1960

Secondary "Low Intensity" Exposure Method of Latensification

Vincent Gallo

Donald Forst

SECONDARY

"LOW

INTENSITY"

EXPOSURE

METHOD

OF

LATENSIFICATION

BY

VINCENT GALLO

AND

DONALD J. FORST

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TABLE OF CONTENTS

A study was made into the effect of the secondary "low intensity" latensification on Super Panchro Press, Type B film. The response variables tested for were speed, D-Max, gamma, and fog. Tests were conducted to appraise the effect of Daylight and Tungsten illumination for Exposure and Latensification and their interaction. The experiment revealed that a significant speed increase is possible; gamma is affected by Latensification time and illumination; D-Max is affected by illumination; and that the degree of latensification is dependent upon the time of secondary exposure. It was found that a significant latensification effect can be achieved with a small fog level increase.

Latensification is the name given to the intensification of the photographic image after it has been exposed, but before it has been developed; thus intensification of the latent image.

The obvious purpose of latensification is to increase the speed of the material; ideally without altering any of the other characteristics, i.e. gamma, graininess, and fog level.

Much work has been done with the different methods of latensification. The only one that does not require a chemical treatment is "low intensity" secondary exposure. This method is the only one which will allow the correction for underexposure of a single frame in a roll. Many areas of this method have been experimented with extensively e.g., effect of developer and development time, time duration between initial and latensification exposures, and various classes of films. The essence of this experiment has been the application of "low intensity", long-duration, secondary exposure latensification to practical use, i.e. by the photographer.

EXPERIMENTAL MATERIALS AND PROCEDURE:

Super Panchro Press , Type B film was used for all tests. Development was in DK-50, full strength at 68°F for 4.5 minutes with ASA agitation (tray). Two Kodak model 101 sensitometers were used for all exposures. Filtration was introduced into the sensitometers to produce desired illuminant changes for both color temperature and light intensity. A 21 step 0.15 increment wedge was used for all initial exposures. Latensification was carried out in a sensitometer with the step wedge removed from the light path. The approximate light intensity of the "low intensity" latensification was in general of a 0.002 meter candle range. All density readings were made on a Welch Densicron densitometer.

Initial tests involved reaching adequate exposure of the film in the sensitometer. The exposure time was kept at 0.2 seconds in all tests for initial exposures. Latensification tests were made for time factors of 10^2, 10^3, and 10^4. (These were multiples of the original 0.2 second exposure e.g. 0.2 seconds X 10^2 = 20 seconds.)

In order to achieve the "long" exposure durations necessary for latensification, a modification was made on the model 101 sensitometer. The shutter was set for a "time" exposure and the shutter mechanism designed for 0.2 second exposures was by-passed.

Because of the long duration exposures, extraneous light falling on the film plane became sufficient to cause fog. Additional light shields were added to the sensitometer to prevent this from occuring.

A fog increase of 0.1 above the original base + fog level of the film was set for all latensification. This was deemed sufficiently high so as to be reproducible while not objectionable.

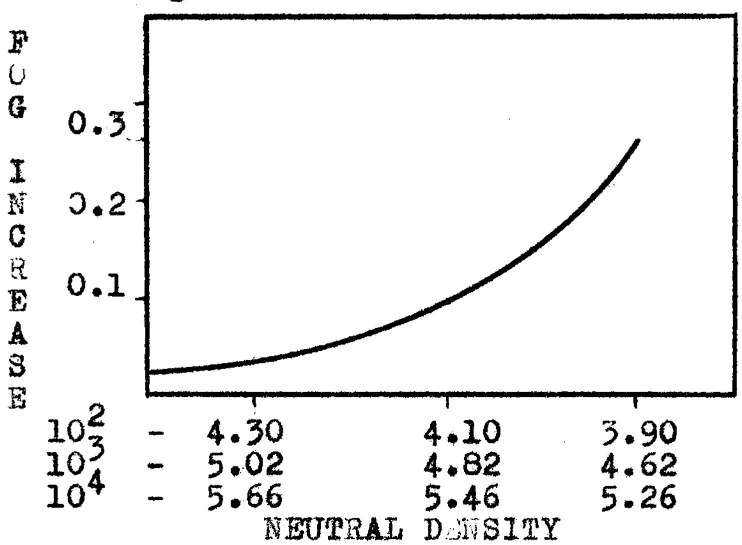
Preliminary tests were made on factors affecting the overall result. Tests were made on degree of development for times of 4.5, 6, 8, and 12 minutes; latensification time factors; fog levels; and time duration between exposure and latensification.

