Photographic Processes User Guide

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Preparation & Use

Siderotype

Cyanotype, Vandyke Brownprint, Argyrotype, Ziatype

B&W Silver Gelatin

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1. Introduction

The Special Edition Art Project was created to afford photographers and artists practical access to the creation of wet processed photographic prints. This photographic processes user guide focusses instruction on classic B&W sliver gelatin print making as well as several historic processes wedded with modern chemistries, all with ecological wisdom. We've picked particular processes for their low Earth impact – good for you and good for the environment – while at the same time allowing for creative latitude in texture, tonality, and image presentation. Our expectation is that you can learn and practice these processes in a group environment, in an environmentally safe manner, and hone your skills in your personal space using the wisdom imparted to keep the world safe, clean, and filled with beautiful works of self expression.

Two distinct types of image processing are described: DOP, the develop out process where the image forms during the chemical tray processing cycle and POP, the print out process where the image forms during the ultraviolet (UV) exposure cycle. The noted processes are classic B&W Silver Gelatin and several light sensitive iron based Siderotype processes which include Cyanotype (iron), Vandyke Brownprint, aka VDB, (silver / gold), Argyrotype (silver / gold), and Ziatype (palladium / gold / tungsten / platinum).

This guide is a working reference and by no means a treatise on the covered processes; 'Principal References' can be found in Appendix C. The procedures and quantities documented in this guide are by no means set in stone, but rather provide guidance to a known working baseline when creating with the processes described herein. Even with the eco-friendly processes and processing chemistries described, the flip side is that you will be using chemicals, so need to be aware of spilling, touching, drinking. You should be wearing gloves when appropriate. You should be keeping splashing and dripping to a minimum. You should be working wet processes in designated areas only. You should not be looking directly into the ultraviolet light sources – these are not tanning stations. Refer to Appendix F 'Spill Response Procedures' in the event of spillage.

2. Photographic Processes

The silver halide process - gelatin sized papers sensitized with silver bromide in the early days and silver chlorobromide in the paper's latest manifestations - muscled out its photosensitive iron based predecessors due to silver halide's much higher light sensitivity. The higher sensitivity allows for smaller cameras with smaller negatives which in turn requires prints to be created via enlargement onto large sheets of photographic paper. No longer were practitioners tied to contact prints from equal sized negatives or slow exposure times for print making. With marketing at its best, these practitioners then became beholden to the makers of silver gelatin enlargement printing papers. Time marched along and then came high resolution digital cameras and affordable archival/gallery/museum quality color printers.

2.1. Overview

B&W Silver Gelatin, the silver halide standard bearer and historic culmination of analog photographic wet print processing, comes to an end, sort of. A funny thing happened on the way to evolving wet print processing out of existence – with the commoditization of high resolution digital cameras and archival quality, digital printmaking systems from the likes of Epson and Canon, along came the ability to produce high resolution digital negatives for analog contact printing processes. In one fell swoop the advent of high quality digital cameras & printers decimated the end game of film & B&W silver halide wet print creation while at the same time enabling a resurgence of contact printed traditional wet photographic processes using full sized negatives. Traditional processes that were left for dead as film negatives became smaller and more compact, leading the necessity of silver halide print enlargement printmaking. What is old is new again, in a very big way.

2.2. Definitions, Capacities, Extras, and Negatives

Before we start this chapter in earnest, we need first provide a brief overview of working nomenclature, capacities, and optional extra chemistry for use with Siderotype processes.

2.2.1. Definitions, Notational and Other

% w/v: Percent weight by volume. Used where a solid chemical is dissolved in liquid. For example, dissolving 10g of table salt, sodium chloride, into water to make a total volume of 100ml creates a 10% w/v sodium chloride solution. The % w/v notation will primarily be used for the preparation of citric acid, photographic fixer, etc. from powders.

gtt (or gt): Abbreviation meaning drops (from the Latin “guttae")

gt/ml: Drops per milliliter of solution.

Hypo: Standard photographic fixer. Short name for fixer's historical chemical name sodium hyposulphate. Modern namenclature for this chemical is sodium thiosulphate.

Hypo Clear: The standard name for the washing agent used to remove photographic fixer from a photographic print. While the underlying fixer chemical name has changed, the shorthand name for the clearing agent remains. Hypo clearing agents replace the absorbed hard to wash out thiosulfate (hypo) with sulfites that are much easier to wash out with water.

2.2.2. General Capacities

Capacity of a loaded dropper from a typical 30ml bottle: Approximately 16 drops (16 gt) and approximately 25 drops per 1ml (25 gt/ml) with average chemistry density.

- 1 dropper full ~= .6ml
- 2 dropper full ~= 1.25ml
- 4 dropper full ~= 2.5ml

Emulsion Volume Guideline for Siderotype Processes: Generally 2ml emulsion per 8x10 print. Sometimes as little as 1.5ml or as much as 3ml pending emulsion class, paper type, application style, and environmental conditions.

2.2.3. Process Extras

Acidic Initial Wash Water:

- Processes: Vandyke Brown, Argyrotype, Ziatype. A good practice for Cyanotype as well.
- Purpose: To prevent yellow staining of the paper substrate (rust formation) from residual ferrous iron created in an alkali environment, use an initial water wash that is slightly acidic - pH 5-7.
- Measure: Created by using 5-10gt / 1.5L 40% citric acid in standard city delivered tap water.

Thymol & Undecylenic acid:

- Processes: Cyanotype
- Purpose: Prevent mold growth in ferric ammonium citrate (Part A Cyanotype).
- Measure: Thymol crystals: add a few crystals to the container. The crystals will not dissolve and will float on the surface.
- Measure: Undecylenic acid (over the counter anti-fungal drops): a couple drops into the container. The liquid is oily so will place an oily film on the surface. More messy than Thymol due to its oily nature.

Tween 20 10%:

- Processes: All Processes

- Purpose: Standard non-ionic surfactant allowing emulsion to sink from the surface and into the paper fibers. Amount to be used greatly depends on the class and type of paper being used.
- Measure: 1gt / 2-3ml emulsion as a starting point

Citric Acid 40% w/v:

- Processes: Cyanotype, New Cyanotype, Vandyke Brown, Argyrotype
- Purpose: Increase the range of useable papers by adding citric acid to the sensitizer. Citric acid neutralizes calcium carbonate (chalk) buffers generally used in alkali buffered papers. By diminishing the calcium carbonate, the neutralized paper inhibits image decomposition, improves the stability of the emulsion coating, and helps wash water clearing. Citric acid should be added to the immediate volume of solution to be used for coating and not the stock solution. As an added bonus with Vandyke Brown and Argyrotype, the use of citric acid seems to increase the richness of the developed image.
- Measure: 1gt / 1ml emulsion

Gum Arabic:

- Processes: All Processes
- Purpose: To facilitate coating on overly absorbent paper, acting as an absorption barrier and medium to hold emulsion evenly on the paper surface.
- Measure: 1gt / 8x10 sheet

Glycerin:

- Processes: Vandyke Brown, Argyrotype, Ziatype
- Purpose: Acts as a humectant to increase the relative humidity (%rH) of sensitized and dried paper.
- Measure: 1gt / 8x10 sheet

Dorland's Art Wax:

- Processes: All Processes
- Purpose: Dorland’s Art Wax as an optional extra post processing step to increase contrast and luster of the final print. Not effective for UV protection.
- A slight application of heated air will allow the wax to sink into the paper’s fibers.

