was learned only related works were available. There has been a call for motion picture films of increased sensitivity in the television, documaentary, educational, semi-professional and amateur fields.

Because of the high sensitometric values of our present day black and white reversal films, it has been generally accepted that if any speed increase was obtainable, it would be so slight as to warrant no pratical use. Such a claim lacks proof.

A variety of methods have been described for increasing the effective sensitivity of emulsions beyond the manufacturers valuations. Most of these methods are too complicated for use in the fields mentioned above. Such treatments are mostly concerned with chemical change of the film and could not be applied to "yellow box" reversal film, since any chemical changes would upset Eastman Kodak developing standards. Some studies concerned with the supersensitization of various still photographic film emulsions have shown

2 Refer to Appendix A in this work, p.57.

promising results. If it were successfully possible to apply a method of supersensitization to motion picture film, an increase in speed without loss of quality would result. Such a method, if available to the cinematographer to use at his own discretion, would enhance the value of todays' motion picture film and allow for its greater use. It was the purpose of this study to find and evaluate a method of supersensitizing certain motion picture film emulsions.

II. DEFINITIONS OF TERMS USED

Contrast. Contrast is the difference between the densities of the most exposed areas and that of the least exposed areas. Contrast is technically measured by gamma.[3]

D-log E curve. This is the curve which relates density with the logarithm of exposure. It exhibits the photographic response of a given emulsion under given conditions of development. It is a type of response curve, which is the same as the H and D curve.[4]

Density. The common logarithm of opacity, which in turn is the reciprocal of the transmission factor of a substance."[5]

Dupe negative. A negative film produced by printing from a positive.

3Raymond Spottiswoode, Film and Its Techniques, Berkeley and Los Angeles 1951, University of California Press, P. 409.

4 Ibid., P. 411

5 Ibid., P. 412

Emulsion speed. "The numerical value of speed is usually related inversely to the minimum useful exposure, so that the rated speed of an emulsion is high when the required exposure is low."[6]

Exposure scale of an emulsion. The ratio of the maximum exposure to the minimum exposure between which the emulsion yields satisfactory reproduction.

Flashing. A method of pre-exposing or post exposing a film to light.

Gamma. "The slope of the straight part of the D-log E curve of a photographic emulsion, as measured by the tangent of the angle which this part of the curve makes with the exposure axis."[7] Mathematically, gamma equals the density increase divided by the log exposure increase.

Graininess. "The characteristic of an emulsion brought about by its being composed of microscopic particles called grains, which are irregularly clustered together into clumps. If these clumps are visible when the image is projected, the image is said to be grainy."[8]

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6 H. A. Miller, R. W. Henn, and J. Q. Crabtree, Methods of Increasing Film Speed, 1946, Reprinted from The Journal of the Photographic Society of America, Number 10, Volume 12, Communication No. 1108 from the Kodak Research Laboratories, P.587.

7 Spottiswoode, op, cit., P. 425.

8 Ibid., P. 426

Hypersensitization. "...treatment of the film before exposure to produce increased sensitivity to light."[9] Methods of hypersensitizing include: (1) bathing the film; (2) vapor treatment; and (3) pre-exposing to light.

Intensification. Treatment of a negative to bring about an increase in contrast.

Latensification. Treatment of the film between camera exposure and development in order to bring about increased sensitivity. Methods of latensification include (1) bathing the film; (2) vapor treatment; and (3) post-exposing to light.

Latent image. "A latent image is the invisible image registered on a photographic emulsion due to the reaction produced in the emulsion by exposure to light."[10]

Original negative. The original film to first be exposed; in this case, original negative stock.

Original reversal. The original film to first be exposed; in this case, reversal (positive).

Positive print. A positive image film produced by printing from an original or dupe negative.

Pre-flash. To hypersensitize a film by pre-exposing it to a uniform light.

[9] Methods of Increasing Film Speed, op. cit., P. 595.

[10] Spottiswoode, op. cit., P. 432.

Resolving Power. The ability of a lens or emulsion to record exceedingly fine detail.

Sixteen millimeter film. "The principal nontheatrical standard gauge of film, sometimes called substandard."[11]

Supersensitization. The increase of sensitivity of photographic emulsion.

Threshold exposure. "The minimum exposure that will yield a perceptible darkening."[12]

Tonal contrast. The ability of a film to record and separate true tonal values.

"Yellow box" reversal. Amateur sixteen millimeter motion picture film sold by Eastman Kodak across the retail counter.

11 Ibid., P.465

12 J. E. Mack and Miles J. Martin, The Photographic Process, 1939, McGraw Hill Book Co., Inc., New York and London, P. 206.

CHAPTER II

REVIEW OF RELATED WORKS

Much has been written in regard to the supersensitizing of photographic emulsions. Studies, however, show relatively few data has been published concerning the supersensitization of motion picture film. Related studies concern still film. Emulsions of still film differ slightly from those of motion picture film. The differences are negligible, nevertheless, due to the relative use of each type of emulsion. Both emulsions yield a photographic image and both emulsions are composed of the same basic elements. Development of reversal film (motion picture) differs from that of negative (still) film. Both emulsions, however, are exposed and sensitive to light. By use of these facts, the works published concerning hypersensitization by pre-exposure of still films were studied and set up as a comparison for the supersensitizing of the motion picture test films.

The hypersensitization of motion picture films. Sheppard[1] experimented with three types of motion picture film; (1) Experimental Panchromatic; (2) Experimental Motion Picture Positive; and (3) Experimental Pure Ag Br. These studies not only were concerned

[1] *Journal of the Franklin Institute*, op. cit, P. 466.

with pre-exposure, but also post exposure. The results of the experiments indicated the sensitizing by pre-exposure to be more effective. Since three different film emulsions were tested, a variety of results could have been expected. But the gain in speed was equally evident in all of the emulsions when pre-exposure was the hypersensitizing agent. Each emulsion had a far different speed rating, which would indicate a stable effect by pre-exposure. There was no mention of reversal film in these experiments. Sheppard[2] reasoned the experiments to be inconclusive and inadequate. He states: "A pratically important procedure of either hypersensitization or latensification should produce the rise of speed claimed without increasing graininess, or reducing resolving power."

The hypersensitization of photographic still film. As stated before, there has long been the need of increased emulsion speed. Early in the history of photography, photographers devised methods of increasing the speed of their wet collodium film plates. Various methods of gaining film speed in still photographic emulsions have been discovered over a number of years. Most of these methods are not appliable to motion picture film supersensitization on the amateur or semi-professional scale.

2 Ibid., pp. 465-466

Processing of still film is readily done by the photographer. Many sensitizing methods are available to him since he controls the chemical development of his film. The semi-professional does not usually process his movies. He relies upon outside laboratories for development and extra prints. The still photographer has on hand today various high speed developers and intensifying agents. He makes his own standard of processing and controls all the variables himself. Sixteen millimeter film such as Super X and Super XX Reversal are processed by a constant method, not allowing for any increase or decrease in developing time, or chemical intensification of developed film. If using reversal films, chemical supersensitization would be out of the question. The amateur and semi-professional know these limitations put upon them. Eastman Kodak motion picture reversal films have a wide exposure range due to the automatic corrective process[3] used at the Kodak developing laboratories. This is a method that safeguards the exposure of reversal films. It compensates for any underexposure or overexposure to a noticeable degree of three full f. stops. This process automatically gives the cinematographer more film speed range with which to work. By incorrect exposure, however, some losses are evident since the exposure rating of the given film was set to give the best photographic results.

3 How To Make Good Movies, Eastman Kodak Company, Rochester, New York. pp. 32-33.

It has thus been pointed out, that supersensitization of amateur reversal film should not affect the developing process. Perhaps the most convenient method of supersensitizing motion picture film would be pre-exposure to light. One of the best and most recent works concerning this pre-exposure method was by Franklin[4], in which methods of hypersensitization, latensification, and intensification of still films were discussed. His four methods of supersensitizing were; (1) extended development; (2) hypersensitizing by light; (3) hypersensitizing by mercury vapors; and (4) intensification. Of the four methods mentioned, only one, hypersensitization by light, would be feasible for motion picture supersensitization. The other methods called for developing and chemical changes.

For pre-flashing cut film, Franklin took a meter reading of a plain grey wall, (1/100 at f.4), and with focus set on infinity exposed (1/100 at f. 16), just four full f. stops below the normal reading. His subsequent exposures showed increase in speed. Further results made use of intensification and latensification. But it was in this simple and convenient method of pre-flashing film that a possible use of pre-flashing in motion picture film was thought of. This basic method of pre-flashing by underexposure was applicable to any black and white motion picture film, since it required no chemical treatment and no change in development procedure.