In the latter it was found that the time interval one hour was already too great. At this time interval, the latensification effect was almost totally lost. Hence for all further tests it was decided to maintain a constant time interval of one minute between exposure and latensification. (This interval was sufficient for making any filter changes for illuminants and light intensity while not affecting latensification effect.)

The effects of illumination were then investigated. Tungsten and Daylight initial exposures were tested with Tungsten and Daylight latensification. In further tests the illumination was varied; that is if Daylight was used for the initial exposure then Tungsten was used for the latensification. Color temperature of the illuminant in the sensitometer was varied by filtration.

Upon completion of all preliminary tests the collected data was analyzed and graphed. From the data, information for further tests was extracted. An example of this was a graph of Base + Fog VS Neutral Density. (see figure 1.)

Figure 1:



It was found that a relationship believed to be consistant in nature exists between amount of fog increase and neutral density i.e. illumination. This was useful in determining necessary neutral density for the various time factors of Latensification.

A Factorial experiment was prepared to test the significance of important factors. These were: the initial exposure illumination; the latensification illumination;

and the time factor of the latensification.

Response variables tested for were speed (ASA), gamma, and D-Max. The ASA speed was determined by extrapolating the toe area of the curve to total base + fog of the process. Speed factors were determined by a division of "normal" film speeds into the latensified film speeds. The difference due to the inherent sensitivity of the emulsion with illuminant was thus eliminated.

From this an Analysis of Variance was performed and statistical significance of test factors obtained.

EXPERIMENTAL RESULTS:

Results show that as development time increased the effect of latensification decreased. The optimum effect was achieved with 4.5 minutes. (see figure 2.) Increased development tends to raise gamma and D-Max as in the "normal" sensitometry of the film. (see figure 3.)

figure 2:

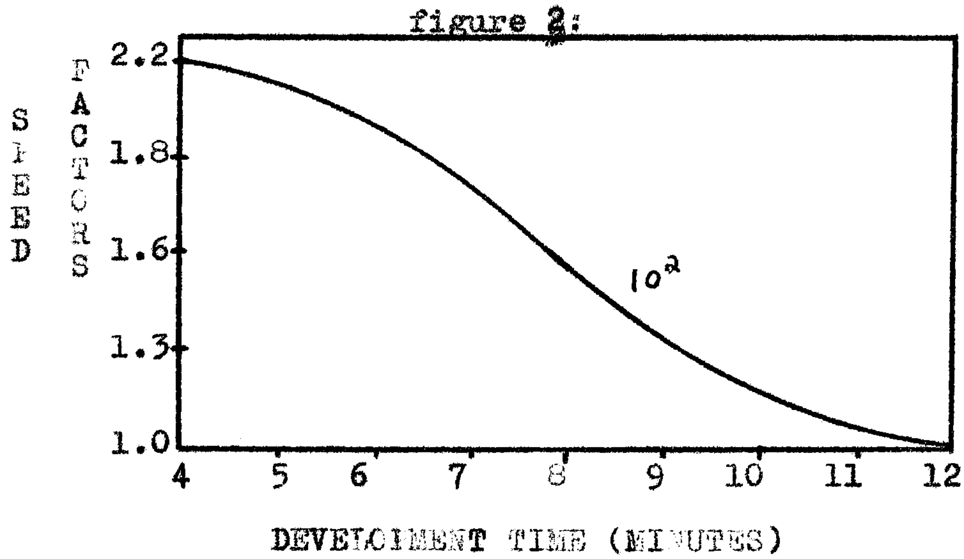
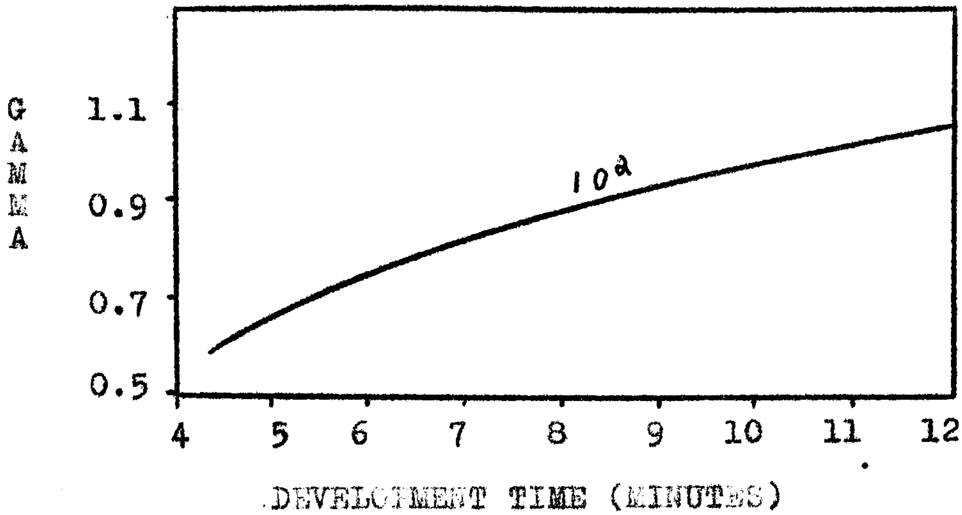


figure 3:

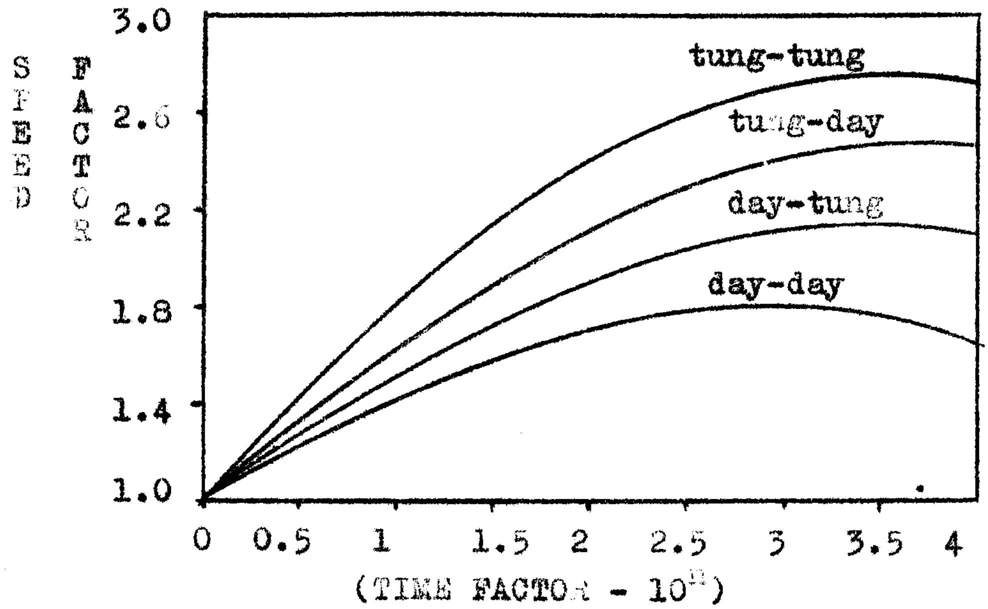


The graphs of Base + Fog VS Neutral Density for each Latensification Time factor are of similar shaped curves. Hence they can be combined into one curve. (see figure 1.) The graph indicates the amount of neutral density necessary for a pre-specified Base + fog density increase. The curve may be considered analogous to the toe of the characteristic curve.

