Pleased be advised that this pamphlet is not to be photostated, printed or reproduced in any form whatsoever without written permission of the Author. He considers the information herein especially the dyes, the formulas & their preparations valuable to the purchaser only.

BARD
EXPERIMENTAL ENTERPRISES
DYE TRANSFER PHOTOGRAPHY

469 S.W. Fagler Avenue
Pompano Beach, Florida 33060
Phone: (305) 781-1927
DYE TRANSFER
FORMULAS AND DYESTHES

This paper is principally written for:

1. The advanced college or university photography student who is interested in the dye transfer process.
2. The advanced amateur who wishes to improve the "State of the Art" and at the same time improve his work.
3. The professional who is desirous of understanding the reasons why and how the process works.

This information was suggested by a dear friend of mine - Mr. Frank McLaughlin - formerly head of the dye transfer department at Kodak prior to his retirement.

His suggestion was appropriate since this paper will give the dyes and formulas to make a standard stock solution of each color.

Needless to say, Frank taught me everything I know about the photographic formation of the matrix, both theory and practice.

At this point, let me advise that the knowledge of making a matched set of separations is of the utmost importance.

Books and periodicals too numerous to mention have been devoted to this subject. Explanations and advice can be found wherever the subject is mentioned, but I find that the most concise and explicit interpretation can be found in the Kodak's E80 series of pamphlets.
<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>E80</td>
<td>Kodak Dye Transfer Process</td>
</tr>
<tr>
<td>E-80A</td>
<td>A Dye-Withdrawal Control Technique For The Kodak Dye Transfer Process</td>
</tr>
<tr>
<td>E-80B</td>
<td>The Order Of Matrix Transfer In The Kodak Dye Transfer Process</td>
</tr>
<tr>
<td>E-80C</td>
<td>Notes On Dye Transfer</td>
</tr>
<tr>
<td>E-80D</td>
<td>Notes on Dye Transfer</td>
</tr>
<tr>
<td>E-80E</td>
<td>Basic Requirements For Dye Transfer Printing</td>
</tr>
</tbody>
</table>

These booklets were formerly sent free, but if there is a charge now, it is well worth whatever the cost.

Don't let the first E-80 scare you if you are a beginner, but after a couple of readings, especially between the lines, the interpretation and the understanding will come gradually.

A Kodak punch for the matrixes and metal slides for holding the punched mats are indispensable - remember punch each mat separately.

Another reliable supplier for hardware for this process is:

Condit Mfg. Co.
Philo Curtis Rd.
Sandy Hook, Conn.
66482

I have found their work excellent - especially when it comes to special punches that you may want to use to transfer for 4/5 to 5/7 or 8/10 as your experience progresses.
A vacuum plate will help, but is not an absolute necessity.

During my early days in dyeing, we were taught that the use of time - temperature - and concentration were the three requisites for a duplication of results. I find in photography that agitation is a fourth requisite for good work and exact duplication.

I am referring to the developing in trays, especially on large 16/20 film.

Kodak has explicit instructions on how to move a tray in developing, but if you measure the density of the color on a color densitometer, I doubt that the exact results will prevail after a number of tests.

I have covered this by building a rocker as described by Kodak on page 17, figure 8, of the latest E-80 - except that mine is much simpler and a lot less expensive. I have described this rocker for dye solutions in the dyeing section, but a brief description may cover the matter of agitation thoroughly.

I purchased a small 1/4 h.p. motor from Grainger Company that is normally used for vending machines that is stopped down to about 50 r.p.m. I attach a 3" pulley to the shaft (you may need a bushing) and drill a hole at the outer edge of the pulley. I attach a flat piece of aluminum 1/8" thick by 3/4" wide to a screw (10/32) at one end and to the edge of the table that moves up and down in the middle so that one turn of the 3" pulley will lift the table approximately two inches and
of course pull it down on the bottom turn. This reciprocating motion moves my solution in a tray on top of the table. A small switch connected to my timer will give you the exact time and the same solution movement.

I use this apparatus both in my darkroom for all darkroom tray film developments and matrix tanning.

In matrix development, I develop one sheet at a time because I have the process under complete control in spite of the advice of many, to interleave three sheets at a time. With 16/20 matrix film costing approximately $5.00 each, I do not have deep enough pockets to see $15.00 go up in smoke if I make a small mistake.

While the matrix is being wet out, I start my tray moving and add my tanning solution and then my alkaline. I slide my single matrix with the mixed tanning developer and start my timing at the timing bell. I remove my matrix at the corner and after slightly draining put it into the wash off H2O that I wash for at least three minutes before it goes into the hot wash off bath to remove the excess gelatin.

My next matrix goes into completely fresh baths and from my experiences I find that my results are as excellent as possible.

One must keep in mind that there is a vast difference in handling 5/7 or 8/10 and 16/20 film.

I did not have the intention of going into matrix production with this paper, but I hope these meager hints may help.
This paper is devoted principally to the dyeing end of dye transfer, a subject I have fitted into and studied in the first recognized State textile college that offered full four year prescribed courses on the subject with the culmination of a Bachelor of Textile chemistry degree - (B.T.C.). Lowell Textile Institute was the only higher grade College in the country in the late 20's with this distinction - all others offered courses of study or seminars or lectures. Masters Degrees and P.H.D.'s were unheard of at least to my knowledge at that time. Dyes and dyeing in the late 20's were in a primitive state and although the first synthetic dye was stumbled on in 1855 by a Royal College chemistry student -W. H. Perkins - in England, he at that time was working to produce a synthetic quinine - a drug for the cure of Malaria which was quite prevalent in India. Remember, the British controlled India during this period.

In a previous paper of mine, I tried to enumerate the various changes of natural plant dye production from Country to Country before the age of the manufactured dye. Although the breakthrough occurred in England and though the idea was pursued further by the French and others, the Germans dominated the field and furthered its future by experimentation, hard work, and advanced studies of organic dye chemistry.

Dyes are manufactured in batches, not on a continuous production line and shipped to the Lab for analysis and standardization - since every batch varies according to concentration and color.
A broad description, as a starter, can be described as both Aromatic and Aliphatic compounds.

1. The Aromatic compounds, the original being Benzene which was discovered by Faraday in 1825, was obtained in the coking of coal and in the product of illuminating gas from coal - evidently named Aromatic because of its peculiar almond smell. Its formula:

![Benzene ring](image)

The H or hydrogen radical, is usually replaced by another compound.
2. The Aliphatic compounds are hydro-compounds of the open chain series that do not contain a Benzene ring or Benzene-like structure - they principally come from petroleum.

Ethylene Glycol

$\text{HOCH}_2\text{CH}_2\text{OH}$
(C2H6O2)

These two compounds are combined by various means - Sulphonation, Nitratin, Acetilization and by the use of a catalyst and usually by heat.
Benzene Ring with numbers for identification.

Note the numbers assigned to the positions for identification - coupling usually takes place at either the:

2 - 3 or 4 positions.