4 Joseph Franklin, "How To Multiply Your Film Speed 25 Times," U.S. Camera, (July 1949), Volume 12, No.7, pp. 58-59.

It was also possible to use latensification of light for the flashing of motion picture film. This procedure is similar to hypersensitizing with light except that whereas hypersensitizing is preferably done with a strong light, latensification uses a light of low intensity.[5]

> "Light of low intensity is about as efficient as an equal amount of bright light in causing continued growth or intensification of an existing latent image. It is, however, less effective in starting new latent image centers."[6]

Whether hypersensitizing or latensifying with light, the supplementary exposures are to be kept at a point which will not affect the overall contrast or density too greatly. Analysis of the studies indicated that hypersensitizing by pre-flashing with light would be most practical as a method of supersensitization. Latensification by light requires a light of low intensity and long exposures. It would be difficult and would require special equipment to control long exposures.

5 Methods of Increasing Film Speed , op. cit., p. 600.

6 Loc. cit.

CHAPTER III

METHOD OF PRE-FLASHING MOTION PICTURE FILMS

Procedure of pre-flashing the test films. The pre-flash method used in sensitizing still cut film in which a grey wall was taken at an underexposure of four full f. stops, was modified to be used in the flashing of motion picture films. The films to be tested were all sixteen millimeter black and white reversal and negatives: (1) Cine' Kodak Super X; (2) Cine' Kodak Super XX; and (3) Cine' Kodak Background X. Each film is used extensively by amateurs and professionals.

In any testing situation there are variables. In the case of pre-flashing films, such things as lighting, camera speed, and exposure, must be carefully controlled. In order to achieve the best results in evenexposure and registration of the test films, it was decided that the Eastman Kodak Cine' Special II would be the best for the purpose. The main reasons for its use was its constant speed spring driven motor which made constant exposure speed posible. The actual setting up of a pre-flashing procedure is fairly simple; either still or motion picture film can be flashed using one setup.

A grey card may be used instead of a grey wall. The light source should be placed behind and slightly above the camera so as to eliminate any shadows and provide an even illumination. For the experiments a 15 X 20 inch grey card was purchased. For reading the grey card a Weston reflection type meter was used to be sure of even illumination. It was decided that the amount of light should be set to give a basic exposure of f.1.4 at 24 frames per second for each of the films exposed. Any f. stop could have been chosen for a constant, but if a large opening was used as a constant, such as f. 1.4, a greater range of pre-flashing could be accomplished and the amount of underexposure could be at a greater degree.

The camera speed of 24 frames per second was chosen as the other constant, since it is standard speed for motion picture sound.

A theoretical method of pre-flashing motion picture film was now ready to be put into use. But before the actual pre-flashing was done, a method of testing the film had to be devised.

Method of testing the pre-flashed film. A method of adequately testing the pre-flashed film in its characteristics had to be set before any actual pre-flashing could take place. Certain things are relative concerning film emulsions. Things such as density, resolving power, and graininess determine the quality of negatives and positives alike. In order to correctly test a motion picture film emulsion, a simple yet reliable method of testing would be ideal, although such methods of testing are usually impossible.

Taking into mind the various factors concerning photographic quality, a test chart was designed to test these various qualities and also to annotate other scientific variables used in the testing.

Such a test chart was made to valuate the film on properties of grain, resolving power, and tonal contrast. The chart also served to record: (1) the type of film used; (2) the f. stop used for each exposed film section; (3) the amount of flashing given to each film section; and(4) whether or not it was a normal (unflashed) or flashed section.

In order to record the tonal contrast, it was necessary to make a series of white to black tabs of equal size. A tonal scale of twenty four steps was produced.

Testing tonal contrast. In order to correctly record tonal contrast, each tab was made slightly darker in gradation than the next. A series of white to black tabs greater than ten to one were unavailable. It was necessary to hand paint the tonal scale using white and black tempera paints. The tabs ran from pure white to pure black; the pure white being number one, the pure black being number twenty-four.

Testing resolving power. The recording of resolving power or resolution of the film emulsion presented a problem as to what subject should be used for testing. Having decided upon the use of a one inch lens and a grey card, 15 by 20 inches, then it would follow that the test card should be of the same proportions. It was found that at a distance of five feet a 15 by 20 inch card would neatly fit in the frame of the one inch lens finder. This meant that the resolving power scale must be appropriate at such a distance of five feet using the field of a one inch lens. It was decided a series of black and white checks would serve the purpose. A total of nine black and white check square patches, each patch containing different sized checks, were used. A black and white check chart was photographed using a wide angle lens to get smaller checks on the copy negative. From this copy negative the various checkered squares were made by contact printing and through enlargements. As many as forty different sized checkered photographs were made. A selection of nine different sized checked patches was made. They were arranged in a gradation of small to large checks on the test chart.

Testing Graininess. The degree of graininess would be evident in comparison of the tonal tabs and resolving power of the checkered squares. A direct comparison of flashed and unflashed frames would show if any increase in grain size was evident.

Recording experimental information. Slips of paper were used to record: (1) the type of film being used; (2) the amount of flashing, if any; and (3) whether or not a normal or flashed section was being exposed.

Because of the various f. stops to be used, a listing of each full f. stop from f. 1.4 to f. 22 was marked horizontally above the tonal range tabs. A white arrow on a thumb tack was made to serve as an indicator of which f. stop was being used for each exposed section of the film.

The mounting board used for the test chart was of a neutral grey tone; one which would not reflect excessive light. Upon completion of the test chart[1] and its components, the testing was ready to get under way.

1 Refer to Appendix A for photograph of test chart., p.58

CHAPTER IV

PRE-FLASHING THE FILM

Pre-flashing Super X. The first film to be pre-flashed was Cine' Kodak sixteen millimeter Super X. For exposure to incandescent light, the films ASA tungsten rating was 32. The lens opening was to remain constant at f. 1.4, and the camera speed was to remain constant at 24 frames per second. A wall served the purpose of holding the grey card in place. About five feet from the wall the spreader was laid down and a tripod set. It was necessary to have a steady base for the pre-flashing experiments. The Cine' Special II was then set on the tripod, the film plane being parallel to the grey card.

A three section light was used with a number one photoflood bulb in the reflector bowl. The light was set up directly behind the camera and at a higher angle to the grey card. All other lights in the room were turned off, only the photoflood bulb was lighted. The light was then adjusted to give even illumination on the grey card. By putting the light nearer to, or farther from the card, the correct light intensity was accomplished. The light was adjusted in this way until the Weston reflective light meter gave a a reading of f. 1.4 at 24 frames per second for the Super X film to be used. This was to be the normal exposure for the grey card and the test chart also. By controlling the exposure at f. 1.4

at 24 frames per second, under exposures could be made by simply closing down the f. opening. It was decided the amount of flashing could be controlled easily by varying the f. stop openings. An example of controlling the pre-flash exposure would be if the normal exposure was f. 1.4 and the speed was at 24 frames per second, then if the film was to be pre-flashed 6X (six full f. stops below normal), it could be exposed at f. 11 at 24 frames per second.

Each film to be pre-flashed was in one hundred foot rolls. By pre-flashing ten foot sections at different f. openings, a comparison of pre-flashing results could be made. It was also necessary to reserve ten feet of film for normal (unflashed) exposure in order to compare pre-flashed frames with unflashed frames. When each was loaded in the camera for pre-flashing, a punch mark was made in the film at the beginning of the leader. The purpose of a punch mark was to leave a method of determining when to set the footage counter on zero for each time the test film was to be exposed. After pre-flashing, the film would have to be re-threaded in the camera and a punch mark would allow the film to be tested accurately as possible for each section of film, each section of film being determined by the footage counter.

In other words, the film could be run off again knowing at which points a change in flashing took place; the punch mark serving as a starting point for the pre-flashing experiments. The film was broken down into the following footage and exposures:

FILM: CINE' KODAK SUPER X

FOOTAGE	PRE-FLASH EXPOSURE	f. STOP
0-5 (leader)	no pre-exposure	lens capped
5-15	no pre-exposure	lens capped
15-25	6X (6f. stops underexposed)	f. 11
25-35	5X (5f. " ")	f. 8
35-45	4 1/2X(41/2 " ")	f. 6.3
45-55	4X (4f. " ")	f. 5.6
55-65	3 3/4X(3 3/4 " ")	f. 5.2
65-75	3 1/2X(3 1/2 " ")	f. 4.8
75-85	3 1/4X(3 1/4 " ")	f. 4.4
85-95	3X (3 " ")	f. 4.
95-100 (run out)		

The only variable was the change of f. stops. Having completed the flashing, the film was removed from the camera and taken to a darkroom for rewinding.