<u>THE EFFECT OF LATENSIFICATION:</u>

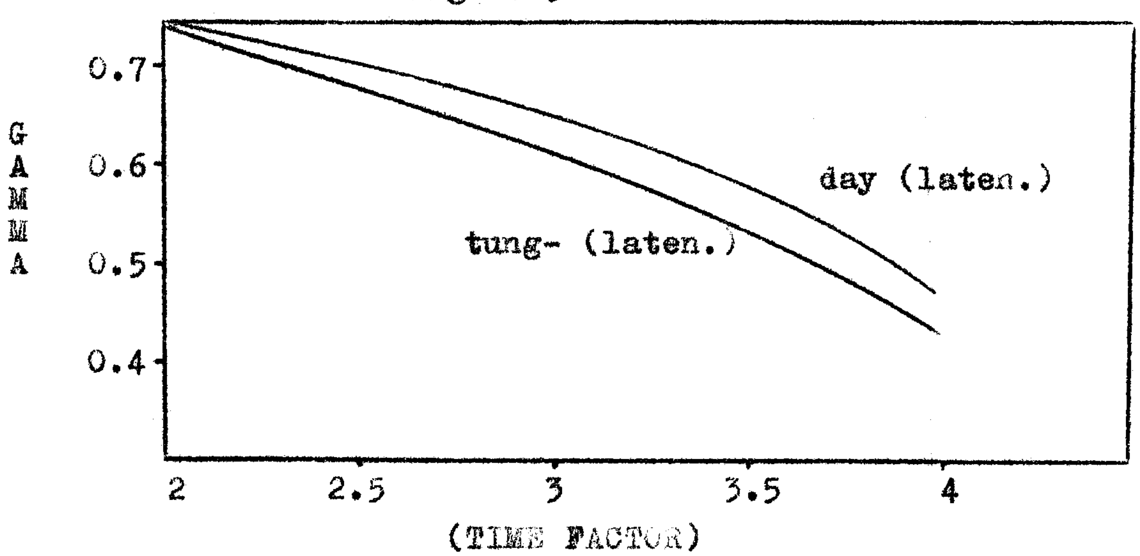
SPEED: (see figure 4.) The graph of Latensification time factor VS Speed factor indicates that an optimum exists between a factor of 10^3 and $10^{3.5}$. The greatest speed increase occurred with Tungsten exposure - Tungsten latensification. The least effect was present in the Daylight exposure - Daylight latensification tests. The interaction of the illuminants produces an intermediate effect between the extremes.

figure 4:



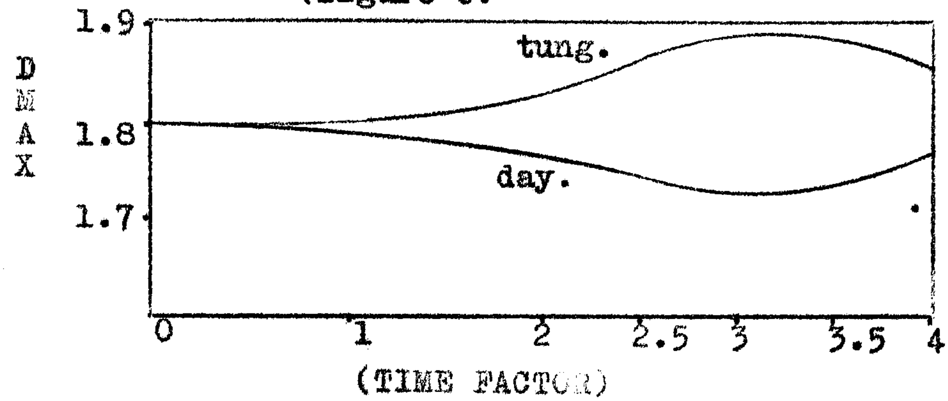
GAMMA: (see figure 5.) A graph of Gamma VS Latensification time factor indicates as time factor increases gamma decreases for both Daylight and Tungsten illumination. Latensification illuminant and Time factor were found to be highly significant in their effect on gamma.