2.2.4. Processing Flow Commonalities

Preparation

- Chemistry kit for process of choice
- Mixing tray, a wasabi or tea bag dish, and stirring stick
- Application brush specific to the process being used
- Small tub w/ water to keep brush moist
- Selected paper, cut to size
- Emulsion layup board

Coating

- Work under low level incandescent or warm LED lighting, avoiding all UV light sources.
- Mix appropriate amount of process chemistry into the mixing tray. For an 8x10, use approximately 2ml total emulsion chemistry.
- For Cyanotype, New Cyanotype, Vandyke Brownprint, and Argyrotype, add 1gt citric acid 40% per 1ml of chemistry.
- For average paper, add 1gt Tween 20 10% per 2-3ml chemistry.
- Mix the solution well with the stirring stick.
- Dry the moistened brush until the bristles are cold and damp, not wet. This allows the emulsion to sit on the bristles and not soak into them.
- Place the brush into the mixing tray and load as much emulsion as the brush can handle. Best results so far have been with the Richeson Magic Brush 9010 series. Standard hake brushes seem to be better at cold press textured papers where its bristles can better force the emulsion into the valleys of the paper texture.
- Apply the emulsion onto the paper in an even and consistent manner, starting from the upper left to the lower right. Grab the remaining emulsion from the tray, reversing application orientation several times until all of the emulsion in the tray and brush are applied to the paper in a criss-cross full coverage manner.
- Let the paper dry in a warm, dry, dark environment until the it sounds like a dull drum when flexed. This can be a handful of minutes or upwards of an hour or two.
- Most paper/process combinations can be used for up to several days without image degradation. Be aware that the ability to bring out highlights degrades over time. As well, some process emulsions have a paper dependent propensity to self-expose over time - New Cyanotype is especially prone to this behavior.

Exposure

- All processes will have a characteristic exposure response, and hence will have an exposure response curve associated with each process type. Special Edition Art Project has created response curves for the most used processes in our facility.
- Sandwich the process characterized negative with the readied paper, emulsion against image side of the negative into a contact frame.
- Place the frame into the UV light box (or good ol' Sol) for an appropriate time to create a good exposure. As a starting point most processes take 5-7 minutes, where Cyanotype can take upwards of 20+ minutes.
- Check the print early to gauge its progress.

2.2.5. Siderotype Lessons Learned

- Filter all wash water through a good sized carbon filter containing catalytic carbon granules. This class of carbon filtering is required to remove the chlorine and chloramine antiseptics used by local water municipalities. Chloramine, made from chlorine and ammonia, is a strong bleach wholly incompatible with photographic wet processing.
- Self-masking: This is a thing. With Cyanotype and all the other Siderotype chemistries, self-masking is the effect created where exposed areas of an image slow down in their exposure ability due to less and less light reaching the paper's fibers, while at the same time the highlights keep moving full speed in exposure as they remain un-masked by the print out process. This ability allows Siderotypes to be over exposed to a point without compromising much of the shadow detail in order to bring in hard to reach highlights.
- Richeson 9010 'magic' brush is a great applicator as it has soft synthetic non-absorptive bristles, allowing for a silky smooth emulsion application. For some cold press papers a hake brush can do better with its stiffer bristles to settle the emulsion down into the rough paper texture. Hake brushes do absorb an amount of emulsion, so more emulsion is needed per square inch of paper. A hake is also good to create brush marks at the edges of your print if that is a desired look for your images.
- Always characterize new papers. Papers used with Siderotypes will all have their own unique characteristics affecting how a paper handles emulsion, its wet processing ability, shrinkage and curl in drydown, exposure characterization corrections, dry down tonality, and overall look and feel.
- Double coating Cyanotype, VDB, or Argyrotype produces spectacularly awful results. Adding the double coat appears to lift up the first layer of emulsion resulting in mottling and inconsistency of tonality - looking like cold butter spread on ripped up toast. The results are indeed darker and richer but at the expense of the image itself as a whole. At the end of the day there is no need for a double coat - the reward is simply not great enough. Better to go with a thicker first coat.
- Of glycerin and gum arabic
    - A drop of glycerin or gum arabic added to the working emulsion along with the other standards of citric acid and Tween.
    - Adds 1 to 2 minutes to exposure times
    - Gum Arabic: Produces smoother emulsion consistency with very little mottling in the tonal range. The overall tonal reproduction is similar to a standard emulsion mix.
    - Glycerin: Overall tonality comes in more vibrant with Cyanotype and darker with VDB & Argyrotype. The tradeoff is more exposure time (a minute or two) to bring in the highlights. The behavior with VDB & Argyrotype is consistent with the keen observations of Dr. Mike Ware that glycerine helps keep much needed moisture within the paper's fibers to better move along the UV exposure chemical reactions of the emulsion.

2.2.6. A Word About Negatives

The Exposure Response Correction Curve

All light sensitive materials (eg light sensitive emulsions on paper) have a non-linear relationship to the light that falls on them, their exposure to light. Allowing 100% of an amount of light to reach a material for the right amount of time results in 100% image density on the material. However, working down through 90%, 80%, 70% … 30%, 20%, 10% transmission with the same amount of light and exposure time does not yield equally progressing densities on the material, instead growing unevenly from shadows to highlights. The relationship is not linear but rather viewed as an 'S' shaped exposure response curve. This light sensitive response was first understood by a pair of researchers, Hurter & Driffield, while studying the sensitometric characteristics of light sensitive silver compounds in the late 1880s and is generally referred to as the "H&D Curve".

Understanding this, we see that shadows, highlights, and mid-tones expose at different rates to produce an accurate image with an expected density. Analog negatives, those negatives that started as light sensitive materials, have this non-linear characteristic and, surprise surprise, closely match the exposure characteristics of light sensitive silver gelatin B&W photographic paper (the positive). In turn, the negative and positive go hand in hand correcting the exposure rates, creating a photographic print with linear image density.