CHAPTER V

TESTING THE PRE-FLASHED FILMS

Testing Super X film. Since the size of the test chart was the same as the grey card, and the taking lens used to photograph each card was a one inch lens, it was unnecessary to re-position the camera. The only adjustments to be made were to replace the grey card with the test chart and to focus on the test chart. The test chart was then tacked in place of the grey card. The testing of the pre-flashed film had to allow for the best results to be obtained. Therefore, it was necessary for a variety of exposures over the pre-flashed sections to be made. By keeping the exposure at f. 1.4 at a speed of 24 frames per second, it was felt that under exposure of 4X (5.6) would be adequate to test the power of supersensitization by flashing. It was hoped an acceptable image would result due to pre-flashing, although the test chart was to be photographed as much as four full f. stops (5.6) below normal exposure (1.4). Following experiments made use of underexposures as much as eight complete f. stops (f. 22) below normal (f. 1.4).

Because of the various tones on the test chart to be photographed, a Norwood[1] incident light meter was used to make sure of standard basic exposure of f. .4, at 24 frames per second. "Through the lens" focusing was made on the small checkered squares. The focusing had to be critical and exacting to be sure of testing the

1 Norwood meter not affected by tonal differences.

pre-flashed films resolving power. The chart was exactly centered in the Cine' Special, and the punch mark was lined up in the frame and footage counter set on zero. The film was then ready to be taken.

At first, for the Normal, 6X, and 5X sections, every two feet of film received a different exposure. Each time two feet of film were taken the lens opening had to be changed. The arrow on the chart which indicated the f. stop being used had to be changed also. This change had to be made every foot for the 4 1/2, 4X, 3 3/4X, 3 1/2X, 3 1/4X, and 3X sections. When one section of the film, say for example 6X, was completed, the slip on the test chart would be changed from 6X to 5X . For each change to the film, a corresponding change was made on the test chart to indicate what method was being used. By using the chart in this way, a visible check of the results was possible upon projection.

Testing Background X film. Testing of the Cine' Kodak Background X negative film was identical in most respects to the testing of the Super X. Less light was needed for exposure of the Background X when filming the test chart. Adjustment of the light easily gave correct exposure of f. 1.4 at 24 frames per second. This time, the filming of the test chart called for changes in every foot section.

After each film was exposed to the test chart, they were put in their respective containers and shipped fordevelopment.

The Super X film was sent to Eastman Kodak for development.[2] The Background X negative film was sent to a local Boston concern[3] for development.

The return of the original reversal (SuperX) and negative (Background X) films called for an eagerly awaited viewing. Because they were original and important documents, the films were not projected for fear of damage. They were ,however, inspected on a viewer and also by magnifying glass. It was evident the films had been correctly exposed.

A side by side comparison of the different sections at the moment was impossible without cutting the original film. Satisfied that both films were suitable for tabulating results, copies had to be made. From the original negative, a positive was made and from the original reversal positive, a dupe negative and positive print were made. It was necessary to have positives made for comparison purposes. Motion picture release prints are positive prints made from either dupe or original negatives. There are some losses in quality by going through the dupe stage. These losses of quality would show up and thus could be compared on the pre-flashed and normal frames.

The films were sent for printing. Because of the nature and importance of the experiment, it was necessary to have the best in laboratory work done. Specific instructions were given to the printer to get the best possible printing from the exposed films.

2 Processing laboratory, Rochester 4, New York.

3 Master Motion Picture company.

The quality of printing had to be the best possible, since the comparison of the positive prints would signify the usefulness or weakness of hypersensitizing film to light.

CHAPTER VI

FILING THE ORIGINALS, DUPES AND PRINTS

Within a week the films were back from the laboratory:

1.	Original reversal positive	1.	Original negative
2.	Dupe negative	2.	Positive print
3.	Positive print		

This made a total of 500 feet of film. Such a large amount of footage was impossible to handle for purposes of comparison.

Separating the film sections. It was necessary to break the five hundred feet down into small sections. Since the shooting of the test chart called for various sections of film having different exposures, it was possible to separate these sections and record them separately. In other words, each section of film would be cut according to f. stop number and pre-flashingexposure amount. In each one hundred foot roll of film, excluding the Normal, 6X, and 5X sections of the reversal group, there were nine different f. stops used for each differently pre-exposed or flashed section. The nine f. stops that were used throughout the experiments were (1) f. 1.4, (2) f. 2., (3) f. 218, (4) f. 4., (5) f. 5.6, (6) f. 8., (7) f. 11., (8) f. 16., (9) f. 22.

There were also nine different pre-flashed ten foot sections in each one hundred foot roll: (1) normal, (2) 6X, (3) 5X, (4) 4 1/2X, (5) 4X, (6) 3 3/4X, (7) 3 1/2 X, (8) 3 1/4X, (9) 3X.

This made a total of eighty-one pieces of differently exposed pieces of film which were to be separated. In order to file the many film sections, eighty-one correspondingly marked large office envelopes were used. The reversal original and prints had no exposures of f. 8, 11, 16, and 22 for the normal, 6X, and 5X exposures. In other words, for three different exposures there were four f. stops omitted. This would mean twelve less pieces of film to be tabulated for the reversal original and each print. This meant a total of sixty-nine pieces of film from the reversal original, the dupe negative, and positive print alike. Therefore, from the original and prints there was a total of two hundred and seven pieces of film (3X 69).

From the original negative and positive print there were one hundred and sixty-two pieces of film (2X 81). For a total of the five films, there were to be three hundred and sixty-nine pieces of film to be separated and filed for comparison.

Using a code system. In order to prevent any mismatching of the five different films, a system of coding was decided to be used. Although the five different films could be distinguished by their own markings, it was felt that coding them more visibly would help in the separation process and save time in filing.

Punching the film offered the quickest and most visual way of coding. By using two punches, one with a diamond punch mark and the other with a round punch mark, a method of coding was worked out as follows:

PUNCH CODE SYSTEM

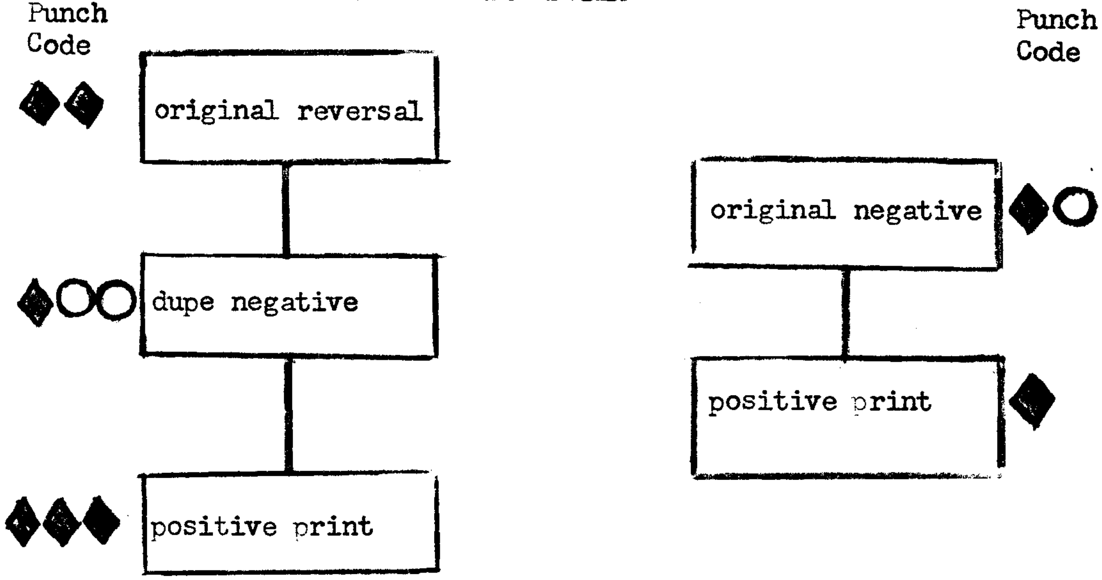


Figure 1

Each foot of the differently exposed film was punched in this way. Some sections were more than a foot long and required a punch at the beginning and then again at the end. In this way every foot section of film was punched a code number. Many sections of film were cut in halfs and quarters so they would fit in the filing envelopes. There were, for the most part, five different pieces of film in each envelope. The normal original and its prints taken at f. 5.6 were exposed incorrectly due to mechanical failure and were omitted from the test group.

By putting the many film sections in numbered envelopes, a system of filing for future use and reference was accomplished. Each one hundred foot roll of film was then cut into sections. Each section was placed into its corresponding envelope. It was made sure each section of film had its own punch mark. When cutting the film and filing it, it was necessary to eye check the test chart with a lens making sure of the f. number and pre-exposure number. Checking each section before filing helped to prevent any future mistakes that might arise when comparing the different film sections. After all the film sections were punched and filed, a comparison was needed.