Can also take place at the 1 - 6 or 5 positions.
2 Position - Ortho
3 Position - Meta
4 Position - Para

If the new compound is formed into another of these positions, usually there is a different chemical produced.
The \( H \) radical in either the:  
\#3 Ortho  
\#4 Meta  
\#5 Para

position of the Benzene ring is removed from the Aromatic compound and combined with the Aliphatic compound to form either the intermediate or the dye.

The intermediate is an in-between compound that may be colorless and used with some other compound for further dye production.

Dyes are not produced by just adding two compounds together.

According to what is projected there are numerous additions made with intermediates under various conditions in a continuous chemical buildup.

At this point, let me point out the production of what is called an insoluble AZO reaction. Basically there is an insoluble AZO reaction where you have one colorless liquid, the component on the film and another chemical, the coupler in the color solution. When combined they form color, the basis of color photography — except Cibachrome and possibly Kodachrome.

In my early days as a chemist in a dye Lab, my job was to standardize color coming in 55 pound drums from the manufacturer.

Every batch had its variations and had to be either diluted with Glauber Salt salted down with \( \text{NA}_2\text{SO}_4 \) if it was over 100% of value, or more concentrated dye
added if it was not up to strength standard. I wonder if the dye people have the same problems today?

My attention was particularly drawn to the subject that, since the development of the dye transfer print in the early 1930-35's, there has been a tremendous increase in technology in the field and improved theory and manufacture on new dyes. New dyes that are much faster to light.

During this period, new fibers, such as Nylon and Polyester, were not available and dyes for these fibers had not been developed as yet. But, I felt that there was an opportunity for new research on this subject (dye transfer) to improve the "State of the Art", especially the dyeing of the matrix and new dye investigations. The developers of the process, Louis Condaix and Robert Speck, evidently had some expert advice on the selection of the dyes they used that were available at that time and I was rather uncertain as to the dyes that they used.

Needless to say, my help from Kodak was rather infinitesimal (since everything is proprietary), and I have never been able to contact any of their dye chemists after repeated efforts.

I made a thorough study of the new dyes that had come on the market since the late 30's and checked out each classification as to their adaptability for use in dye transfer and came to the conclusion that a new class of colors had been developed by the I.C.I. Americas. This was a
British dye and chemical firm with their American Branch which they called I.C.I. America—(Imperial Chemical Industries). An English company who, taking a different track, came to the conclusion that cellulose (the component of dye transfer print paper) was not as inert as most chemists thought at the time. They called these dyes the reactive dyes—using a chemical called cyanuric acid—for their manufacture. Why had most chemists overlooked this type of dye for about 100 years?

The general thought then was that cotton, or cellulose, was an inert fiber and could not become part of the dye, but the best that could be accomplished would be a surface covering of cotton.

There are dyes that merely cover the surface of the fiber, particularly in the new fabrics (Nylon, Polyester). These reactive dyes were recommended to be applied cold (70 to 74 degrees F) and become bivalent—that is they become a chemical part of the fiber—properties that interested me because they fit into the dye transfer process. With this in mind, I spent quite a number of days at the New York Public Library thoroughly photostating all reactive dyes with a light-fastness of at least #6, #7, or #8 in The Color Index. (As an explanation, The Color Index is a series of 7 or 8 books published by The American Association of Textile Chemists and Colorists, the official association of the industry. The set of books costs about $1,000.00 and it
lists all the dyes now in use, their properties, fastness to various sources, and their distinguishing features, by their manufacturer and class identification giving their Color Index (C.I.) number, properties of various fastness and any unusual reactions.

Enclosed are three pages from The Color Index. A blue - a red - and a yellow.

As regards the #6, #7 and #8 fastness, it is indicated in a numbered series from 1 to 10 - #1 being not fast and #10 being very fast. When it comes to light-fastness, there are few, if any, colors that have a high light-fastness of #9 or #10; the majority of colors fall into the #6, #7 and #8 category.

As a further explanation, I am enclosing sheets from The Color Index of a red, yellow and blue - the subtractive colors, used for the dye bath. Note that we are interested only in the fastness to light in photographs, which I have circled.

To emphasize this fastness, I had them tested by a recognized testing company used by the auto companies for checking on the light-fastness of auto seat fabrics. Laboratory test and method of testing are enclosed plus the Commercial Laboratory report.

Dye transfer paper dyed by these selected dyes were submitted by me for light-fastness evaluation.

They were subject to light similar to the sun in a fadeometer for:
1. 40 hours equivalent to 260 hours of continuous Florida sun.
2. 80 hours equivalent to 520 hours of continuous Florida sun.
   Approximately one year of continuous sunlight.

Note their evaluations list fading on general terms as slight fade, moderate fade, severe fade, etc. To bring it down to percentages to make it more understandable - I picked exact spots on each reading, and got a reading on my color Densitometer to give me an Arithmetic reading in percentages to make it more understandable. This was done for each color.

The Association also published a Dyeing Primer, which gives a comprehensive description of all types of dyes manufactured and sold in the United States. I would recommend anyone interested in dyes to get a copy of this primer:

The American Association of Textile Chemists and Colorists
P. O. Box 212218
Triangle Park, N.C. 27709

The next problem was the procurement of these dyes and their application to the matrix.

My first tryouts were very disappointing since the dye dyed the matrix plus the gelatin and would not transfer to the print paper. Other tries ended up with a dyed gelatin and no transfer of color.
## Color Index Sheet

<table>
<thead>
<tr>
<th>104</th>
<th>105</th>
<th>C.I. Reactive Blue</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>CHEMICAL CLASS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>REACTIVE SYSTEM</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C.I. CONSTITUTION NO.</td>
</tr>
<tr>
<td>Blue</td>
<td></td>
<td>ILUE</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bright blue</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Duller and more green</td>
</tr>
<tr>
<td>Pad-thermotox and single-bath pad-steam methods</td>
<td>Pad-thermotox and single-bath pad-steam methods</td>
<td>DYEING</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cellulose</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Nylon</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Silk</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wool</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cellulose: Neutral steam. Suitable for over-printing with caustic alkali</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cellulose: Fixation by two-stage steaming, caustic shock, cold pad-batch, thermofix or print-dry methods. Suitable for naphthalated goods. Unsuitable for viscose</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PRINTING</td>
</tr>
<tr>
<td></td>
<td></td>
<td>FASTNESS PROPERTIES</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fibre Method</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Alkali Burner Gas Furnace</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Carbonising — Alkaline rinses Neutral rinses</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Decatizing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lights — 1 ± 1 normal normal 2 ± normal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bereside Bleach — Alteration Staining</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Perspiration — Alteration Staining</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Soda Bleach — Alteration Staining</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Washing — Alteration Staining</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OTHER PROPERTIES</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dischargeability</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Effect of Metals — Copper Iron</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reactions in Substance H2SO4, conc. Dilute HCl Dilute NaOH</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NON-TEXTILE USAGE</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NOTES</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Solubility in water at 25°C &gt; 100 g/l</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Suitable for PVC coating</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Crease-resist finishes: variable effect on hue; light fastness usually slightly reduced</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Solubility in water at 25°C, 70 g/l; with 100 g/l urea (with or without 20 g/l soda ash), &gt; 100 g/l</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Suitable for PVC coating</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Crease-resist finishes: hue usually somewhat weaker; light fastness usually somewhat reduced. The dyesings may become slightly phototropic</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6319</td>
</tr>
</tbody>
</table>
# Color Index Sheet