figure 5:



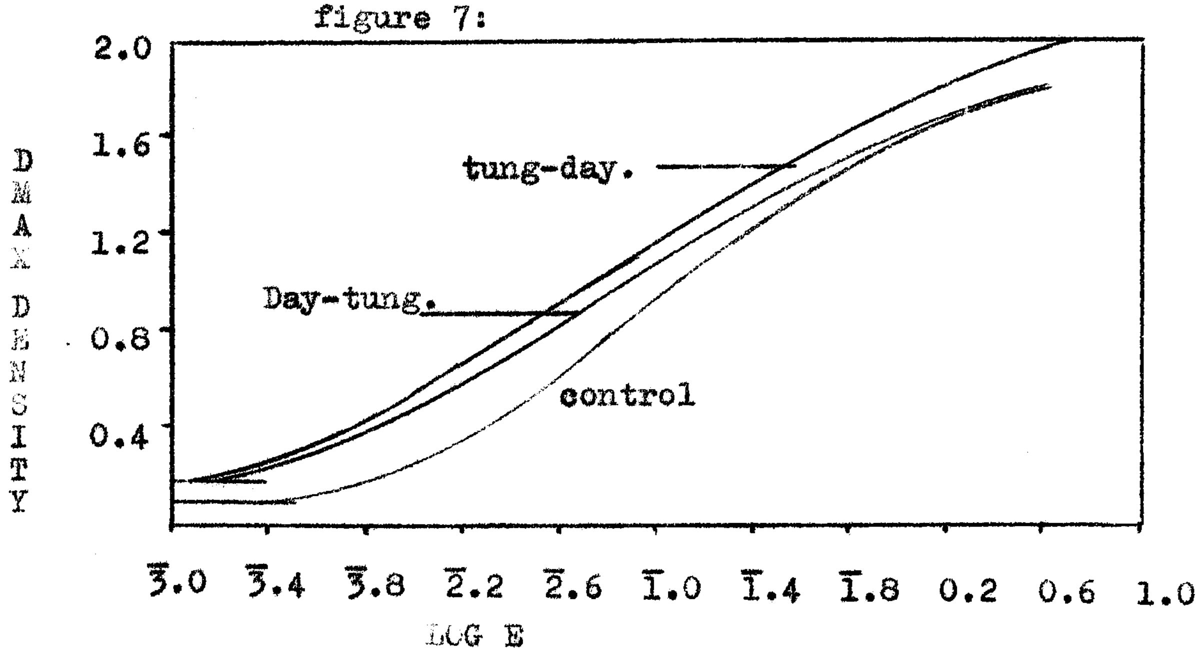
D-MAX: (see figure 6.) A graph of D-Max VS Latensification time factor indicates a maximum density is obtained with Tungsten illumination whereas Daylight illumination results in a minimum density.

(figure 6:



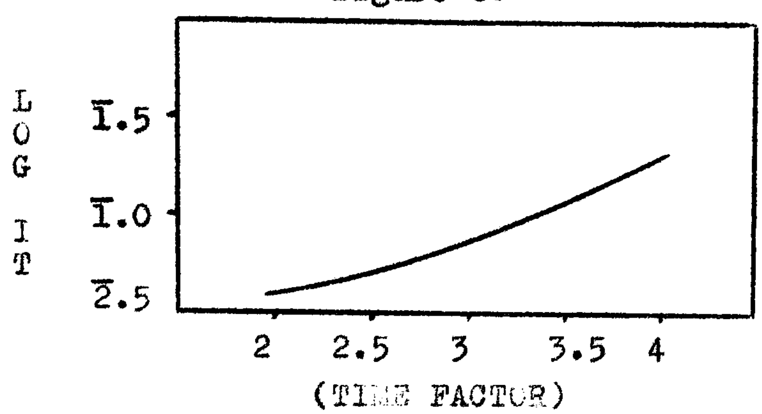
The characteristic curves comparing Daylight and Tungsten initial exposure with those that were Latensified, show that D-Max increases for Tungsten illumination but not for Daylight illumination. (see figure 7.)