CHAPTER VII

A METHOD OF COMPARISON

Making of glass slides. With such a large number of film sections, comparison by hand viewing would be a tedious and unpractical task. Comparing separately would allow only one person at a time to view and compare the different sections of film. By presenting the gathered material in a more visual manner, its meaning would be more easily conveyed and understood. More than one person could compare the film sections if projection of the compound sections were possible. In other words, a more critical analysis of the slides could be brought out if there was a more visual means of comparing the films.

This best possible way to present this material was by slide projection. Since the single frames of each film section represent that whole section, it was decided single frames from the sections to be compared would be mounted on 2 by 2 glass slides. Single frames from the same section of each of the five film types were mounted together. They were alike in the respect of having the same f. stop and the same amount of pro-flashing exposure. There were five different film sections for each f. stop and exposure rating. Therefore, five separate frames, one from each film section, would constitute all the straight comparisom slides.

Since five single frames of sixteen millimeter film take up very little room, 2 by 2 glass mounting slides were used. The following materials were used for the mounting of the slides: (1) two boxes of 2 by 2 glass slides, each box containing one hundred slides; (2) two rolls of photographic binding tape; (3)one roll of double coated masking tape; (4) a cardboard slide projection mask. This card indicates the amount of projection area on a 2 by 2 slide; (5) one crow quill point and holder; (6) one bottle of indelible yellow marking ink; (7) a pair of scissors.

It was decided before any slides were made that at least one hundred and sixty-two pieces of glass would be needed to make the minimum amount of slides. There were eighty-one envelopes and there were to be at least eighty-one slides containing single frames of the film sections from each of the eighty-one envelopes; two pieces of glass needed to make one slide.

The size of a single frame of sixteen millimeter film makes itexceedingly hard to handle. In order to keep five of these single frames in line and within the projection area of the slide, it was necessary to use double base sticking tape. Double coated masking tape was used to hold the slides in place while the top glass was put on and taped. The following diagram shows the method of mounting single frames of sixteen millimeter film:

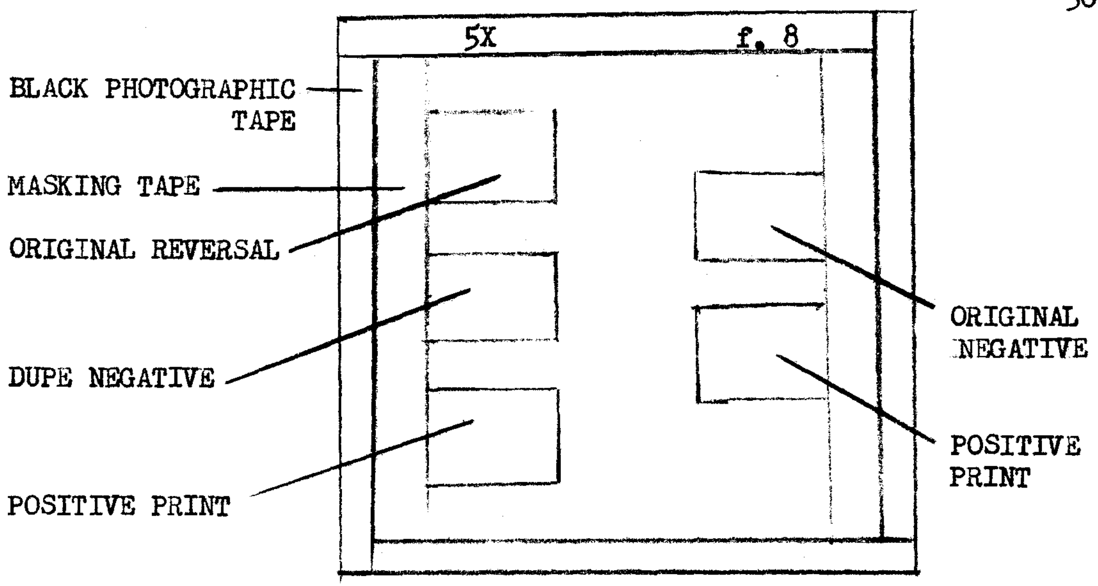


Figure 2.

The separate frames of each film section were mounted in such a manner as to indicate the steps in printing a motion picture positive from eithet an original reversal or original negative film. Each slide was numbered with yellow ink to indicate which frames it compared.

Comparison by slide projection. Having mounted all the comparison slides,[1] the next step was to project them and determine differences by comparing the normals with the pre-flashed slides. Also to be compared was the effect of printing a positive from a dupe negative. By using two slide projectors, it was possible to compare two slides side by side on one motion picture screen. A slide containing normal film frames was mounted on one projector, and a slide containing pre-flashed film frames on the other projector.

[1] These slides are on file at the Boston University Motion Picture Film office.

By comparing the frames of the different film sections on a large screen, it was possible to directly view any outstanding or small differences intonal quality or resolving power.

After comparison by projection, each slide was carefully checked by eyesight using a magnifying lens. The small checkered squares could be more easily distinguished using this method; a sharper check on tonal contrast was accomplished also.

Tabulation of results. After complete comparisons were made, the following results were concluded:

1. There was a noticeable increase in the overall exposure of the pre-flashed frames.
2. There was a slight overall drop in contrast in the pre-flashed frames.
3. The contrast decrease was greater in the original negative flashed frames.
4. Grain size increased slightly with the increase of pre-flashing exposures.
5. Resolving power loss was noticeable in the pre-flashed frames. The loss was due mainly to increased graininess.
6. The normal exposures of the original negative gave better results than the pre-flashed exposures.
7. There was an overall decrease in density in the pre-flashed frames.
8. Pre-flashing gave better results with reversal film due to the fact the loss of contrast was not as great as that of the pre-flashed original negative.
9. By going through the dupe negative stage, increased contrast was added to the positive print. In the case of the pre-flashing where the contrast is lost in the original reversal, it is again picked up in the positive print. Some,not all, contrast is regained in this way.
10. There was unnoticeable increase in contrast in the positive print made from the original negative.
11. Resolving power loss due to printing from either the dupe or original negatives was negligible in the positive prints.
12. The original negative showed a greater range of film speed than the original reversal, but at the same time suffered high losses in contrast.

13. No image was visible on the normal frames taken at f. 22 . There was an extremely underexposed but still visible image on the pre-flashed frames taken at f. 22 .
14. The best results of pre-flashing seem to have been at f. 4 . The tonal value of the blacks was more distinguishable in the 3X and 4X frames than in the normal frames.
15. The normal exposure of f.1.4 for the original negative held true. The exposure at f.2 gave the best results for the original reversal film and was used in the comparisons. *
16. The greater the underexposure, the greater the loss of contrast.

Making extra slides. By making more slides concerned with the most useful sections of the films, a comparative chart could be made to show direct comparisons. After studying the first basic comparison slides, it was evident that slides containing frames of pre-flashed and normal sections should be made into one slide. Such a comparison of unflashed and flashed frames on one slide would enable a more direct comparison upon projection. These slides would compare: (1) the pre-flashed frames all of one given f. stop to the normal frames all of one givem f. stop; and (2) the pre-flashed frames all of one given pre-exposure to the normal frame of the original normal exposure.

As mentioned in the results, it was found the normal exposure for the reversal film and prints to be at f.2 instead of f.1.4 ; therefore, f.2 was used as the normal exposure in mounting the comparison slides.

* Underexposure in this sentence meaning the same as pre-flash exposure.

The pre-flashed frames at 6X were found to be insignificant by comparison to the normal group and were therefore, left out of the comparison group. The pre-flashed frames at 3 3/4, 3 ½ X and 3 ¼ X, were also omitted since the exposures at 3X and 4X were more of more value in comparison to one another without the intermediates.

<u>The f. stop comparison slides.</u> In order to show the best advantages of hypersensitizing film by pre-flashing to light, the f. stop range was set from f.2.8 to f.8 on the comparison slides. By starting at f.2.8, a comparison of one full f. stop below the normal of f.2 could be made. In this way, f.2.8, f.4, f.5.6, and f.8 were used, each being compared to the normal of the same f. stop. Where no normals were available, a direct comparison of the pre-flashed exposures were made. The f. stop comparison slides were mounted in the following manner:

F. STOP COMPARISON SLIDES

5X f.2.8	—	Normal f.2.8	5X f.4	—	Normal f.4
4½X f.2.8	—	same " "	4½X f.4	—	same " "
4X f.2.8	—	same " "	4X f.4.	—	same " "
3X f.2.8	—	same same	3X 3X f.4	—	same " "

Figure 3.