**C.I. Reactive Red 98—103**

<table>
<thead>
<tr>
<th>C.I. Reactive Red</th>
<th>98</th>
<th>99</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CHEMICAL CLASS</strong></td>
<td>Monocyclic (metal complex)</td>
<td>Azo</td>
<td>Azo</td>
</tr>
<tr>
<td><strong>REACTIVE SYSTEM</strong></td>
<td>Dichlorophenylazocarbonyl</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td><strong>C.I. CONSTITUTION NO.</strong></td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td><strong>HUE</strong></td>
<td>Barley</td>
<td>Red</td>
<td>Brilliant Red</td>
</tr>
<tr>
<td><strong>Daylight</strong></td>
<td>4 (yellowed)</td>
<td>Yellower</td>
<td>Somewhat yellower</td>
</tr>
<tr>
<td><strong>Artificial light (tungsten)</strong></td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td><strong>DYEING</strong></td>
<td>As for C.I. Reactive Red 95</td>
<td>Net dyed</td>
<td>Stained</td>
</tr>
<tr>
<td><strong>Cellulose</strong></td>
<td>Dyed</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td><strong>Nylon</strong></td>
<td>Heavily stained</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td><strong>Silk</strong></td>
<td>pH 4.5-5; acetic acid + auxiliary*</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td><strong>Wool</strong></td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td><strong>PRINTING</strong></td>
<td>As for C.I. Reactive Red 95</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

## FASTNESS PROPERTIES

<table>
<thead>
<tr>
<th>Fiber Method</th>
<th>Cotton ISO</th>
<th>Wool ISO</th>
<th>Wool ISO</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Alkali</strong></td>
<td>4 (blue)</td>
<td>4-5</td>
<td>4</td>
</tr>
<tr>
<td><strong>Burst Gas Fumes</strong></td>
<td>5</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td><strong>Carbonylation</strong></td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td><strong>Azo</strong></td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td><strong>Neutral rinse</strong></td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td><strong>Light</strong></td>
<td>6-7</td>
<td>5-6</td>
<td>5-6</td>
</tr>
<tr>
<td><strong>1 normal</strong></td>
<td>6-7</td>
<td>5-6</td>
<td>5-6</td>
</tr>
<tr>
<td><strong>2 normal</strong></td>
<td>—</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td><strong>Peroxide Bleach</strong></td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td><strong>Azo</strong></td>
<td>4-5</td>
<td>4-5</td>
<td>4-5</td>
</tr>
<tr>
<td><strong>Ozonation</strong></td>
<td>4-5</td>
<td>4-5</td>
<td>4-5</td>
</tr>
<tr>
<td><strong>Soda Bleach</strong></td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td><strong>Azo</strong></td>
<td>4-5 (ISO No.4)</td>
<td>4-5 (15°C)</td>
<td>4-5</td>
</tr>
<tr>
<td><strong>Washing</strong></td>
<td>4-5 (ISO No.4)</td>
<td>4-5</td>
<td>4 (5°C)</td>
</tr>
</tbody>
</table>

## OTHER PROPERTIES

| Dischargeability | 3 (neutral or alkaline) | 4 | 4 |
| Effect of Metals — Copper | 4 | 4-5 | 4-5 |
| Iron | 4 | 4-5 | 4-5 |
| Reactions in Substance | 4 | 4 | 4 |
| H₂SO₄ conc. | 4 | 4 | 4 |
| Dilute HCl | 4 | 4 | 4 |
| Dilute NaOH | 4 | 4 | 4 |

## NON-TEXTILE USAGE

<table>
<thead>
<tr>
<th>Solubility in water: 100 g/l at 30°C, 60°C, and 90°C</th>
<th>Solubility in water: 91-100 g/l at 30°C</th>
<th>Solubility in water: 1-50 g/l at 30°C</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>May be treated with ammonia for deep dyes on wool or chlorinated wool</em></td>
<td><em>May be treated with ammonia for deep dyes on wool or chlorinated wool</em></td>
<td><em>May be treated with ammonia for deep dyes on wool or chlorinated wool</em></td>
</tr>
</tbody>
</table>
## Color Index Sheet

### C.I. Reactive Yellow 1—2

<table>
<thead>
<tr>
<th>C.I. Reactive Yellow</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEMICAL CLASS</td>
<td>Monoazo (pyrazolone)</td>
<td>Monoazo (pyrazolone)</td>
</tr>
<tr>
<td>REACTIVE SYSTEM</td>
<td>Dichlorotriazinyl</td>
<td>Monochlorotriazinyl</td>
</tr>
<tr>
<td>C.I. CONSTITUTION NO.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HUE</td>
<td>Bright Greenish Yellow</td>
<td>Bright Yellow</td>
</tr>
<tr>
<td>Daylight</td>
<td>Redder</td>
<td>Redder</td>
</tr>
<tr>
<td>Artificial light (tungsten)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DYEING</td>
<td>1 (a, b, c), 2 (a, b), 3 (a, b, c)</td>
<td>4 (a, b), 5 (a, b), 6 (a, b, c)</td>
</tr>
<tr>
<td>Cellulose</td>
<td>Formic acid at 40–95°C</td>
<td>Formic acid</td>
</tr>
<tr>
<td>Nylon</td>
<td>(Degummed): NaSO₄ at 50°C; soda ash added. Or formic acid at 40°C–85°C</td>
<td>—</td>
</tr>
<tr>
<td>Silk</td>
<td>Acid (for intraind effects), Acetic acid + cationic agent for level dying</td>
<td>As for C.I. Reactive Yellow 1</td>
</tr>
<tr>
<td>Wool</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PRINTING</td>
<td>Cellulose, silk and wool: with NaHCO₃, urea and a reduction inhibitor, with alkali or emulsion thickener; fixed by steaming (on wool NaHCO₃ is omitted).*</td>
<td>Cellulose: with NaHCO₃ or Na₂CO₃, urea and a reduction inhibitor, thickened with sodium alginate; fixed by steaming or dry heat, silk and wool: as for cellulose, but NaHCO₃ is omitted on wool*</td>
</tr>
</tbody>
</table>