Where film negatives and paper do not wed as expected, mitigation in the analog world involves film development controls, graded papers, and variable contrast filter / paper accommodations. An alternate route is to create and print a negative from the digital realm and move on from there. Handcrafted digitally produced negatives must also, however, have their exposure response targeted to a matching positive response - targeted toward specific light sensitive emulsion / paper combinations. Knowing all of this, SEAP has generated characteristic response curves for the supported processes discussed in this User Guide. Our response curves are good starting points with our operating procedures, printing and exposure equipment, papers, local water supply, temperature, humidity, etc. All exposure correction graphs in this User Guide are shown in 'Density % (0-100)' view and the numeric tables in 'Light (0-255)' form to allow precision in curve creation. Modifying, tuning, recreating, and altogether ignoring these response curves are completely acceptable and highly encouraged.

Preparing the Digital Image

The exposure response curves documented in this User Guide were created with a specific workflow to be practiced when creating a digital image, providing consistency across the broadest array of printers used to create digital negatives. We have produced great results on Epson and Canon professional printers as well as a simple HP Color Laser Printer which produced serviceable negatives. The first step is correctly setting up the image to produce

a quality digital negative. Specifically, a B&W 16-bit image set to a color space of Adobe RGB. Photoshop is used in the setup examples, other image editing tools with these capabilities would work just as well.

- Image is set to 16-bit
    - Photoshop: Image —> Mode —> 16-bits/Channel
- Image color space is converted to Adobe RGB
    - Photoshop: Edit —> Convert to Profile…
- Image made B&W, meaning all of R, G, and B channels are the same
    - One method
        - Photoshop: Image —> Adjustments —> Black & White…
    - Other methods include third party B&W conversion tools
    - Assure the image remains in the Adobe RGB color space

Creating the Negative

You may apply the exposure correction curves directly to the image or layer upon layer. If layering, the stack up is the image as the lowest layer, then the correction curve layer, then the 'invert' layer to make the whole thing negative. First is to apply the exposure correction curve for a specific process / paper combination. Lastly is to invert the image to make it 'negative'. When printing, the image must be flipped horizontal in the printer's layout settings to make the image reversed from an emulsion point of view.

- Apply the Correction Curve
    - Photoshop: Image —> Adjustments —> Curves
    - Type the curve points in by hand and then save the curve for later use
- Make the Negative
    - Photoshop: Image —> Adjustments —> Invert

Printing the Negative

The printing process involves a couple of simple important settings. At the core, we rely on the printing application, not the printer, for all color management. The paper profile for OHP digital negative material is set to the printer's Photo Paper Glossy equivalent. The image is printed "Flip horizontally" in the Print Settings / Layout setup. The image is printed 16-bit with Perceptual Rendering Intent.

- Print Dialog
    - Print Settings
        - Layout: Flip Horizontally
        - Note: We are making a negative, so it needs to be reversed
    - Color Handling: Application Manages Colors
        - Note: We trust the system to produce generally consistent images across printers and operating systems when color management is used. The printer should not manage colors in this case.
    - Send 16-bit Data
        - Note: We want all available pixel bit depth to be printed

- Printer Profile: Photo Paper Glossy
    - Note: Quality OHP material closely matches Photo Paper Glossy ink quantities
- Rendering Intent: Perceptual
    - Note: Simply a preference for consistency
- Black Point Compensation enabled
    - Note: Simply a preference for consistency

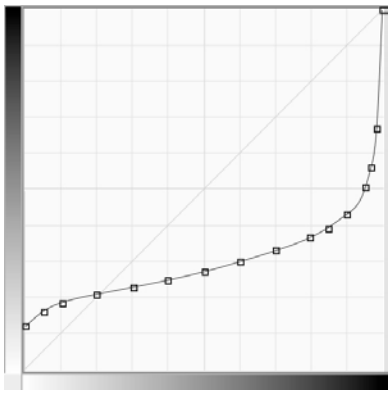
2.3. Cyanotype

2.3.1. Overview

The 1800s classic, safe, affordable, indeed rather strident, Prussian Blue process. One of the more interesting plays with Cyanotype is to create images that actually work well with Cyanotype. It can be tough. Early morning before sunrise when the sky is dark blue and the scene before you is cast in a cool twilight monotone for example. The underwater world is a wonderful aquamarine when viewed under natural light. And so it is, safe, affordable, strident, and, well, blue. The cost of the chemistry is as low as $0.02 per 8x10 print, effectively making the chemistry free when compared to the cost of the negative and paper the image is printed on.

2.3.2. Sensitivity

The Cyanotype print out process is sensitive to ultraviolet light only, so the entire process can be carried out safely under normal incandescent room lighting conditions. A safelight is not necessary but bright fluorescent lights which contain broad spectrum radiation should be avoided. Exposure times can be upwards of 15 to 30 minutes pending base density of the negative, source of UV light (UV light box or the Sun), thickness of emulsion, and paper choices. Generally, Cyanotype is four to five times slower (less light sensitive) than other Siderotype processes. Average times are 15:00 - 21:00 minutes for full densities.



Papers: Fluid HP, Lana Aquarelle

Cyanotype characteristic exposure response curve

Cyanotype: Input / Output															
0	4	8	12	25	39	52	76	102	127	153	178	204	229	242	255
0	84	112	126	145	155	162	171	179	186	192	197	202	208	214	225

Note: Chart shows density % and table shows ‘light’ values used for curve creation

2.3.3. Image Processing Flow

Preparation

- Chemistry kit with the following dropper bottles:
  - Cyanotype Part-A & Part-B
  - Citric acid 40%

- Tween 20 10%

Coating

- Mix a 1:1 working amount of A/B cyanotype chemistry into the mixing tray. For an 8x10, use approximately 1ml - 1.5ml (~35gt) each of parts A & B Cyanotype chemistry.
- Add 3gt citric acid 40%
- Add 1gt Tween 20 10%. This step is very much paper dependent
- Mix the solution well with a stirring stick
- Coat the paper the best way you know how

Exposure

With a standard UV light box, 20 minutes is a good starting point. The print is fully exposed when a grey solarization begins to form in the dense shadow areas of the image.

Processing

Cyanotype: Practical Processing Sequence

Process Step	Time
Initial Water Wash	5-10 minutes
Secondary Wash	3-5 minutes
Hydrogen Peroxide (optional) [a capful per liter water]	20s
Final Wash	2 minutes

Once exposed, the image is agitated face down in plain (or slightly acidic) water for 5-10 minutes until all of the unexposed yellow emulsion (highlight areas of the image) has washed out of the paper. Flip the image face up, refresh the wash water, and keep agitating the water over the image. A final fresh water wash for 5 - 10 minutes will allow any residual chemistry to leach out of the paper, and is then ready for drip drying. Fixing is not needed as this is an iron/iron process containing no silver. Cyanotype has a significant dry down where image density takes upwards of 24 hours to come into play by oxidizing into a rich Prussian Blue. A good cheat is a 20 second pre-final rinse in diluted consumer grade Hydrogen Peroxide (a capful or two per liter) to instantly oxidize the image to its full Prussian Blue glory, saving 23 hours 59 minutes of anticipation. The final image is unlikely to impacted by this process, but do take care to keep delicate highlights from getting overdeveloped in the process. Watch for bleaching if the print stays in the peroxide for too long.