Each frame mounted in the slides was from a positive print made from the original reversal. These were used since most release prints today are positives from the original reversals or original negatives. The positive prints from the original negatives were not used, since pre-flashing results were very slight to be compared.

The pre-exposure comparison slides. In order to give direct side by side comparison of the pre-flashed exposures, slides were made by mounting frames of different f. stops with the same amount of pre-flash exposures. These pre-exposure slides were mounted in the following manner:

3X f.8 ———————— Normal f.2.8

3X f.5.6 ———————— Normal f.2.8

3X f.4 ———————— Normal f.2.8

3X f.2.8 ———————— Normal f.2.8

Figure 4.

Comparing the slides. Upon completion of the comparison slides, a study of the results was made. Slide projection showed the tonal contrast to be different in the various comparison slides. With the study of each slide by magnifying lens, it was found the tonal contrast had a direct relationship to the amount of pre-exposure and f. stop used. On the test chart were twenty-four white to black tabs. Each tab was numbered, starting with the white, from one to twenty-four. Each slide was checked as to the last tab in which change in tone was visible. The positive prints from the original negative were also checked in the same manner. The last tab in which there was a visible change in tone was recorded by it's number. Since there were 24 ~~ton~~ tabs, there were twenty-four numbers. Each tone number was recorded and a chart was made. The white blocks of the chart indicate the results of the positive print from the dupe negative. The red blocks indicate the results of the positive print from the original negative.

FILM DEFINITION CHART

	3X	4X	$4\frac{1}{2}$X	5X	NORMAL
f.2.8	21	19	17	17	17
	20	20	20	20	24
f.4	20	17	16	15	15
	19	19	19	19	21
f.5.6	19	16	16	15	no normal
	16	16	16	16	17
f.8	16	15	15	no normal	no normal
	15	15	15	15	15

TABLE I

Results of the chart would indicate:

1. The pre-flashed frames of the positive prints from the original reversal gave better tonal value than the positive normal print from the original reversal.
2. The pre-flashed frames of the positive print from the original negative showed less increase in tonal contrast than the positive prints from the original reversal.
3. Pre-flashing the original negative gave unsatisfactory tonal reproduction results. The unflashed normal original negative gave the best tonal reproduction in a positive print.
4. The greater amount of pre-flashing of the original reversal print gave better results in the dark tonal scale than the unflashed original reversal print.
5. The pre-flashed original reversal positive frames at 3X gave the best reults in tonal reproduction, although they were of a lower contrast than 4X.
6. The greatest difference in the reversal positive print group was between 3X at f.4 and the Normal at f.4.

Since there was the greatest significant difference in the positive prints from the original reversal taken at f.4, a comparison slide was made containing the original reversals taken at f.4. :

f.4 Original Reversal

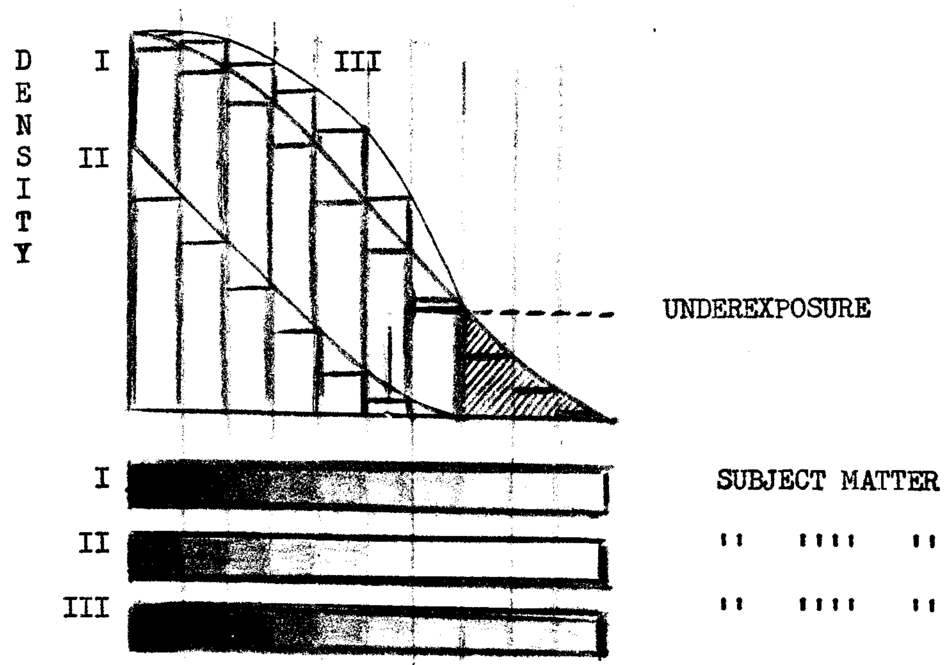
5X	f.4	———	Normal f.4
4½X	f.4	———	Normal f.4
4X	f.4	———	Normal f.4
3X	f.4	———	Normal f.4

Figure 5.

<u>Results of the f.4 comparison.</u> The results of this slide indicated the following:

1. The pre-flash exposure of 3X showed the best tonal reproduction results.
2. The darker regions of the chart were distinguishable on the 3X frames and not on the Normal frames.
3. Both 3X and 4X gave better results than the Normal for the exposures taken at f.4.
4. Plotted on a D-log E curve, a considerable increase in effective speed would be shown.

The following chart shows the probable increase in effective speed due to pre-flashing by light hypersensitization:



Curve I is the normal D-log E characteristic curve representing conventional processing of a properly exposed film such as Cine Kodak Super X "yellow box" Reversal. Curve II represents the same film, this time underexposed. Curve III shows the results of pre-flashing the underexposed film to light. As the minimum density increased, the contrast was reduced and the effective film speed was increased as shown by Curve III.

Thus, pre-flashing by light raised the overall exposure so that with even serious underexposure in the camera, the pictures could be placed on the best part of the D-log E characteristic curve.[2] The exposure was thus moved up from the toe or underexposure region of the curve. The overall subject contrast, or log exposure range of the picture, was reduced by the pre-flashing,or light fogging, of the film. Therefore, for useful increase in speed, a balance between camera and pre-flashing exposures should be selected.[3] In the shadow regions of the picture the increase in D-log E contrast should be appreciably greater than the loss in subject contrast due to the pre-flashing. This is noticeable when comparing the blank frames of the test films. The pre-flashed blank frames have a higher minimum contrast than the unflashed frames. In other words, the blackest black can be no blacker than the fog level of the pre-flashed film; the fog level of the pre-flashed frames being greater than the fog level of the unflashed frames. Therefore, as the amount of uniform pre-exposure pre- flashing increases: (1) the effective speed increases; (2) the minimum density

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2 Refer to D-log E diagram in Appendix A. p.59.

3 Methods of Increasing Film Speed. , op. cit., pp. 602-603.

of the derived curve rises; and (3) there is a drop in the overall contrast.

CHAPTER VIII

NEGATIVE INTENSIFICATION

A method of intensification. The positive prints obtained from the pre-flashed frames at 3X and 4X showed an increase in speed over the Normal frames. However, with the increase in effective speed, the contrast dropped off to a great degree. The pre-flashed original negative suffered decrease in contrast also, but to a much greater degree. A method of increasing the contrast by intensifying the dupe and original negatives was to be tried next. By intensifying the negatives and mounting them with: (1) intensified negatives of the same f. number and emulsion; and (2) the negative of the same emulsion and correct basic exposure, a ways of comparing the effects of intensification could be accomplished.

After studying each of the comparison slides a second time, it was decided negative intensification of the 3X, 4X, and Normal groups would show the best results. For the normal exposure comparison f.1.4 was used for the original negative, and f.2 for the dupe negative. Any increase in contrast for the exposures at f.2.8 was unnecessary since their contrast was normal. The intensification of f. stops 4, 5.6, and 8. would give an adequate exposure coverage for intensification comparison.

Using the intensifier. Negative intensifiers are plentiful and varied. The *Victor* intensifier was decided to be used since it required no after development or bleaching. It was perfect for motion picture film. Many intensifiers call for special formulas and chemicals unknown to the average photographer. The *Victor* intensifier is a simple mercury intensifier complete in itself.

The film sections from 3X, 4X, and Normal were to be intensified. The f. stops of 4., 5.6, and 8. were each cut from the film sections. Pieces four inches long were cut from both the dupe and original negatives. Steel film clips were used to hold the film sections for dipping in the intensifier, since mercury is poisnous to the skin.