### FASTNESS PROPERTIES

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Allakali</td>
<td>3</td>
<td>—</td>
<td>—</td>
<td>3</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>Burnt Gas Furnes</td>
<td>—</td>
<td>—</td>
<td>—</td>
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</tr>
<tr>
<td>Carbonization — Alkaline rinse</td>
<td>—</td>
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<td>—</td>
</tr>
<tr>
<td>Neutral rinse</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Desalting</td>
<td>—</td>
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<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Light</td>
<td>6–7</td>
<td>6–7</td>
<td>2–4–6</td>
<td>1–9</td>
<td>6–7</td>
<td>6–7</td>
</tr>
<tr>
<td>Peroxide Bleach — Alteration Staining</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Perspiration — Alteration Staining</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Soda Soil — Alteration Staining</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Washing — Alteration Staining</td>
<td>2 (90–100°C)</td>
<td>5</td>
<td>5</td>
<td>3</td>
<td>4–5</td>
<td>4</td>
</tr>
</tbody>
</table>

### OTHER PROPERTIES

| Dischargeability | Dischargeable to white 4 (duller) Unaffected | Suitable at all depths 1 (redder and duller) 3 (redder) |
| Effect of Metals | — | — |
| Copper Iron | — | — |
| Reactions in Substances | — | — |
| H₂SO₄ conc. | — | — |
| Dilute HCl | — | — |
| Dilute NaOH | — | — |

### NON-TEXTILE USAGE

<table>
<thead>
<tr>
<th>OTES</th>
<th>Solubility in water: very good</th>
<th>Suitable for printing on C.I. Azoo Coupling Component 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>*May also be printed on cellulose by nip padding with a thickened alkaline solution and fixed by drying on cylinders, baking at 100–110°C or air hanging. Nylons: printed with a thickened solution containing thiores, phenol and (NH₄)₂S₂O₇ and steamed. Suitable for printing on C.I. Azoo Components 2 and 3</td>
<td>*Discharge and resist styles on cellulose Printing on nylons with thiores, phenol and ammonium sulphate; steamed 30 min</td>
<td></td>
</tr>
</tbody>
</table>
# Commercial Laboratory Report

## Exposure Test

**Bard Experimental Enterprises**
469 S.W. Playlot Ave.
Pompano Beach, Fl. 13080

**REPORT No.** 1 - Final

**DATE OF INSPECTION:** 1-10-81

**BEE-2-X-179**

**MATERIAL:** Color Photo Samples

EXPOSED: 1-4-83

**EXPOSURE TIME TO DATE:** 20, 40, 60, & 80 Hours

**Letter dated 12-2-82**

**TYPE OF TEST:** AATCC 16-E

---

## Inspection Report

The purpose of this test is to determine, by accelerated testing methods, the resistance of the subject samples to color change. Fourteen (14) samples were submitted by Mr. H. A. Bard and exposed in an Atlas CI-65 Fadometer to the requirements of AATCC (American Association of Textile Chemists & Colorists) method 16-E. Test parameters are detailed in the attached letter. One fourth of the exposed area of each specimen was masked at twenty (20) hours. Additional one fourth areas were masked at forty (40) and sixty (60) hours and the specimens were removed at eighty (80) hours for evaluation.

At the conclusion of the eighty hour period, the following color changes were noted.

<table>
<thead>
<tr>
<th>SAMPLE</th>
<th>20 Hours</th>
<th>40 Hours Yellow</th>
<th>60 Hours</th>
<th>80 Hours</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kodak Cyan</td>
<td>Sl.Fad.</td>
<td>Sl.Fad. 23.8</td>
<td>Pro.Fad.</td>
<td>Sev.Fad.</td>
<td>30.3</td>
</tr>
<tr>
<td>B.E.E. Cyan 1</td>
<td>Tr.Fad.</td>
<td>Vy.Sl.Fad. 2.4</td>
<td>Vy.Sl.Fad.</td>
<td>Sl.Fad.</td>
<td>4.4</td>
</tr>
<tr>
<td>B.E.E. Cyan 2</td>
<td>Tr.Fad.</td>
<td>Vy.Sl.Fad. 4.1</td>
<td>Vy.Sl.Fad.</td>
<td>Sl.Fad.</td>
<td>6.2</td>
</tr>
<tr>
<td><strong>B.E.E. Cyan 3</strong></td>
<td><strong>Tr.Fad.</strong></td>
<td>Vy.Sl.Fad. 3.6</td>
<td>Sl.Fad.</td>
<td>Sl.Fad.</td>
<td>5.1</td>
</tr>
<tr>
<td>B.E.E. Mag. 1</td>
<td>Sl.Fad.</td>
<td>Med.Fad. 25.4</td>
<td>Pro.Fad.</td>
<td>Sev.Fad</td>
<td>45.1</td>
</tr>
<tr>
<td><strong>B.E.E. Mag. 3</strong></td>
<td><strong>Vy.Sl.Fad.</strong></td>
<td>Sl.Fad. 6.5</td>
<td>Sl.+Fad.</td>
<td>Sl.+Fad.</td>
<td>14.1</td>
</tr>
<tr>
<td>Kodak-Red</td>
<td>Sl.Fad.</td>
<td>Sl.Fad. 24.0</td>
<td>Sl.+Fad.</td>
<td>Sl.+Fad.</td>
<td>33.4</td>
</tr>
<tr>
<td>B.E.E. Yel. 1</td>
<td>Tr.Fad.</td>
<td>Tr.Fad. 6.5</td>
<td>Vy.Sl.Fad.</td>
<td>Vy.Sl.Fad.</td>
<td>13.3</td>
</tr>
<tr>
<td>B.E.E. Yel. 1A</td>
<td>Tr.Fad.</td>
<td>Tr.Fad. 7.8</td>
<td>Vy.Sl.Fad.</td>
<td>Vy.Sl.Fad.</td>
<td>15.6</td>
</tr>
<tr>
<td>B.E.E. Yel. 2</td>
<td>Tr.Fad.</td>
<td>Vy.Sl.Fad. 12.4</td>
<td>Vy.Sl.Fad.</td>
<td>S1.Fad.</td>
<td>25.4</td>
</tr>
<tr>
<td><strong>B.E.E. Yel. 3</strong></td>
<td><strong>Tr.Fad.</strong></td>
<td>Tr.Fad. 4.6</td>
<td>Tr.Fad.</td>
<td>Tr.Fad.</td>
<td>4.6</td>
</tr>
<tr>
<td>D.E.E. Yel. 4</td>
<td>Tr.Fad.</td>
<td>Tr.Fad. 8.8</td>
<td>Tr.Fad.</td>
<td>Tr.Fad.</td>
<td>4.1</td>
</tr>
</tbody>
</table>
Kodak Cyan Faded Approx. 30.3%
B.E.E. Cyan 3 faded Approx. 5.1%

Kodak Magenta faded Approx. 17%
B.E.E. Magenta 3 faded Approx. 14.1%

Kodak Yellow faded Approx. 33.4%
B.E.E. Yellow 3 faded Approx. 4.6%

These dyes were applied in a dye solution at 70 degrees F. for five minutes at a pH of 3.5 using 100cc of each color. To 900cc distilled H2O.