2.3.4. Toning

- Toning a Cyanotype results in everything from a dark eggplant sepia through neutral to a rich desert patina, all pending the paper type, tannin origin and bleaching order – before or after the tannic bath.
- Cyanotype acts like Velcro™ with its toning process. Full metal replacement toning involves bleaching or 'ripping apart' the Prussian Blue portion of the image, leaving a faint yellow image behind - like ripping the loops layer of Velcro™ off the hooks layer, leaving the hooks ready to accept something else. In the case of Cyanotype, the faint yellow image is awaiting a new iron metal. The initial bleaching of the Cyanotype is performed easily with a teaspoon or less of Arm & Hammer™ Washing Soda (also known as sodium carbonate or soda ash, purchased from a pool supply store) mixed with a quart of water (remember, these processes are more like baking than formal chemistry, both more precise than cooking).
    - The wet print is bleached for tens of seconds until all of the blue is removed, but before the remaining yellow image starts to degrade.
    - If bleaching takes only a few seconds, the solution is too strong and needs to be diluted.
    - If the bleaching does not quite take place, the solution is to weak and needs more washing soda.
    - When the image is (almost) bleached to satisfaction, quickly rinse the print in clean tap water to stop the alkali bleaching action.
- The image is now ready to accept its new iron metal, generally gallic or tannic acid – pure tannic acid or tannins from strong black coffee, green tea, or thick red wine. Extra strong dark roast instant coffee is wonderful for this situation.
    - Once bleached, immerse the print in the tannic acid bath for 3- to 60-minutes until the desired tonality is reached.
    - Care must be taken to avoid unexpected dying of the paper white substrate.
- Toning via tannic acid (pure or from coffee, tea, red wine, etc.) added directly to a Cyanotype without bleaching results in a dark warm eggplant tone. Again, care must be taken to avoid dying of the paper media itself.
- Full image formation occurs in the tannic bath within the first 10 to 15 minutes. Further toning increases the depth of the resulting paper stain.

2.3.5. Lessons Learned

- Applying a second Cyanotype coat on top of dry or wet paper will produce results that are stunningly awful. Best to apply a thick first coat and leave well enough alone. Application of the second coat appears to lift off the first coat producing an inconsistently mottled paper. Attempts to apply a second coat using gum arabic and/or glycerin produced no better results. That said, a second coat will yield a deep dense

Prussian Blue image at the expense of areas compromised by aggression to the first coat. Best to lay it on thick the first time.

- A few drops of citric acid added to the working emulsion helps both neutralize alkaline buffering agents of calcium carbonate used in most watercolor papers as well as help clearing in the initial fresh water wash. Citric acid can also be used to lower the pH of high alkaline wash waters. Pool & Spa supply pH test strips come in handy for wash water testing.
- An initial wash water of pH 6-7 will help remove the resulting iron waste and prevent insoluble rust forming within the paper's fibers. The citric acid added to the working emulsion is plenty for this chemistry. Mike Ware - Cyanomicon II: "Most acids will assist clearing because a low pH prevents hydrolysis of the iron(III) to its insoluble yellow hydrated oxide. …Chemical fogging ("greening") of the coating due to paper impurities may often be prevented by adding citric acid to the sensitizer, before coating."
  - Note: Fogging is especially true for Mike's New Cyanotype when used with incompatible papers such as Fluid HP where the emulsion self-exposes (fogs), turning green/blue in a matter of hours.
- Five week old coated paper vs. 24 hour coated paper: The older paper has generally lost its ability to render highlights compared to the fresh paper. That said, the old paper is quite serviceable after being stored in a dark cool place. Takeaway: several day old paper is useable if stored in a dark paper safe bag in a cool dark place and has not yet begun to show signs of green/blue fogging.
- Measuring the A/B working emulsion as a 1:1.5 ratio (1.5x more of B than of A) resulted in an expected longer exposure time but otherwise unremarkable results. This is baking not chemistry at the end of the day so the ratio of A/B 1:1 as a the rule means to get as close to that as possible.
- We have observed a behavioral difference between the dry A/B chemistry from Bostick & Sullivan and the pre-mixed A/B liquid chemistry from Photographers' Formulary. The color tonality between the two are identical. The Formulary chemistry tends to have a higher light sensitivity, producing denser images for a given exposure time. A 21min exposure using the dry Bostick & Sullivan mix produces the same image density as 19min with the liquid Photographers' Formulary mix. We have not tried the powder A/B form from Photographers' Formulary.
- When using COT320, Hahnemuehle Platinum Rag, and Arches Platine, the exposure characteristic curve looks very close to that of Silver Gelatin, with COT320 being the closest and clearing the best. So much so that one can make beautiful Cyanotype A/B contact prints from 135, 120, 4x5, etc. sized negatives. With COT320, the contact print exposure time is on the order of a short 6-10 minutes. To bring in the highlights after contact printing, a final bleaching step is needed (1/4tsp washing soda in 1L water for a few seconds) then a good final wash & soak.

2.4. New Cyanotype

2.4.1. Overview

New Cyanotype is a modern, circa 1994, variation of the classic A/B Cyanotype process, invented by Dr. Mike Ware in a effort to overcome downsides of this classic process. The primary Cyanotype downsides the Ware formulation overcame are it's tedious exposure times, ability to thoroughly penetrate into paper and cloth fibers, and issues with Prussian Blue itself washing out of the paper and leaching into the highlights during wet processing. Generally, conferring greater speed, stability, convenience and quality on the process.

Changes made to the classic formula were the replacement of ferric ammonium citrate with ferric ammonium oxalate and replacement of potassium ferricyanide with ammonium ferricyanide. These changes in chemistry increase cost to the sensitizer solution (90x cost increase of kit form over classic A/B Cyanotype) and adds paper compatibility issues to the equation, while increasing light sensitivity almost 4x, has no mold growth, can keep emulsion in a single-bottle solution for extended periods of time (year+), and paper and cloth absorption being greatly improved. The change from potassium ferricyanide to ammonium ferricyanide allows the image hold up well under wet processing – little image dispersion or bleeding into the highlights resulting in a dense image with clear highlights.

2.4.2. Sensitivity

Ware's New Cyanotype print out process is sensitive to ultraviolet light, can be carried out safely under low incandescent room lighting conditions. A safelight is not necessary but bright fluorescent lights which contain broad spectrum radiation should be avoided. Standard Siderotype exposure times in the 5 to 10 minute range are the norm pending base density of the negative, source of UV light (UV light box or the Sun), and paper choices. A single coat of New Cyanotype is generally sufficient due to its enhanced wet processing capability.

The New Cyanotype characteristic exposure response curve has not been characterized at the Special Edition. Initial peeks into this process indicate a repose close to B&W Silver Gelatin if not slightly more linear.