Eight ounces of intensifier was mixed in a graduate. Instructions called for even intensification by constant agitation of the intensified film; this was accomplished by dipping the film in and out of the graduate, Holding the intensified negative to a light indicated how the intensifier was working and how long the intensification would be needed. Immediately after intensification, the intensified negative was put into a tray of running water to prevent any further intensification.

The instructions as to intensification time gave anywhere from five seconds to five minutes, according to the degree of intensification needed. The time needed to intensify the negatives worked out in the following manner:

NEGATIVE	f. STOP	PRE-EXPOSURE	TIME INTENSIFIED
original	8	4X	5 minutes
"" ""	5.6	" "	" "
"" ""	4	" "	" "
"" ""	8	3X	" "
"" ""	5.6	" "	" "
"" ""	4	" "	" "
"" ""	8	NORMAL	" "
"" ""	5.6	" "	" "
"" ""	4	" "	" "
dupe	8	4X	3 minutes
" "	5.6	4X	3 minutes
" "	4	4X	2 minutes
" "	8	3X	2 minutes
" "	5.6	3X	$1\frac{1}{2}$ minutes
" "	4	3X	$1\frac{1}{2}$ minutes

TABLE II

The intensified negatives were washed for at least an hour. After washing each negative for an hour, they were dipped in a photoflo solution to facilitate drying. The intensified negatives took on a brownish hue. After drying, the negatives were ready to be mounted in comparison slides. On one side of the slide the dupe negatives were mounted; on the other side, the originals were mounted

The intensified slides were mounted in the following way:

pre-flashed dupe negative	f.4 4X	f.4 4X	pre-flashed original negative
pre-flashed intens-ified dupe negative	f.4 4X	f.4 4X	intensified pre-flashed original negative
normal dupe negative	f.4 4X	f.4 4X	normal original negative

A comparison of the intensified Normals of the original negatives was also made:

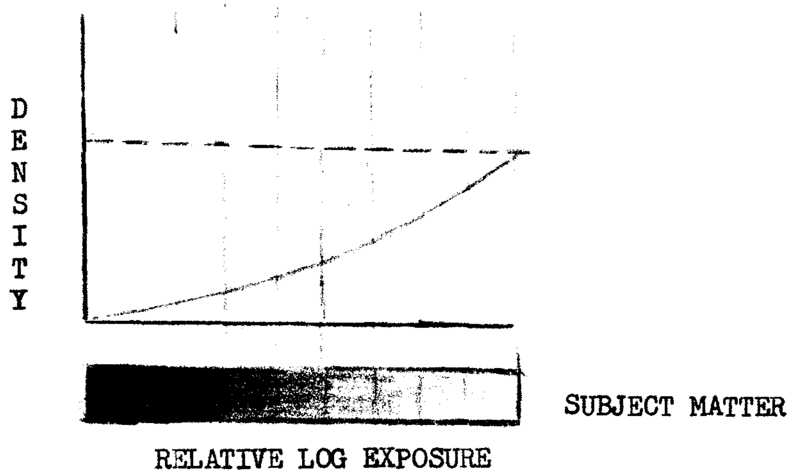
intensified original negative	f.8	f.8	un-intensified original negative
" "	f.5.6	f.5.6	" "
" "	f.4	f.4	" "

<u>Results of the intensification.</u> After comparing the effects of the intensification on the original and dupe negatives, the following facts were concluded:

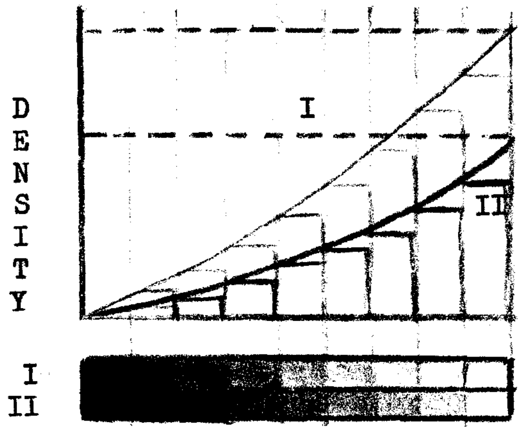
1. Intensification definitely raised the contrast of both the original and dupe negatives.

2. The dupe negative took less time to intensify.
3. Intensification of the dupe negative gave a higher degree of contrast than intensification of the original negative.
4. Intensification of the dupe negative brought out larger grain.
5. Intensification of the original negative did not bring any appreciable increase in grain size.
6. The resolving power of the intensified original negative was better than the resolving power of the intensified dupe negative due mainly to the larger grain size in the dupe negative.
7. The extreme underexposures showed what benefit could be obtained by intensifying the dupe negative.
8. Intensification of both negatives, the dupe and original, gave results which would allow for positive prints of good quality.

In the case of extremely underexposed negatives, such as those taken at f.8, the image is located principally at the toe of the D-log E curve; much of it being at contrasts below the minimum useful gradient.



The effect of the intensification is directly proportional to the density of the original negative, which is indicated on the slope of the curve of the following diagram:



SUBJECT MATTER

RELATIVE LOG EXPOSURE

Curve I is the intensified negative. (unflashed)
Curve II is the un-intensified negative. (unflashed)

"In case of extreme underexposures, where the fate of the normal exposure region can be disregarded an increase in the threshold or extreme underexposure speed will result from improvement in the toe gradient by whatever means accomplished, whether by treatment of the emulsion before or during processing [or] by subsequent intensification...."[1]

1 Methods of Increasing Film Speed. , op. cit., p.587.

CHAPTER IX

PRAGMATIC TESTING

Pre-flashing the test films. Each slide was inspected, filed, and numbered. A test using motion picture film was to be made next. The amount of pre-flash hypersensitization to be used was determined by comparing the various slides. It was decided the most effective method of light hypersensitization would be to give the test films a pre-flashing of 3X.

Stufy of the intensified slides at f.8 showed the advantage of pre-flashing when lighting conditions were substandard. Therefore, four full stops underexposure had given good results comparable to the normal exposure of f.2.

The two most popular films used today in the sixteen millimeter black and white field are Cine' Kodak Super X and Super XX. The emulsion speed of the two films vary slightly:

Super XX		Super X	
ASA Daylight	100	ASA Daylight	40
ASA Tungsten	80	ASA Tungsten	32

The Super XX film is one and one half f. stops faster than Super X. Since there was a difference in emulsion sensitivity, a comparative testing of the two films by pre-flashing would be possible. Both the Super XX and Super X films were to be given the same amount of pre-flashing.

The pre-flashing procedure was set up in the same way as previous pre-flashing experiments. The Cine' Special II Camera was used to expose the test films. The plain grey card was tacked in place on the wall and lined up in the camera or viewer. The lighting arrangementwas the same as before, giving an exposure of f. 1.4 at the constant speed of 24 frames per second.

Since the comparison slides indicated the best pre-flashing results to be 3X, it was decided each test film should be pre-flashed at 3X. For pre-flashing the film, the Cine' Special one inch lens was set at f. 4 which is three full f. stops (3X) below f. 1.4. Each film was pre-flashed at this same exposure; however, only the fifty feet were pre-flashed; the other fifty feet were unflashed. By pre-flashing half the film, a comparison of the pre-flashed and normal unflashed sections could be made:

Super XX

FOOTAGE	
0-5	leader
5-50	pre-flashed at 3X
50-100	unflashed

Super X

FOOTAGE	
0-5	leader
5-50	pre-flashed at 3X
50-100	unflashed

After fifty feet of the film was pre-flashed, the lens was capped and the rest of the film run through the camera. The film was then removed from the camera and rewound in the dark.

A method of testing. In order to test the results of pre-flashing, each subject to be photographed was to be underexposed four full f. stops. According to the comparison slides, pre-flashing at 3X and exposure of four full f. stops below normal gave visible results of overall speed increase. The Super X film was to be filmed at four full f. stops below normal for its entire length. The Super XX film was to be filmed at three full f. stops below normal for its entire length. By keeping the exposures constant in each test film, a direct comparison of the pre-flashed and normal unflashed sections could be made by projection.

Choosing the subject material to be tested. Since an increase in emulsion speed would be most useful under substandard lighting conditions, the test films were photographed inside a building. Daylight photography always offers enough light for proper exposure; inside photography, however, usually calls for extra lights in order to achieve adequate exposure.

The School of Public Relations building was chosen for the test filming. Since a variety of shots were needed to test the films, light meter readings were taken inside the various rooms and hallways using the Norwood Incident light meter. The meter readings indicated a need of extra lights in every room and hallway. If using a constant film speed of 24 frames per second with an opening of f. 2, the meter reading indicated Super X film would be underexposed 4 1/2 full f. stops and that Super XX film would be underexposed 3 full f. stops.

Each film was photographed at f. 2 at the speed of 24 frames per second.