As you can see from the testing report, I have developed three Cyans, three Magentas and five yellows of various hues.

The field of color developing needs some dedicated people to check into new additions for color for this process to improve "The State of the Art".
METHOD OF TESTING

Ref: Test No. BET-3-X-198  Case No. 56459
Your Ref. Letter dated 6-21-33

Dear Sir:

The following samples have been returned via UPS, Insured for $200.00
Seven color photo samples.

Test Method: AATCC 16-E
Exposure Device, Type: CI-65
Serial Number: C3-1127
Light Source: Xenon Arc
Filter Type: Borosilicate inner, soda lime out

Elapsed Exposure Time: 20, 40, 60 & 80 Hours
Cam Number: BLANK
Continuous light

Black Panel Temperature: 145 ± 3°F
Relative Humidity: 50 ± 5%
Type Spray Water: None
Type Spray Nozzle: --
Specimen Relocation: None

This return concludes this test program. Our inspection report is
enclosed. We trust we may be of further service to you.
Reference should be made to our test number in all correspondence.

Please do not hesitate to contact us if there are any questions
regarding this test.

Very truly yours,

SOUTH FLORIDA TEST SERVICE, INC.

William E. Auld
Vice President

Enclosure
I.

THE MANUFACTURE OF A DYE

WE START WITH BENZENE:

Benzene ring
ADD THE INTERMEDIATE:

6235. 2-Naphthol. 2-Naphthalenol; β-naphthol; beta-naphthol; β-hydroxynaphthalene; isonaphthol; C.I. Azoic Coupling Component 1; C.I. Developer 5; C.I. 37500. C_{10}H_{12}O; mol wt 144.16. C 83.31%, H 5.59%, O 11.10%. Prepn from sodium naphthalene-2-sulfonate: Schoeffel, Barton, U.S. pat. 2,760,992 (1956 to Sterling); Stevens, Harris, U.S. pat. 2,831,895 (1958 to Dow); Fr. pat. 1,326,175 (1963 to Ciba); by oxidation of naphthalene: Simons, U.S. pat. 2,530,369 (1950 to Phillips Petroleum); from 2-bromonaphthalene + tert-butyl hydroperoxide: Lawesson, Yang, J. Am. Chem. Soc. 81, 4230 (1959).

Crystals, mp 121-123°, bp 285-286°. d 1.22. Flash pt 161°. Slight phenolic odor. Darkens with age on exposure to light. Sublimes when heated, distillable in vacuo; volatile with vapors of alcohol or water; reduces ammoniacal silver nitrate. uv max (95% ethanol): 226, 263, 275, 286, 320, 331 nm (ε 91,194, 3911, 4559, 3301, 1861, 2163). One gram dissolves in 1000 ml water, 80 ml boiling water, 0.8 ml alcohol, 17 ml chloroform, 1.3 ml ether; sol in glycerol, olive oil, solns of alkali hydroxides. Protect from light. Incompat: Antipyrine, camphor, phenol, ferric salts, menthol, potassium permanganate and other oxidizing agents, urethane.

Sodium salt, C_{10}H_{11}NaO, sodium β-naphtholate, sodium naphthol, Microcidin. Grayish-white powder; becomes reddish or brownish on exposure to light and air. Soluble in 3 parts water. Keep well closed and protected from light.

Human Toxicity: Ingestion of large quantities may cause nephritis, lens opacity, vomiting and diarrhea, abdominal pain, circulatory collapse, convulsions, hemolytic anemia, death. Fatal poisoning from external application has been reported. Caution: Local action may produce peeling of the skin which may be followed by persistent pigmentation, cf. Clinical Toxicology of Commercial Products. R. E. Gosselin et al., Eds. (Williams & Wilkins, Baltimore, 4th ed., 1976) Section II, p 126.

USE: Manuf medicinal organics, oyes, perfumes; the largest single use is probably in making antioxidants for the synthetic rubber industry.

Therap Cat: Formerly as anthelmintic; antiseptic.

Therap Cat (vet): Has been used as antiseptic, anthelmintic and counter-irritant in alopecia.
THEN WE COUPLE AFTER NITRATION:

6735. Orange II. 4-[(2-Hydroxy-1-naphthalenyl)azo]-benzenesulfonic acid monosodium salt; C.I. Acid Orange 7; C.I. 15510; Tropaeolin OOO no. 2; Betanaphthol orange; D & C Orange No. 4. C_{19}H_{11}N_2NaO_{12}S; mol wt 350.33. C 54.85%, H 3.16%, N 8.00%, Na 6.56%, O 18.27%, S 9.15%.


Pentahydrate, orange needles from water. One gram dissolves in 20 ml water. Sol in alc. Absorption max 4844 Å.

USE: One of the most common dyes. Infrequently used as indicator: Amber to orange pK 7.4-8.6; orange to red pK 10.2-11.8. Caution: Delisted by the FDA for internal use in 1968. May be used externally without restriction.
I estimated the problem, starting from the beginning:

1. The dye must be fast to light, as a starter.
2. It must be very soluble since it must be used cold (70-74 degrees F).
3. It should not precipitate out of solution.
4. It must be controlled by a normal pH, heavily buffered, to give constant, similar dyeing.
5. It must stain only the gelatin of the matrix.
6. It should not stain or dye the matrix film.
7. It should be transferrable from the matrix to the paper in a reasonable time (3 to 5 minutes).
8. It should combine with the cellulose in the print paper. If possible, it should combine with the cellulose to form a Bivalant compound. If all the dye could not be removed, that a standard amount would remain in the matrix.
9. The unremoved dye from the matrix should then be dissolved or removed without affecting the matrix for the next dyeing. Since this would be an endless task of dyeing sample matrixes, I looked for a so-called short cut to at least shorten the procedure.

After a bit of experimentation, I would take a smidgen of the dye I was testing on a spatula and dissolve it in a beaker of hot H2O and enter a piece of wool and a
half-strip of white cotton fiber 1" by 4", heat it for about one minute and then thoroughly wash the fibers. If the cotton came out white and the wool slightly stained, I knew that this dye had the properties I was looking for, thus cutting down considerable work.

To digress slightly, I realized that the reactive dye I was looking for must have the property of staining gelatin only and the matrix should be clear. The stain especially from the gelatin must be transferrable to the print paper in its entirety. This could not be done because there is a residue left in the gelatin of approximately 30 to 60 percent. This gelatin stain is usually partially reduced or washed out, with a hot H2O bath plus 5% of 50 cc of a Calgon solution for 5 minutes in one litre of H2O.

After contacting numerous color manufacturers, I was able to obtain samples of some of the colors that looked good in the tests but I finally found that there was a jobber in the dyestuff industry who catered to the small users and experimenters.