2.4.3. Processing

Once exposed, the image is agitated in a fresh, or slightly acidic, water wash for 5-10 minutes until all of the unexposed yellow emulsion (highlight areas of the image) has washed out of the paper. A second fresh water wash for 20 minutes will allow any residual chemistry to leach out of the paper, and is then ready for drip drying. Fixing is not needed as this is an iron/iron process containing no silver. New Cyanotype has a significant dry down where image density takes upwards of 24 hours to come into play by oxidizing into a dark Prussian Blue. A good

cheat is a 10 second pre-final rinse in diluted consumer grade Hydrogen Peroxide (a capful per liter) to instantly oxidize the image to its full Prussian Blue glory.

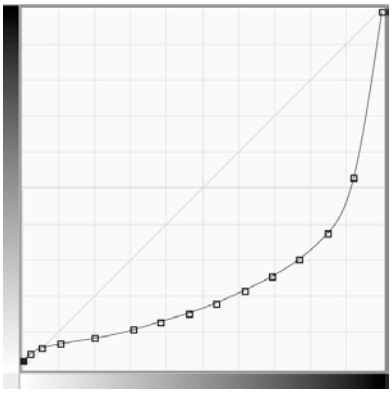
2.5. Vandyke Brownprint (VDB)

2.5.1. Overview

Vandyke Brownprint, VDB for short, is an eminently easy and affordable late 1800s silver process resulting in rich sepia toned images and archival quality cooler tones when gold salts are introduced. VDB is only ever so slightly more expensive than Cyanotype, and only ever so slightly more complicated from a processing point of view.

2.5.2. Sensitivity

The VDB print out process is sensitive to ultraviolet light only, so the entire process can be carried out safely under normal incandescent room lighting conditions. A safelight is not necessary but bright fluorescent lights which contain broad spectrum radiation should be avoided. Exposure times are typical for Siderotype, in the 4-7 minute range pending base density of the negative, source of UV light (UV light box or the Sun), and paper choices. Average times are ±7:00 minutes for full densities.



Papers: Fluid HP, Lana Aquarelle

Vandyke Brownprint characteristic exposure response curve

Vandyke Brownprint: Input / Output – VDB & VDB (dark)														
0	20	39	59	78	98	118	137	157	177	204	229	242	250	255
0	120	160	178	190	200	209	216	222	228	234	238	241	245	250
0	123	161	178	190	200	209	216	222	227	232	236	239	243	249

Note: Chart shows density % and table shows ‘light’ values used for curve creation
Note: VDB (dark) to lighten the shadows and darken the highlights

2.5.3. Image Processing Flow

Preparation

VDB Chemistry Preparation

Process Step	Chemistry	Practical Mix	8x10 Prints per Mix
Initial Wash Water	Citric Acid 40%	5gt / 1.5L water	1
Dilute Rapid Fixer	eco•pro Neutral Fixer	~ 15ml / 1L	3
HypoClear / PermaWash	eco•pro Hypo Wash	25ml / 1L	10
Optional Gold Toner	Bostick & Sullivan Gold Toner for POP	5ml each of parts 1 & 2 to make 100ml	1 Print - Single Shot

- Initial wash water
  - Add 5gt / 1.5L citric Aacid 40% to standard tap water (result pH 5-7)
- VDB Fixing bath (~1.25% rapid fix solution)
  - 15ml / 1L water eco•pro Neutral Fixer from concentrate
- Hypo Wash clearing bath (50% diluted standard B&W working strength solution)
  - 25ml / 1L water eco•pro Hypo Wash from concentrate
  - This step is optional and can be replaced with a longer final wash
- Optional Gold Toner, print dependent mix as needed
  - Bostick & Sullivan Gold Toning Kit For Salted Paper, Vandyke and Kallitype
  - 1:1 Mix of .2% gold chloride Solution and 2% ammonium thiocyanate
  - To help prevent print yellowing, let the mixed solution mature for a few minutes before use
  - 50ml each into 1L for multi-print bulk mix
  - 5ml each into 100ml for one print single shot mix
  - 10ml each into 200ml for one print single shot mix with dense prints
- Chemistry kit with the following dropper bottles:
  - Vandyke Brownprint working solution
  - Citric acid 40%
  - Tween 20 10%
  - Glycerin

Coating

- Load a working amount of VDB chemistry into the mixing tray. For an 8x10, use approximately 2-3ml (48gt) of VDB chemistry.
- Add 3gt citric acid 40%
- Add 1gt Tween 20 10%. This step is very much paper dependent
- Mix the solution well with a stirring stick
- Coat the paper the best way you know how

Exposure

With a standard UV light box, 5 minutes is a good starting point. The print is fully exposed when highlight detail begins to form in the image. These highlight details will come into their own during the fixing stage and in final dry down.

Processing

VDB: Practical Processing Sequence

Process Step	Time
Initial Water Wash (pH 5-7)	5-10 minutes
Second Water Wash	3-5 minutes
Fix	2.5-3 minutes (or until bleaching begins)
Hypo Clear (optional)	1 min
Water Wash	20 min

Once exposed, the image is agitated face down in plain water for 5-10 minutes until all of the unexposed yellow emulsion (highlight areas of the image) has washed out of the paper. A second fresh water wash for 3-5 minutes will allow any residual chemistry to leach out of the paper. A slightly acidic initial wash water, pH 5-7 (pH7 is pH neutral), is desirable to assure iron byproducts do not form into rust inducing components which will destroy the silver image over time. Use a pH test meter or pH test strips (pool or spa test strips for example) to verify efficacy of the wash water. A fixing bath is required as this is an iron/silver process where the silver needs to be fixed to assure image permanence. A rapid fixer can be used. We use eco•pro Neutral Fixer in a 15ml / 1L solution (1:4 for a standard working solution, diluted again 1:10 to 1:15 for VDB* and Argyrotype). Once fixed, the absorbed fixer must be throughly removed from the paper in an optional short hypo clearing bath (or extended final wash) then a final wash to assure archivability, and is now ready for drip drying. The Vandyke process has a significant dry down where image density takes upwards of 12 hours to come into its deep sepia brown tonality.

*Jill Enfield and others indicate use of a rapid fix working solution diluted to 1:10 - 1:15

2.5.4. Gold Toning

- Gold toning is a wonderful process for these silver print methods. The gold metal will replace the silver within the print, starting with the highlights and going down into the shadows, making everything cooler, moving towards the blues/purples/grays. Metal replacement gold toning will also make the resultant image more archival as it replaces the environmentally sensitive silver. Split tones can be created by partial toning (less time in the toner solution) where only highlight areas are allowed to cool, leaving the more dense earth tones to become richer.