<u>Exposing the test films.</u> Because of its flexible and candid use, a Bell and Howell 70 DA sixteen millimeter camera was used to photograph the test films. Each subject that was photographed on the first fifty feet of each film was again photographed on the last fifty feet of the same film for comparison. Each film was photographed in the existing room or hall light.

A variety of subjects were photographed in order to test the pre-flashed film under varying light conditions. A list of the film subjects include: (1) students examining film; (2) teacher writing at desk; (3) student inspecting film in editing room; (4) student discussion group; (5) hallway and stairs; and (6) clock in hallway.

Subjects filmed on Super X include: (1) school television studio; (2) actors rehearsing; (3) students working on motion picture set; and (4) camerman using motion picture camera. By photographing such a variety of subjects, the value of pre-flashing motion picture film to light was tested in anactual situation.

In order to test the results of printing from the original, a dupe negative and positive print were made from the original Super X.

CHAPTER X

INTERPRETATION OF RESULTS

<u>Comparing the test films</u>. Projection of the pre-flashed Super XX and Super X films pointed out the following facts:

1. Pre-flashing definitely increased the overall film speed of each film; the speed increase was more noticeable in a Super X film since its underexposure was greater.
2. The unflashed sections were noticeably underexposed.
3. The underexposure was not noticeable in the pre-flashed sections.
4. The contrast was very low in the pre-flashed sections.
5. The contrast was too high in the unflashed sections.
6. Better prints would be possible from the pre-flashed film sections, since they did not have excessive contrast.
7. The resolving power of the unflashed film sections was only slightly better than the resolving power of the pre-flashed sections.
8. A slight increase in grain size was noticeable in the pre-flashed sections.
9. By pre-flashing both the Super X and Super XX films at 3X, good picture quality should be expected although the underexposure may be as low as four and one half f. stops below normal

<u>Comparison slides</u>. In order to show a side by side comparison of the pre-flashed and unflashed frames, extra comparison slides were made comparing the unflashed underexposed frames to the flashed underexposed frames.

After the slides were completed and checked with a magnifying lens, it was easy to see the appreciable increase in overall speed of the pre-flashed frames. Shadow detail was more evident on the pre-flashed frames. In many of the pictures, heavy densities in the unflashed frames gave poor projection quality. A more overall even exposure was evident on the pre-flashed frames.

Dupe negative and positive print.[1] Contrast in the positive print was increased by printing from a dupe negative. Intensification of the dupe negative would result in further contrast increase. The amount of contrast in the unflashed sections of the Super X film was very prominent at times. White objects were burned out and glaring since the printing laboratory had to give the unflashed film section maximum print light exposure in order to give a correctly exposed dupe negative and positive print. The pre-flashed sections showed even exposure and minimum glare in the whites. In order to compare the original, the dupe, and the positive print, comparison slides were made. An example:

Unflashed original reversal underexposed (4X)	Flashed original (3X) underexposed (4X)
dupe negative	dupe negative
positive print	positive print

Results of the slide comparison. A study of the comparison slides indicated the following facts:

1. The dupe negative from the unflashed original was higher in contrast than the dupe negative of the pre-flashed original.

1 These and originals are on file at the Boston University Film Office.

2. The positive print from the unflashed original gave very poor shadow detail.
3. The positive print from the unflashed original showed a good gain in contrast.

Summary. Positive prints of good quality, both in contrast and resolving power, could be made from the pre-flashed underexposed original reversal film. The positive prints from the unflashed original reversal showed poor results due to their excessive contrast. Best results in light hypersensitization can therefore be expected by printing a dupe negative and positive release print from the pre-flashed original. Further intensification of the dupe negative from the pre-flashed original will give a satisfactory positive release print.

CHAPTER XI

CONCLUSION AND RECOMMENDATIONS

When to pre-flash film. The supersensitizing of any film will be determined by the lighting conditions which are present. If the amount of light is substandard for exposure requirements, pre-flashing of the film may be one method of gaining increased exposure speed. Certain factors must be kept in mind before making use of supersensitizing methods. Sacrifices are often made in overcoming substandard lighting conditions. If too great a gain in emulsion speed is attempted, graininess, low contrast, and loss of resolving power could result. It is reasonable that pre-flashing supersensitization should be carried out only if the situation demands it.

Use of pre-flashed film. In the documentation of news events, speeches, awards, inside sports, plays, and other functions under which substandard lighting conditions exist, a supersensitized film would be of great value. Lighting equipment would be unnecessary. The motion picture camera with supersensitized film could be more mobile and photograph scenes usually only available to flash cameras.[1]

[1] Boston University is to cover school news through the use of motion pictures and plans to film all inside documentary footage with pre-flashed motion picture film.

__Pre-flashed films for television.__ Many of the films being used on television are outdate. The greater part of these films are unsuited for television transmission. The high contrast of these films makes transmission of a good image difficult. The lighting contrast used in motion pictures is higher than that in television. The brightness range is no more than twenty to one on the average home television screen.[2] More highlight tones and shadow detail are distinguishable on the motion picture screen than on the television screen. A motion picture print for television should be of lower contrast (gamma) than one which is to be used for motion picture projection. The density range must not exceed a certain value if good tone reproduction is to be obtained in both the highlightd and shadows.

Since television requires a lower contrast in films, pre-flashed films and their prints would transmit satisfactorily. Most of the pre-flashed films at 3X gave a brightness range of twenty to one or less, which would be ideal for television transmission. All films exposed under substandard lighting conditions should be pre-flashed for use on television film broadcast. Films exposed under standard lighting conditions should not be pre-flashed for television but should be exposed with a lower lighting contrast. If a pre-flashed television film is extremely underexposed, intensification of the otiginal or dupe negative would give the needed contrast that

2 __The Use of Motion Picture Films in Television__, pamphlet, Motion Picture Film Department, Eastman Kodak Company, 1951, Rochester, N.Y. p. 13.

was lost in the extreme underexposure.

Suggestions for further studies. Intensification of the dupe negative is needed to acheive normal contrast in the positive prints. If a method of intensifying a hundred or fifty foot roll of motion picture pre-flashed dupe negative could be devised, positive prints of good quality could be expected from an original film that could have been underexposed as much as five full f. stops.

The possibilities of color sensitizing were not discussed. It is probable that light hypersensitization would increase the overall emulsion speed. In 1951, the Eastman Kodak Research Division made the follwing statement:

> "Color sensitizing might be included with hypersensitizing as a pratical pre-exposure treatment for increasing the sensitivity of an emulsion to exposing light. However, satisfactory dyes for the purpose are not readily obtainable by the amateur experimenter..." [3]

It is possible these dyes are now available for experimental use.

Another possible method of hypersensitizing motion picture film is by mercury vapor. By placing the roll of film in a tightly sealed non-metallic container along side an open jar containing a small amount of liquid mercury, hypersensitizing effects are possible.[4]

3 Methods of Increasing Film Speed , op. cit., p.595.

4 Ibid. p.597.

Recommendations. If hypersensitization methods are used correctly and under circumstances warranting their use, the results will be satisfying and very useful. Pre-flashing will yield a good image under substandard lighting conditions, whereas normal unflashed film would give a poor image. The photographic emulsions available to the amateurs and professionals are of high speed and excellent quality. Supersensitization is often unnecessary if the film is no more than two full f. stops underexposed. Black and white reversal films have a wide sensitivity range due to a control of developing process. Pre-flashing will increase this sensitivity range with slight sacrifices. Before deciding to pre-flash any motion picture film, certain things should be taken into consideration: (1) what subject matter is to be filmed; (2) the conditions under which it is to be filmed; and (3) for what purpose the film is to be used. By the careful use of pre-flashing in this way, the best results can be expected.

APPENDIX

EASTMAN KODAK COMPANY

ROCHESTER 4, N.Y.

GENERAL OFFICES

343 STATE STREET

January 27, 1953

Mr. Robert A. Gilmore
Boston University
School of Public Relations and Communications
Division of Communication Arts
84 Exeter Street
Boston, 16, Massachusetts

Dear Mr. Gilmore:

We have received your letter dated January 19 requesting information on the supersensitizing of 16mm reversal films.

The only material we have on this subject is a reprint of the paper published by Mr. H. A. Miller, R. W. Henn, and J. I. Crabtree of our Kodak Research Laboratory. I'm enclosing a copy of this reprint for your use.

If we can be of any further help to you in your photographic problems, please feel free to write us at any time.