I found that the Pylan Company, 1001 Steward Avenue, Garden City, N.Y., 11530 could supply me with most of the colors that I was looking for. I tried to interest this company in producing a mixed solution of each color, but they seemed primarily interested in selling dyes only.
My first work showed me that, although the basic instructions in the use of these reactive dyes called for a pH of 10 to 12 — a very alkaline solution. This did not work because the dye did not penetrate the paper and was very weak. I finally settled at a pH 3.5. I have a pH meter and the pH determination was quite simple. I am quite certain that pH paper strips in the range of a 3 to 5 could be used if a diluted solution was checked so that the color would not interfere with the checking results.

The basic unit is to make a stock solution of each of your dyes. These will hold over the years if they are kept in a cool place.

I dye 16/20 matrix's from positives — usually Kodachrome either 25 or 60 — and usually cut my 16/20 film into 1 to 1-1/2 inch strips to start my color determinations.

I make four litres each in a one gallon container — as follows:

**STOCK SOLUTION**

My stock solution is as follows:

1. A. 30cc Glacial Acetic Acid
   B. 30cc Ethylene Glycol
   C. 30cc Diethylene Glycol
   Use 60cc Ethylene Glycol if Diethylene is not available.
2. I dissolve the dye in distilled H2O at 180 to 200 degrees and strain it into the solvent (above).

3. I add the buffer.

   A. 50 grams of Citric Acid
   B. 30 grams of Disodium Phosphate
   C. 40 grams of Borax

The total should be about two litres.

Correct the pH of the solution to pH 3.5 with the addition of 28% Acetic Acid or some store bought household ammonia if the solution is too acid. Heat this solution to 180 to 200 degrees F and add additional distilled H2O to four litres.

Let cool to 70-75 degrees F and you have a standard stock solution of blue (Cyan)-Red (Magenta)- and yellow - subjective colors.

**STRAIN - STRAIN - STRAIN**

First the dyes must be rocked continuously in a one litre tray with the matrix in a constant movement in the dye.

At a temperature of 70-75 degrees F even dyeing of the matrix is one of the most important points - straining to keep the solution free from dirt and other ingredients is very important.

My trays are placed on a table and rocked continuously. The rocking is done with
a small motor (Grainger) that has a 3-inch pulley that has a screw drilled to one side that gives a reciprocal motion with one revolution. At the table bottom a piece of 1/8-inch aluminum is attached to this screw and to the table so that it rocks back-and-forth, taking care of the problem at little cost. The table rocks in the center.

I start my dyeings with 100cc stock - 900cc distilled H2O in blue and red and I use 70 yellow and run a print. Discard this after the print and wash the matrixes.

The second print will give you the picture and what needs correction. Add stock from each primary to give you what you need. Keep track of all additions.

After three to four hours work, I strain my working dye solution into a litre container and note the amount of dye solution left. I replace the missing solution in the same proportions I started with.

If there is a 200cc shortage and I started with 100cc dye in 1 litre, I replace 20cc dye stock and 180cc distilled H2O. Strain back into dye bath for 1000cc of starting solution.

If you want to see if you are improving in your work, check out:
I understand the Pylan Company, who is a jobber, is going out of business.

Below find the addresses of the original manufacturers of the dyes or colors in this booklet:

B.A.S.F. Corporation - BASILEN COLORS
Chemicals Division
Colors and Auxiliaries Division
P. O. Box 668846
Charlotte, N.C. 28266
704-392-4313

H.S.T. - REMAZOL COLORS
American Horchst Corporation
Specialty Products Group
Colors & Auxiliaries
P. O. Box 1627
Charlotte, N.C.
1-800-532-0369
1-800-438-4561

I.C.I. Americas - PROCION COLORS
I.C.I. Americas, Inc.
6601 Interstate & 5 N
Charlotte, N.C. 28213

An Additional Supplier is:

Geige Dyestuff Corp.
P. O. Box 18300
Greensboro, N.C. 27419
I have been asked why the dye on the matrix transfers to the dye transfer print paper.

My answer to this is there is a two-fold reaction:

1. The print paper is less dense than the matrix film and the gelatin, plus the mordant on the print paper, attracts the dye to it.

2. The reactive dyes are anionic in composition - that is, they carry the positive radical and are called anions.

   The negative radical, or the negative charge, is on the paper and is called cations.

   In Electrolysis, the positive charge (anions) on the dyed matrix, including the dyes, travels to the negative (cations) charge on the print paper and deposits the dye on the paper.

   In addition to this, the reactive dye combines with the cellulose on the print paper to form a stable bivalent compound.

Of course, this is my personal evaluation of the subject.
There has been some ambiguity in the amount of dye, buffer and solubilizing agents between litres and gallons.

To clear this up:

1. Dissolve your dye in one litre of distilled water.

2. To this add your solubilizing agents of ethylene glycol and acetic acid dissolved in 100 to 200 c.c. of distilled water.

To finish this off, add the buffer of citric acid, disodium phosphate and Borax also dissolved in about 200 c.c. of distilled water. This will give you approximately 1,400 to 1,500 c.c. of solution. Adjust your ph to 3.5 then dilute with distilled water to one gallon.

This will give you my one gallon of standard stock solution corrected to a ph of 3.5.
1. Registration -
   Get a 25 sheet of stamps from the Post Office Department and make a dye transfer. If you can register without manipulation on all the little holes on all four sides of your print, you have arrived.

2. Color -
   Dye a Cibachrome over-exposed with a Macbeth Color Checker so that the color is .25% lighter. Bring this color back to its original. Observe the gray scale especially step #3 on the bottom of the Color Rendition Chart. Step #3 should be the equivalent of the 17% Gray card. Manipulate the dyes. If you can make a gray 17% scale plus the color corrections you are a good dye transfer operator.

**MY WETTING OUT SOLUTION**

1. 60cc Trietholamine
2. 20cc Glacial AC
3. 100cc Ethylene Glycol

One Gallon or 4000cc

Don't forget wet out for at least one hour. This gives the print paper time to absorb your wetting out solution maximum. Add 50cc Listerine to dye solution - This evidently lowers the surface tension of the dye bath, making penetration of the dye into the gelatin more stable.
Solution should be used at a pH of 5 - 6 - slightly acid - since you are dyeing at a pH of 3.5.

MY DYES

Cyan:

1. Cyan 1 is Procion Blue - Reactive Blue 5
   H.G.R.
   Pylan Company
   1001 Steward Avenue
   Garden City, N.Y. 11530
   Use 18 gram/4 Litre - Gallon

2. Cyan 3 is Basilein Blue
   E.B.G.
   B.A.S.F. Wayndote Corp.
   Charlotte, N.C. 28266
   Use 18 grams/litre, but watch the solubility; it may split out at very high temperatures - 212 to 230 degrees F.

3. Cyan 4 is Renazol Brilliant Blue R.
   Reactive Blue 19
   Pylan Company
   Use 18 grams/litre. I have not done much work on this dye. Looks promising.