- Gold toning before or after silver fixing the image results in similar final images. The benefit to gold toning after fix is the ability to purposefully let the image bleach a bit with a longer than normal stay in the fixer. This produces a less dense working image, resulting in a lighter and cooler image when toned. Toning after fix also allows the print to be fully completed and evaluated for quality before re-wetting and toning at a later date. No need to waste the gold toner.
- Gold Toner, one-shot or bulk mix? When toning a set of images, it may be worth mixing up a bulk quantity of toner, say 1L for a set of 8x10 images. After every image, replenishing the bulk mix with a few milliliters of toner chemistry to keep it up to strength. That said, after a few images toning inconsistencies become apparent. This could be due to toner strength differences, age or temperature of the toner mix, contaminates from previous prints, all of the above, others. When using the toner as a one-shot, every image gets the same treatment at the expense of overall processing time as new chemistry is made up for every print. Experience has shown the one-shot method to produce the most consistent results, using the most chemistry. Use as little toner as possible, but enough for the print being toned (image density dependent) to preference. Use a flat bottom tray so the print suctions down to the bottom leaving the economic use of toning fluid to roll around on top of the image.
- Let the mixed toner chemistry sit for 10 minutes or more to allow the chemicals to react with each other before subjecting them to your paper.

2.5.5. Lessons Learned

- Both VDB & Argyrotype have similar exposure response characteristics, so can use the same response correction curve. Argyrotype is ever so slightly less light sensitive, so needs ever so slightly more UV exposure time.
- Three day old paper is no less for the wear over fresh paper when stored in a closed paper safe bag in a cool dark place. After about a week the paper loses its ability to render fidelity in the highlights, similar to the behavior of older Cyanotype papers. Fresh paper is always better, and a day or two does not hurt for the most part.
- Both VDB and Argyrotype are susceptible to black gunk forming in the bottom of the bottle, excess silver from the chemistry makeup. Best to filter it out less it make its way onto your paper as black mud. Better yet, don't draw chemistry from the bottom of the bottle.
- Never ever store VDB or Argyrotype in plastic bottles or bottles with plastic droppers. The silver will plate out onto and eat into the plastic. This ruins both the chemistry and the container it was in. Use only amber glass bottles with glass droppers.
- A well agitated first wash is critical for a good clear image, face down to prevent image bleed into the highlights. This fresh water wash should be slightly acidic (via a few drops of citric acid) and should be used only once then discarded. There is a good amount of unexposed emulsion that is cleared out in this wash so best to avoid

possible staining of the next print. The second wash of fresh water assures there is no leftover unused emulsion in the paper.

- The silver fixer for both VDB and Argyrotype is prescribed at a 3%-5% working solution of sodium thiosulphate (standard B&W fixer working solution is upwards of 25%). An alternative we have taken is to use rapid fixer (eco•pro Neutral Fixer) at a working solution re-dilution of 10:1 - 15:1 per process expert Jill Enfield. This is 1:4 for the working solution then 1:13ish for a final 15ml / 1L working mix. Be mindful of silver image bleaching out if the image is left in the fixer for too long. Gold toning before fix reduces silver and gold does not bleach out in fixer. A good rule of thumb for fixing is to let the image mature in density and when it is no longer becoming more dense or feels like it is about to start bleaching, pull the print for its final washing stages.
- For the best possible archival properties, the post fix wash stages look like a 1-minute soak in a 50% diluted standard B&W working strength HypoClear / PermaWash to get rid of excess fixer from the paper, then a final 20-minute water wash to wash out the clearing agent and other unwanteds.
- Different papers will result in different final image tonality. Fluid HP vs. Fluid 100 HP results show Fluid 100 HP is cooler and a tad denser than the standard Fluid HP.
- Paper humidity plays a role in overall image density and tonality. Per Mike Ware: “The colour of the print-out image may be shifted to a more neutral tone - an attractive purplish-grey - if the sensitized paper is humidified before exposure by leaving it above water (100% RH) for 30 minutes at room temperature. …glycerol, which is now included in the [Argyrotype] sensitizer formulation as a humectant to ensure a pleasing purplish-brown colour. Without it, the image may be a more yellowish-brown.” With the use of glycerin in both VDB and Argyrotype, we have seen image densities and richness increase v.s without its use.
- Argyrotype is essentially designed to be an upscale VDB with its higher quality working process, as well as a replacement to Kallitype allowing for POP processing, equal or better tonality control and archivability, as well as its cleaner working process. Argyrotype is priced slightly above Kallitype, mostly due to the expense of creating the silver sulfamate salt used in the process over silver nitrate used in the others.
- Yellow staining is a problem, especially when gold toning. Best solution to this bother is to perform a good first water wash in slightly acidic fresh water, a good secondary wash to assure all unused emulsion is rinsed out of the paper. If toning, use one-shot toner that has been mixed and let sit for a few minutes prior to use (there are folks who believe gold toner gets better with age, others who say gold toner self destructs over time and hates the light, all are likely correct). Last to give a good hypo clear wash and final fresh water rinse to fully clear the paper.
- When using COT320, Hahnemuehle Platinum Rag, and Arches Platine, the exposure characteristic curve looks very close to that of Silver Gelatin, with COT320 being the closest and clearing the best. So much so that one can make beautiful contact prints from 135, 120, 4x5, etc. sized negatives. Contact print exposure times will likely be shorter compared to using a purpose built VDB correction curve.

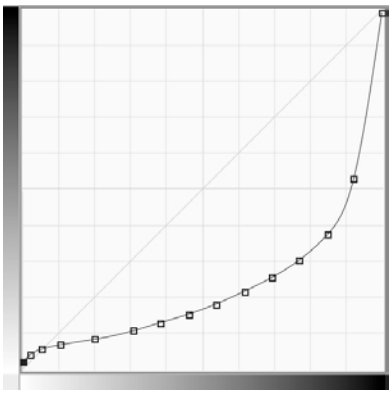
2.6. Argyrotype

2.6.1. Overview

Dr. Mike Ware's circa 1991 Argyrotype print out process is the go-to process for clean, deep, archival quality silver sepia prints, overtaking VDB for clarity, Kallitype in process, and both at a cost premium. With the introduction of gold or palladium salts a rival in quality and richness to the more expensive platinum / palladium (Pt/Pd) process is found. One of the major enhancements over VDB and Kallitype is ease in clearing image highlights without staining – a real nuisance where deep lush shadow areas of an image bleed into delicate highlights, desecrating the print. The other major benefit of this chemistry is its colloidal silver stability in both wet processing and dry print archivability - the silver simply has a much lower chance of 'rusting away' due to the sulfamated silver and mildly acidic working conditions used in the process. The Argyrotype characteristic exposure response and processing steps very closely match VDB to the point of treating both the same in terms of the printmaking process.

2.6.2. Sensitivity

The Argyrotype print out process is sensitive to ultraviolet light only, so the entire process can be carried out safely under normal incandescent room lighting conditions. A safelight is not necessary but bright fluorescent lights which contain broad spectrum radiation should be avoided. Exposure times are typical for Siderotype, in the 5-8 minute range, a slightly longer exposure needed compared to VDB chemistry, all pending base density of the negative, source of UV light (UV light box or the Sun), and paper choices. Start with 6:30 minutes.