figure 7:



A graph of the reciprocity law failure of latensification indicates increased exposure is necessary with increased time factor to produce a Base + Fog increase within the 0.1 limits. (see figure 8.)

figure 8:



DISCUSSION:

The results of latensification with variation of development time indicates that the test film reacts similarly to past work on other materials by former workers; that is, effect of latensification diminishes as development increases.

A base + fog limit of 0.1 + or - 0.05 above the original base + fog density of the film was arbitrarily chosen. This limit provided a small fog increase while being easily reproducible.

The choice of using total base + fog density for ASA speed determination was felt to be more indicative of "normal" practice. The resulting speed increases were thus less than would have been obtained by subtracting the

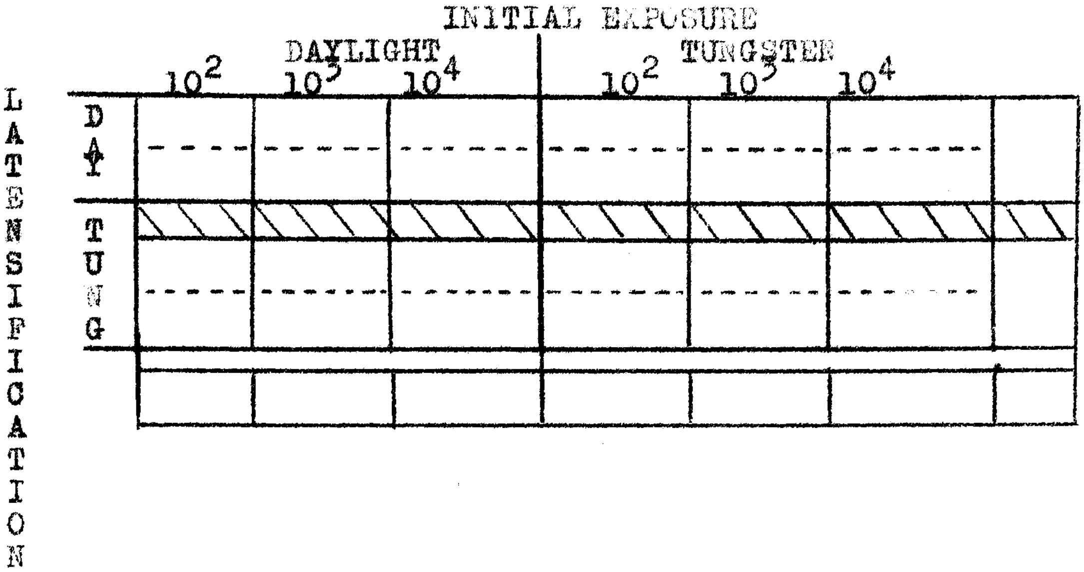
the increased fog produced by the latensification.

A D-Max decrease was found in tests that had Daylight initial exposure. It was enough to be less than the un-latensified tests. This may have been caused by the operation of the Claden Effect. The decrease was nullified with increased development time.

ACKNOWLEDGMENTS:

Acknowledgment is made to the assistance given in this work by Mr. R. Zakia, Mr. H. Todd, and Mr. A. Rickmers.

APPENDIX:



The above statistical design was used for the analysis of the response variables in this experiment. It was used three times. The variables of speed, gamma, and D-Max were tested for.