Magenta:

1. Magenta 1 is Ramazol Brilliant Red - R.F.C.
   C.I. #?
   Bright color but stains slightly.
American Hoechst Corp.
Industrial Chemical Div.
Specialty Chemical Dept.
P. O. Box 1627
Colorants Anx.
Charlotte, N.C.  28216
Use 8 grams/litre.

2. Magenta 2 is Hostalen Red 4 B.N.
C.I. #?

American Hoechst Corp.

See previous (Pylan)
Use 8 grams/litre.

3. Magenta 3 is Remazol Bordeaux B
Reactive Red #49

American Hoechst Corp.

See previous (Pylan)
Use 15 grams/litre.

Yellows:

1. Yellow 1 is Remazol Brilliant Yellow-G.P
   C.I. #?
   American Hoechst Corp.
   Use 18 grams/litre.

1A. Yellow 1A is Remazol Yellow C.L.
    C.I. # Reactive Yellow 37
    Use 15 grams/litre.

2. Yellow 2 is Remazol Yellow G.R.
   C.I. # Reactive Yellow 15
   American Hoechst Corp.
   Use 15 grams/litre.

3. Yellow 3 is Basilin Yellow E.3R.
   C.I. #?
   American Hoechst Corp.
   Use 9 grams/litre.
4. Yellow 4 is Remazol Yellow R.T N.
   C.I. Reactive Yellow #24
   American Hoechst Corp.
   Use 5 grams/litre.

These dyes can all be obtained from the
Pylan Company.

Black:

Procion Black S.P.-4
   I.C.I. Americas Inc.
   6601 Interstate 85 N
   Charlotte, N.C. 28213

Use 25 to 30 grams/Gallon.
For a greenish yellow, add 200cc
of Yellow 1.

I find that a good combination is:

1. Procion Blue H.G.R. (Cyan 1)
2. Remazol Bordeaux Blue (Magenta 3)
3. Remazol Yellow R.T.N. (Yellow 4)
   or 4. Basilin Yellow E.3R. (Yellow 3)

PURE FOOD COLORS

As I mentioned previously, these colors
will give brilliant shades but are not
fast to light. However, I know they are
being used in the advertising trade for
brilliant color illustrations.
1. Cyan

F.D. & C. Blue #1
Crompton & Knowles
17-01 Navins Road
Fairlawn, N.J. 07410
Use 6 grams/litre.

2. Cyan
Acid Blue W.A.
Tricom Colors, Inc.
16 Leilarts Lane
Elmwood Park, N.J. 07407
Use 6 grams/gallon.

3. Magenta
Red L.S. 525
Tricom Colors, Inc.
16 Leilarts Lane
Elmwood Park, N.J. 07407
Use 8 to 10 grams/gallon.

4. Yellow
Tartrazine C. Extra.
Use: Experiment - no data.

These are only a few of the dyes I have worked with, but there must be more available for further research.

Write the Pylan Color Company and ask for their catalog. They have most of the colors listed that are described in the A.A.T.C.C. Primer.
M. A. BARD

1. Graduate of Lowell Textile Institute
   Bachelor of Textile Chemistry
   (B.T.C.) 1930

1A. Winner of Textile Thesis prize -
    Thesis of most value to the Textile
    industry - given by the Textile
    Colorist Magazine - The Insoluble
    AZO's on Viscose Yarn.

II. Did photographic screen printing on
    velvet fabrics to achieve 3-D effect.

III. Perfected pointillism process on
     both positive and negative film -
     duplicated Seurat and VanGough.

IV. International exhibitor with over
    130 acceptances in Photographic
    Society of America International
    exhibitions. Awarded Two Star
    Rating.

V. Did considerable work on experimental
   dyes for dye transfer. Perfected
   series for increased fastness to light.

VI. Perfected the removal of the top
    onionskin from print paper and
    fastened to Artist canvas giving
    various effects, and when fastened
    to a stretcher to resemble a painting.
PHOTOGRAPHIC FORMULAS

KODAK Developer D-11
Water about 90 F (32 C)
Elon Developing Agent
Sodium Sulfite (Anhydrous)
Hydroquinone
Sodium Carbonate (1-Hydrate)
Potassium Bromide (Anhydrous)
Cold water to make

Kodak Developer DK-60a
Elon Developing Agent
Sodium Sulfite (Anhydrous)
Hydroquinone
Balanced Alkali
Potassium Bromide (Anhydrous)
Water to make

Fixing Bath F-24
Water about 68 F (20 C)
Sodium Thiosulfate (5-Hydrate)
Sodium Sulfite (Anhydrous)
Sodium Bisulfite (Anhydrous)

1% Acetic Acid Solution
Glacial Acetic Acid
28% Acetic Acid
Water to make
Matrix Film Developers - KODAK Tanning Developer A and B has a proprietary formula. Other tanning developer formulas that have long been published are:

**Formula No. 1**

**A.**
Water about 125 F (50 C) 750.0 mL
Pyrogallol 15.0 g
Citric Acid 2.0 g
Ammonium Bromide 4.0 g
Cold water to make 1.0 L

**B.**
Water about 125 F (50 C) 750.0 mL
Sodium Carbonate (Anhydrous) 200.0 g
Sodium Salicylate 4.0 g
Cold water to make 1.0 L

Mix 1 part of A to 2 parts of B for normal contrast.

**Formula No. 2**

**A.**
Water about 125 F (50 C) 750.0 mL
Pyrogallol 20.0 g
Sodium Bisulfite 7.5 g
Sodium Thiocyanate 25.0 g
Potassium Bromide 10.0 g
Cold water to make 1.0 L

**B.**
Water about 125 F (50 C) 750.0 mL
Sodium Carbonate 50.0 g
Cold water to make 1.0 L

Mix 1 part A to 1 part B to 6 parts water for normal contrast.
Formula No. 3

A.

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water at 125 F (50 C)</td>
<td>750.0 mL</td>
</tr>
<tr>
<td>Elon Developing Agent</td>
<td>16.0 g</td>
</tr>
<tr>
<td>Sodium Sulfite</td>
<td>3.0 g</td>
</tr>
<tr>
<td>Potassium Bromide</td>
<td>16.0 g</td>
</tr>
<tr>
<td>Pyrogallol</td>
<td>18.0 g</td>
</tr>
<tr>
<td>Citric Acid</td>
<td>4.0 g</td>
</tr>
<tr>
<td>Water to make</td>
<td>3.785 L</td>
</tr>
</tbody>
</table>

B.

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water at 125 F (50 C)</td>
<td>3.785 L</td>
</tr>
<tr>
<td>Potassium Carbonate</td>
<td>884.5 g</td>
</tr>
</tbody>
</table>

Mix 1 part of A to 2 parts of B for normal contrast.
For making Pan Masking
Principal masks:
25cc of H C 110 concentrate
per liter of water.

For separation negatives
using Super XX:
30cc of Concentrate per liter
of water

For separation negatives
using T-Max film
Dilution B  H C 110

For highlight masks:
D11  dev. 2:30 at 68 de-
grees.