Papers: Fluid HP, Lana Aquarelle

Argyrotype characteristic exposure response curve

Argyrotype: Input / Output – VDB & VDB (dark)														
0	20	39	59	78	98	118	137	157	177	204	229	242	250	255
0	120	160	178	190	200	209	216	222	228	234	238	241	245	250
0	123	161	178	190	200	209	216	222	227	232	236	239	243	249

Note: Chart shows density % and table shows 'light' values used for curve creation
Note: Argyrotype & VDB share very similar exposure responses
Note: VDB (dark) to lighten the shadows and darken the highlights

2.6.3. Image Processing Flow

Preparation

Argyrotype Chemistry Preparation

Process Step	Chemistry	Practical Mix	8x10 Prints per Mix
Initial Wash Water	Citric Acid 40%	5gt / 1.5L water	1
Dilute Rapid Fixer	eco•pro Neutral Fixer	~ 15ml / 1L	3
HypoClear / PermaWash	eco•pro Hypo Wash	25ml / 1L	10
Optional Gold Toner	Bostick & Sullivan Gold Toner for POP	5ml each of parts 1 & 2 to make 100ml	1 Print - Single Shot

- Initial wash water
  - Add 5gt / 1.5L citric acid 40% to standard tap water (result pH 5-7)
- Argyrotype Fixing bath (~1.25% rapid fix solution)
  - 15ml / 1L water eco•pro Neutral Fixer from concentrate
- Hypo Wash clearing bath (50% diluted standard B&W working strength solution)
  - 25ml / 1L water eco•pro Hypo Wash from concentrate
  - This step is optional and can be replaced with a longer final wash
- Optional Gold Toner, print dependent mix as needed
  - Bostick & Sullivan Gold Toning Kit For Salted Paper, Vandyke and Kallitype
  - 1:1 Mix of .2% gold chloride solution with 2% ammonium thiocyanate (from kit)
  - To help prevent print yellowing, let the mixed solution mature for a few minutes before use
  - 50ml each into 1L for multi-print bulk mix
  - 5ml each into 100ml for one print single shot mix
  - 10ml each into 200ml for one print single shot mix with dense prints
- Chemistry kit with the following dropper bottles:
  - Argyrotype working solution
  - Citric acid 40%
  - Tween 20 10%
  - Glycerin

Coating

- Load a working amount of Argyrotype chemistry into the mixing tray. For an 8x10, use approximately 2-3ml (48gt) of Argyrotype chemistry.
- Add 3gt Citric acid 40%
- Add 1gt Tween 20 10%. This step is very much paper dependent
- Mix the solution well with a stirring stick
- Coat the paper the best way you know how

Exposure

With a standard UV light box, 6 minutes is a good starting point - Argyrotype is slightly less sensitive than VDB. The print is fully exposed when highlight detail begins to form in the image. These highlight details will come into their own during the fixing stage and in final dry down.

Processing

Argyrotype: Practical Processing Sequence

Process Step	Time
Initial Water Wash (pH 5-7)	5-10 minutes
Second Water Wash	3-5 minutes
Fix	2.5-3 minutes (or until bleaching begins)
Hypo Clear (optional)	1 min
Water Wash	20 min

Once exposed, the image is agitated face down in plain water for 5-10 minutes until all of the unexposed yellow emulsion (highlight areas of the image) has washed out of the paper. A second fresh water wash for 3-5 minutes will allow any residual chemistry to leach out of the paper. A slightly acidic initial wash water, pH 5-7 (pH7 is pH neutral), is desirable to assure iron byproducts do not form into rust inducing components which will destroy the silver image over time. Use a pH test meter or pH test strips (pool or spa test strips for example) to verify efficacy of the wash water. A fixing bath is required as this is an iron/silver process where the silver needs to be fixed to assure image permanence. A rapid fixer can be used. We use eco•pro Neutral Fixer in a 15ml / 1L solution (1:4 for a standard working solution, diluted again 1:10 to 1:15 for VDB* & Argyrotype). Once fixed, the absorbed fixer must be throughly removed from the paper in an optional short hypo clearing bath (or extended final wash) then a final wash to assure archivability, and is now ready for drip drying. As with VDB, the Argyrotype process has a significant dry down where image density takes upwards of 12 hours to come into its deep sepia brown tonality.

*Jill Enfield and others indicate use of a rapid fix working solution diluted to 1:10 - 1:15

2.6.4. Gold Toning

- Gold toning is a wonderful process for these silver print methods. The gold metal will replace the silver within the print, starting with the highlights and going down into the shadows, making everything cooler, moving towards the blues/purples/grays. Metal replacement gold toning will also make the resultant image more archival as it replaces the environmentally sensitive silver. Split tones can be created by partial toning (less time in the toner solution) where only highlight areas are allowed to cool, leaving the more dense earth tones to become richer.

- Gold toning before or after silver fixing the image results in similar final images. The benefit to gold toning after fix is the ability to purposefully let the image bleach a bit with a longer than normal stay in the fixer. This produces a less dense working image, resulting in a lighter and cooler image when toned. Toning after fix also allows the print to be fully completed and evaluated for quality before re-wetting and toning at a later date. No need to waste the gold toner.
- Gold Toner, one-shot or bulk mix? When toning a set of images, it may be worth mixing up a bulk quantity of toner, say 1L for a set of 8x10 images. After every image, replenishing the bulk mix with a few milliliters of toner chemistry to keep it up to strength. That said, after a few images toning inconsistencies become apparent. This could be due to toner strength differences, age or temperature of the toner mix, contaminates from previous prints, all of the above, others. When using the toner as a one-shot, every image gets the same treatment at the expense of overall processing time as new chemistry is made up for every print. Experience has shown the one-shot method to produce the most consistent results, using the most chemistry. Use as little toner as possible, but enough for the print being toned (image density dependent) to preference. Use a flat bottom tray so the print suctions down to the bottom leaving the economic use of toning fluid to roll around on top of the image.

2.6.5. Lessons Learned

- Both VDB & Argyrotype have similar exposure response characteristics, so can use the same response correction curve. Argyrotype is ever so slightly less light sensitive, so needs ever so slightly more UV exposure time.
- Three day old paper is no less for the wear over fresh paper when stored in a closed paper safe bag in a cool dark place. After about a week the paper loses its ability to render fidelity in the highlights, similar to the behavior of older Cyanotype papers. Fresh paper is always better, and a day or two does not hurt for the most part.
- Both VDB and Argyrotype are susceptible to black gunk forming in the bottom of the bottle, excess silver from the chemistry makeup. Best to filter it out less it make its way onto your paper as black mud. Better yet, don't draw chemistry from the bottom of the bottle.
- Never ever store VDB or Argyrotype in plastic bottles or bottles with plastic droppers. The silver will plate out onto and eat into the plastic. This ruins both the chemistry and the container it was in. Use only amber glass bottles with glass droppers.
- A well agitated first wash is critical for a good clear image, face down to prevent image bleed into the highlights. This fresh water wash should be slightly acidic (via a few drops of citric acid) and should be used only once then discarded. There is a good amount of unexposed emulsion that is cleared out in this wash so best to avoid possible staining of the next print. The second wash of fresh water assures there is no leftover unused emulsion in the paper.