Yours very truly

EASTMAN KODAK COMPANY

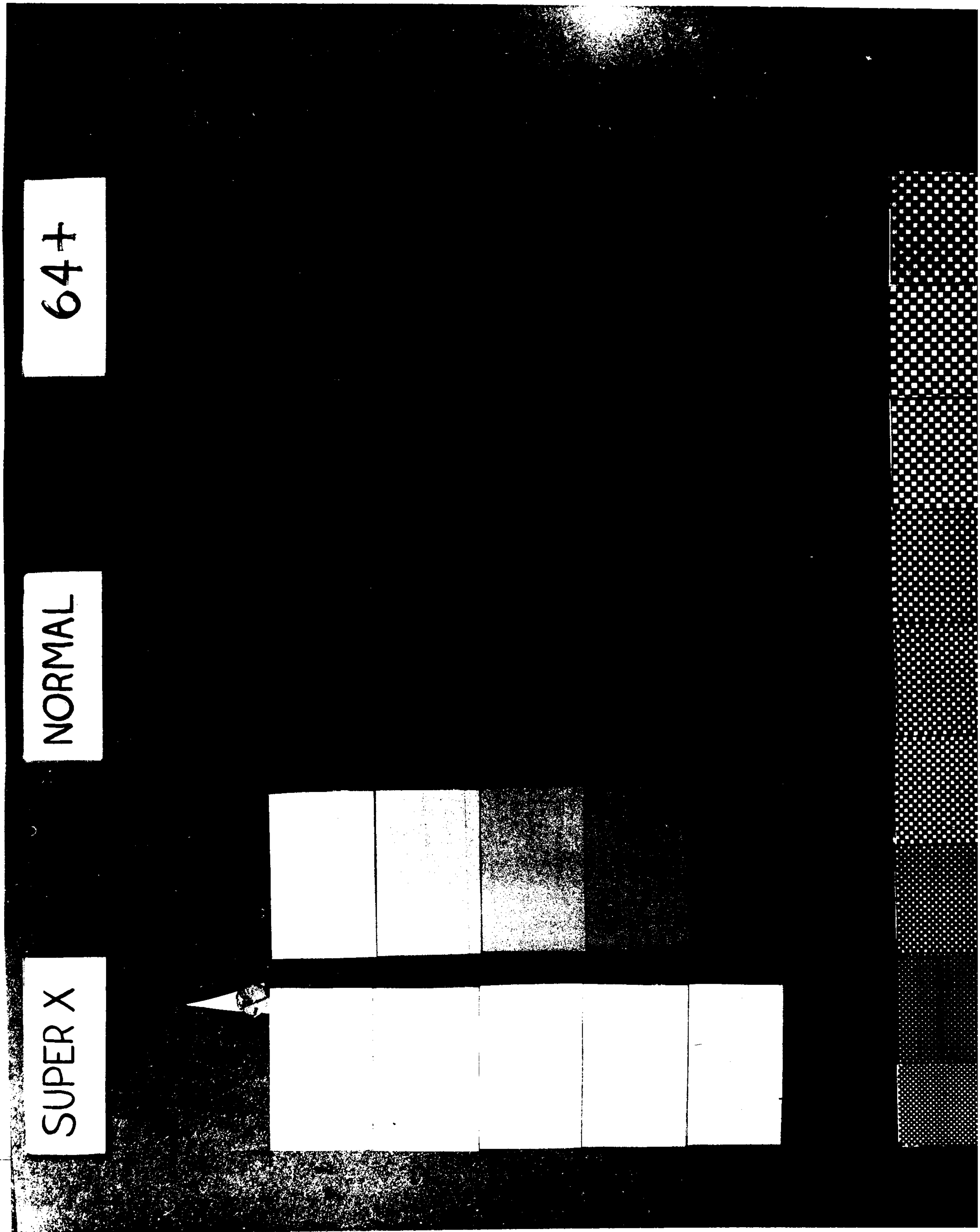
Harris B Tuttle

Sales Service Division

HBTuttle:FEC
Enc.

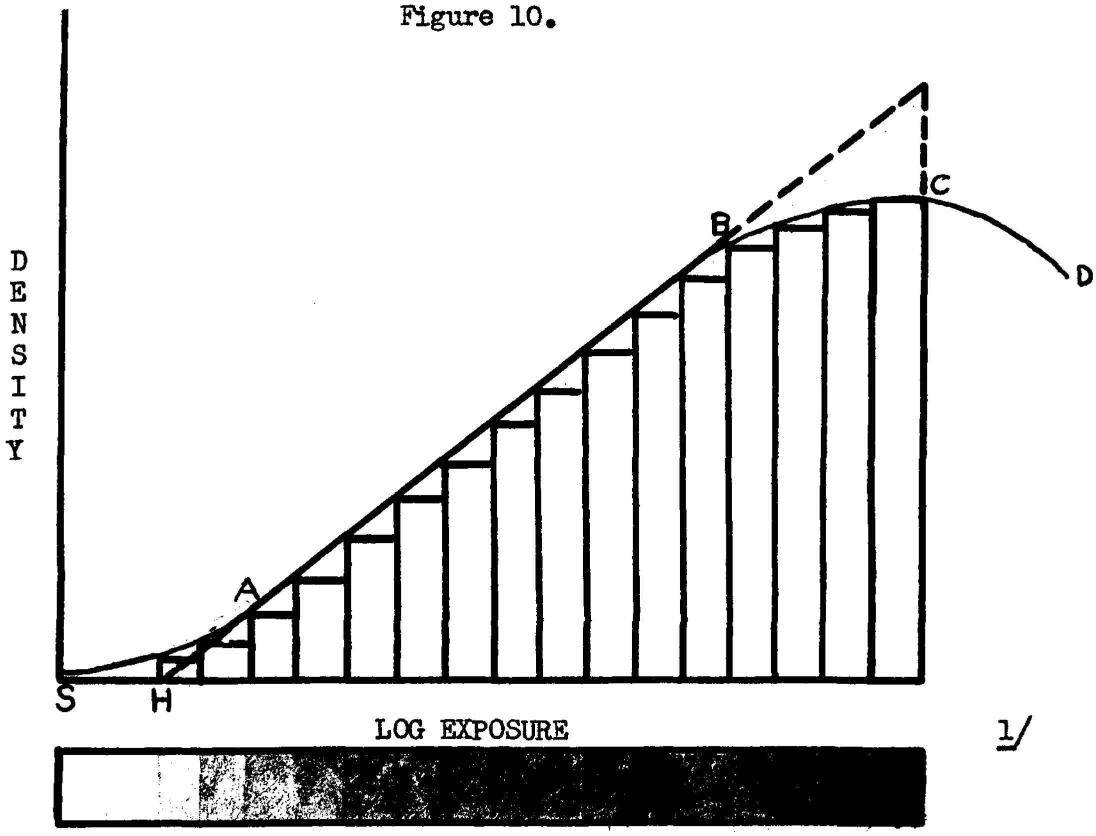
Kodak

FIGURE 9.



TYPICAL CHARACTERISTIC CURVE
and
STEP NEGATIVE

Figure 10.



1/

"Section AB indicates equal increments of density corresponding to equal increments of log E. Section BC is called the knee and a region of overexposure. The relation between density and log E is not linear. Beyond C the density decreases with exposure. The section between S and A is called the toe of the curve. Here the density increases with log E but the relationship is not linear."[2]

1 The Photographie Process , op. cit., p.203

2 Loc cit.

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Contains helpful information on the use of motion picture methods in filming stories. Covers all aspects of amateur motion picture photography without excess technical detail.

2. Franklin, Joeseph, "How To Multiply Your Film Speed Twenty-Five Times," U.S. Camera , (July 1949), Volume 12, No.7: 58-59.

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3. Mack, J.E., and Miles J. Martin, The Photographic Process , McGraw Hill Book Company, Inc. New York and London, 1939.

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4. Miller, H.A., R.W.Henn, and J.I.Crabtree, Methods of Increasing Film Speed,reprinted from the Journal of the Photographic Society of America, Number 10, Volume 12, Communication NO. 1108. Kodak Research Laboratories, 1946.

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5. Motion Picture Film Department, Eastman Kodak Company, The Use of Motion Picture Films in Television,pamphlet, Rochester, New York, 1951.

Concerned with motion picture film production for use on television. Technically describes television transmission set-up, and gives diagrams showing detailed lighting set-ups as used for television broadcast and film work.

6. Sheppard, S.E., W. Vanselow, R.F.Quirk, Journal of the Franklin Institute, Hypersensitizing and Latensification : A Preliminary Survey, Number 6, Volume 240, 1945.

Contains detailed experimental work with both motion picture and still film. Mercury vaporization methods are completely listed.

7. Spottiswoode, Raymond, Film and Its Techniques, Berkley and Los Angeles, University of California Press, 1951.

A technical book concerned with all aspects of motion picture film work; both the creative and mechanical aspects are woven into one story. Contains many technical film definitions.