GAMMA - ANOVA TABLE

SOURCE	SUM SQUS.	D.F.	MEAN SQUS.	CALC. F.
A	0.003	1	0.003	4.48
B	0.174	2	0.087	129.9++++
C	0.027	1	0.027	40.3++++
AB	0.002	2	0.001	1.49
AC	0.000	1	0.000	0.00
BC	0.001	2	0.0005	0.74
ABC	0.003	2	0.0015	2.24
ERROR	0.008	12	0.00067	
TOTAL	0.218	23		

D-MAX - ANOVA TABLE

SOURCE	SUM SQUS.	D.F.	MEAN SQUS.	CALC. F.
A	0.036	1	0.036	18.0^{+++}
B	0.001	2	0.0005	0.25
C	0.003	1	0.003	1.5
AB	0.013	2	0.0065	3.25
AC	0.002	1	0.002	1.0
BC	0.004	2	0.002	1.0
ABC	0.004	2	0.002	1.0
ERROR	0.024	12	0.002	
TOTAL	0.087	23		

SPEED - ANOVA TABLE

SOURCE	SUM SQUS.	D.F.	MEAN SQUS.	CALC. F.
A	2.55	1	2.55	91.06^{++++}
B	1.18	2	0.59	21.06^{++++}
C	0.18	1	0.18	6.43
AB	0.49	2	0.24	8.56^{+++}
AC	0.27	1	0.27	9.64^{++}
BC	0.22	2	0.11	3.93^{+}
ABC	0.22	2	0.11	3.93^{+}
ERROR	0.33	12	0.028	
TOTAL	5.44	23		

SIGNIFICANCE:

+ 0.05   ++ 0.01   +++ 0.005   ++++ 0.001

FACTORS:

A: First Exposure Illumination
B: Latensification Time Factor
C: Latensification Illumination
AB: Interaction - 1st Exposure vs Laten. Time Factor
AC: " - " " vs laten. Illumination
BC: " - Laten. Time Factor vs Laten. Illum.
ABC: Second order interaction

REFERENCES:

Brit J Phot, 1957, pg 432; Review of Latensification by light.
Burton; Photo J., May-June 46' vol 86B, pgs 2-24
Burton; Photo J, Jan-Feb 1948, pgs 13-17
Hautot & Sauvenier; Sci Ind Phot, 51' (2) vol 20 pgs 1-15
James & Vanselow; PSA J, 49', vol 15 pg 688

SUPPLEMENTAL SENIOR RESEARCH REPORT

SECONDARY "LOW INTENSITY" EXPOSURE METHOD OF LATENSIFICATION

BY D.J. FORST & V.C. GALLO

The original goals of the project included the actual camera testing of the latensification procedure tested. Before this could be carried out one more area of investigation was needed. This was the relation between the time factor and the initial exposure range. It had been expected that initial exposures of from about 10 seconds to probably 1/5000 sec. (electronic flash) would be investigated. The camera sensitometer devised by R.I.T. instructor Mr. Norman was to be utilized; however, a problem with a light source which would have allowed the use of a step wedge was anticipated.

Serious difficulties were encountered with extraneous light fog from the sensitometer. The first attempt at masking was considered sufficient; but, erratic results prompted a further examination which revealed that the masking was inadequate. Great quantities of masking paper and tape finally did the job. Some anguish was aroused over the 100 minute latensification exposures because of the heat which would result. Several of the neutral density filters curled and a blister resulted on one. The problem arises because the sensitometer (Kodak 101) was not suited for long exposure times.

The major factors investigated (illuminant & time factor) warrent further examination. No previous work on these factors was found; though it seems inconceivable that they were never studied.

The unusual results that initial exposure illuminant had on the Dmax warrents a full experiment. The curve (Fig 6) consists of 6 time factors yet it still seems incredible that such a relationship exists.

Other films, of course, should be examined to determine if some of the results exhibited are just peculiar to Super Panchro Press B.

Because of the nature of the experiment a great amount of time is needed to accumulate sufficient data. Approximately 100 man-hours were spent on lab work alone; over half of the alloted time. It is suggested that each lab session be well planned so that while, for example, 100 min. exposures are taking place densitometric readings be made, etc.