For Litho film:
Kodalith A & B ,or D 11

Sodium Acetate solution:
A two oz. shot glass (or two
tablespoons) to one liter of
water. (add 30cc of List-
erine)

Highlight reducer:
1/4 teaspoon of Sodium
Hexametaphosphate (pure
calgon) per liter of water.
(add 30 cc of Listerine)

Listerine contains
Thymol. Reduces
surface tension.
To bleach litho negatives:
A farmers reducer. (Potas-
sium Cyanide and hypo in
water).
Wash-Off Relief Formulas

Bleach R-10a
A.
Water about 125 F (50 C) 750.0 mL
Ammonium Dichromate 20.0 g
Sulfuric Acid 4.0 mL
Cold water to make 1.0 L
B.
Sodium chloride (uniodized table salt) 45.0 g
Water to make 1.0 L

Special Hardener SH-1
Water at 65 to 70 F (18 to 21 C) 500.0 mL
Formaldehyde about 37% Solution 10.0 mL
Sodium Carbonate (monohydrated) 6.0 g
Water to make 1.0 L

Non-Hardening Fixers for Matrix Films

The primary recommendation for a non-hardening fixer is Kodak Flexicolor Fixer for Process C-41. However, other fixers can be used without their hardeners, such as Kodak Rapid Fixer.
Farmer's Reducer R-4a

**Stock Solution A.**
- Potassium Ferricyanide (Anhydrous) 37.5 g
- Water at 68 F (20 C) to make 500.0 mL

**Stock Solution B**
- Sodium Thiosulfate (pentahydrated) 480.0 g
- Water at 68 F (20 C) to make 2.0 L

To use, mix 1 part of A and 4 parts of B and apply to the dark spot. Wipe immediately with a water-soaked cotton tuft. Continue this treatment until the area has been sufficiently reduced. Wash the area with water and finish with 1% acetic acid solution.
For 5 gallons of Matrix A developer

Elon 80 grams
Sodium Sulfite 40 grams
Potassium Bromide 90 grams
Pyro 90 grams
Citric Acid 20 grams

Mix the above in 120 degrees water (3 gallons) then add cold water to make 5 gallons.

If you should ever run into a batch of matrix film that is "fogged" or has a slight tendency to pick up a light grey tint overall, just increase the amount of Potassium Bromide in your formula to 120 or even 180 grams.

This will slow down the speed of the film but not enough to make any real problem. That's why f stops were invented.

The B portion of the developer is:
9 1/2 Lbs of Potassium Carbonate to make 5 gallons.
Matrix Clearing Bath, Stock Solution CB-5

Water about 90°F (32 C) 1.0 L
Sodium Tetraphosphate, QUADRAFOS or CALGON Sequestering Agent (Calgon, Inc.) 120.0 g
Ammonium Hydroxide 28% 48.0 mL

To prepare a working solution, dilute 1 part stock solution with 11 parts water. Rinse all three matrixes in the cleaning bath working solution for 1 minute, then in running water for 1 minute, then in 1% acetic acid for 30 seconds, and finally, in running water for 1 minute, before returning them to the dyes.

Matrix Highlight Reducer R-18

Water about 90°F (32 C) 1.0 L
Sodium Hexametaphosphate or CALGON Sequestering Agent (Calgon, Inc.) 1.2 g

For routine use, mix with tap water, add 0.34 to 1.35 ounces (10 to 40 mL) of Matrix Highlight Reducer R-18 per gallon of 1% acetic acid rinse, depending on the amount required to eliminate a tint of color in the highlights.

5% Sodium Acetate Solution

Water at 120°F (51.7 C) 50.0 mL
Sodium Acetate (Anhydrous) 5.0 g
Water to make 1.0 L

Add 5 to 50 mL of the sodium acetate solution to the first acid rinse to reduce the density of the color in the matrix proportionally throughout the scale, depending upon the amount required to eliminate the excess color.
The normal dilution of A and B is one part A to two parts B. Increasing the B will increase the contrast.
Here is the formula for the tanning developer.

**The A portion**
Elon......................16 grms.
Sod. Sulfite...........8 grms.
Pot. Bromide........16 grms.
Pyro.....................18 grms
Citric Acid...........4 grms
Water to make 1 gallon

**The B portion**
1.95 lbs of Potassium Carbonate
Water to make 1 gallon.
PAPER CONDITIONER #1

Triethanolimine 60cc
Glacial Acetic Acid 19.4cc
To make 4000cc
Soak paper at least one hour.

PAPER CONDITIONER #2

Triethanolimine 60cc
Glacial Acetic Acid 20.4cc
Ethylene Glycol 100cc
H2O to 4000cc
paper must be soaked for at least one hour.
K S 10 CLOTHING STAIN REMOVER FOR PHOTOGRAPHIC SOLUTIONS:

1. H2O - 750 ML

2. THIOUREA - 75 Gm.

3. CITRIC ACID - 75 Gm.

Make up to 1 litre.

Rub stain with solution with wet cotton - after stain disappears, rinse spot at once.
UNSUNG PHOTOGRAPHIC HEROES

In closing this paper I would like to give tribute to those photographers who I have had the honor to become acquainted with who are looking for no special honors and are willing to pass their knowledge on to the next generation without any particular gain.

1. Dale Neville - Kenmore, N.Y.
   who publishes a photographic bulletin full of information but does not push for increased circulation. Dale, in my estimation, is one of the most informed individuals in photography but berates himself for not being a graduate chemist. Dale - Edison never went to college and I can give you another 1/2 dozen persons who picked up their knowledge from practical production. Keep up your good work and keep publishing your bulletins.

2. Ed Ramaley - Denver, Colorado
   is not only a photographer's photographer but is interested in running the Experimental Print Group for the Photographic Society of America for a long number of years. He is well versed in biology medicine - automobiles - aircraft - Toxicology and Archeology - to name a few of his interests. He has been listed as a professional Engineer in the American Men of Science.

3. Charlie Carbonaro - Margate, Florida
   has been in photography since 1925, and was one of the originators and
developers of the Carbro process. I have seen some of his work in old out of print books and his Carbro work well surpasses our advanced dye transfer work.

4. Frank McLaughlin - Rochester, N.Y., formerly head of the Dye Transfer Department of Kodak before his retirement, to my knowledge, is the best informed dye transfer man in the country. He is still giving lectures at Winona, the professional school. I attended one of his seminars in Florida and certainly found it extremely instructive. He joined Kodak in 1964 - writing and doing product research and teaching color printing. He continues to teach, write and promote the dye transfer process to the present day.

5. Bob Pace - 13900 Trinidad Avenue, Victorville, California, 92392, publishes a dye transfer periodical called "Keeping Pace". Bob is an old hand at dye transfer and is full of information. He has covered the subject thoroughly with many of his formulas and instructive hints to give one a complete insight of the subject. I highly recommend your subscription to his paper if you want to know what is going on with this subject.