- The silver fixer for both VDB and Argyrotype is prescribed at a 3%-5% working solution of Sodium Thiosulphate (standard B&W fixer working solution is upwards of 25%). An alternative we have taken is to use rapid fixer (eco•pro Neutral Fixer) at a working solution re-dilution of 10:1 - 15:1 per process expert Jill Enfield. This is 1:4 for the working solution then 1:13ish for a final 15ml / 1L working mix. Be mindful of silver image bleaching out if the image is left in the fixer for too long. Gold toning before fix reduces silver and gold does not bleach out in fixer. A good rule of thumb for fixing is to let the image mature in density and when it is no longer becoming more dense or feels like it is about to start bleaching, pull the print for its final washing stages.
- For the best possible archival properties, the post fix wash stages look like a 1-minute soak in a 50% diluted standard B&W working strength HypoClear / PermaWash to get rid of excess fixer from the paper, then a final 20-minute water wash.
- Different papers will result in different final image tonality. Fluid HP vs. Fluid 100 HP results show Fluid 100 HP is cooler and a tad denser than the standard Fluid HP.
- Paper humidity plays a role in overall image density and tonality. Per Mike Ware: “The colour of the print-out image may be shifted to a more neutral tone - an attractive purplish-grey - if the sensitized paper is humidified before exposure by leaving it above water (100% RH) for 30 minutes at room temperature. …glycerol, which is now included in the [Argyrotype] sensitizer formulation as a humectant to ensure a pleasing purplish-brown colour. Without it, the image may be a more yellowish-brown.” With the use of glycerin in both VDB and Argyrotype, we have seen image densities increase v.s without its use.
- Argyrotype is essentially designed to be an upscale VDB with its higher quality working process, as well as a replacement to Kallitype allowing for POP processing, equal or better tonality control and archivability, as well as its cleaner working process. Argyrotype is priced slightly above Kallitype, mostly due to the expense of creating the silver sulfamate salt used in the process over silver nitrate used in the others.
- Yellow staining is a problem, especially when gold toning. Best solution to this bother is to perform a good first water wash in slightly acidic fresh water, a good secondary wash to assure all unused emulsion is rinsed out of the paper. If toning, use one-shot toner that has been mixed and let sit for a few minutes prior to use (there are folks who believe gold toner gets better with age, others who say gold toner self destructs over time and hates the light, all are likely correct). Last to give a good hypo clear wash and final fresh water rinse to fully clear the paper.

2.7. Ziatype

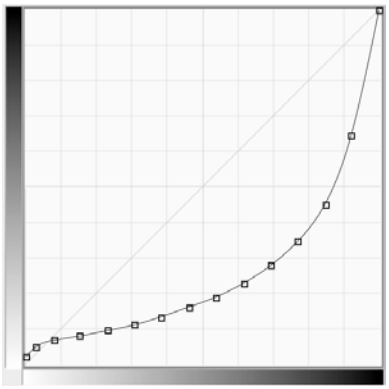
2.7.1 Overview

Ziatype is a highest of quality archival palladium printing process, rivaling the platinum/ palladium DOP process (Pt/Pd) in its tonal production and exceeding with its easily produced range of hues, processing ability, reduced processing toxicity, and affordability. Palladium is faster to print than platinum and achieves a finer, smoother quality under a wider range of conditions and paper choices.

Ziatype (Zia, Anasazi symbol of our sun) is a highly predictable and controllable palladium print out process (POP) developed in the late 1990s in the labs of Bostick & Sullivan by Richard Sullivan. With tremendous assistance from history, then collaborator Carl Weese, and the parallel Pt/Pd POP work of our aforementioned Dr. Mike Ware and his collaborator Pradip Malde, Ziatype has come into its own as a serious player in the Siderotype process spectrum. One goal of Ziatype was to eliminate humidity as a major factor in the development process – a significant lever in the Ware / Malde Platino-Palladiotype process. While this goal was attained to a great degree by use of hygroscopic chemistry, Ziatype is still at the mercy of humidity as a lever to be used in tonal hue determination. Ziatype is in its infancy with regard to its capabilities and Special Edition Art Project is excited to dig into this process to discover its treasures, even with its 20% cost premium over Gold toned Argyrotype.

2.7.2. Sensitivity

The Ziatype print out process is primarily sensitive to ultraviolet light with a slight tail into the broader visible spectrum. The entire process can be carried out safely under **low level** incandescent room lighting conditions, a safelight is not necessary, and fluorescent lights which contain broad spectrum radiation should be avoided. Exposure times are typical for Siderotype, in the 5-8 minute range, all pending base density of the negative, source of UV light (UV light box or the Sun), and paper choices. Average times are ±5:00 minutes for full densities.



Papers: COT320, Hahnemühle Platinum Rag

Ziatype characteristic exposure response curve

Ziatype: Input / Output														
0	20	39	59	78	98	118	137	157	177	196	216	235	248	255
0	90	140	167	184	197	207	214	221	227	231	235	238	243	250

Note: Chart shows density % and table shows ‘light’ values used for curve creation

2.7.3. Image Processing Flow

Preparation

Ziatype Chemistry Preparation

Process Step	Chemistry	Practical Mix	8x10 Prints per Mix
Clearing Bath #1	Citric Acid 40%	30ml / 1L	5-10
Clearing Bath #2	eco•pro Hypo Clear	50ml / 1L	5-10

- Clearing Bath #1: Citric Acid 1.25%
  - For difficult to clear papers
  - Citric acid 40% 30ml / 1L water (1:31) eco•pro Clear Stop Bath from concentrate, standard B&W Silver Gelatin working solution

    Note: Technically this should be 31.25ml / 1L to get the 1:31 dilution. Being that these processes are more like cooking than regimented chemistry, 30ml is much easier to measure out.
- Clearing Bath #2: Hypo Clear
  - For difficult to clear papers
  - eco•pro Hypo Clear 50ml / 1L water (1:19) from concentrate, standard B&W Silver Gelatin working solution
- Chemistry kit with the following dropper bottles:
  - Ziatype #1 - Ferric Ammonium Oxalate
  - Ziatype #3 - Lithium Palladium
  - Ziatype #4 - Sodium Tungstate (warming agent - reduces contrast)
  - Ziatype #6 - Gold Chloride (cooling agent - increases contrast)
  - Tween 20 10%
  - Glycerine

Coating

- For an 8x10 print, mix 32 total drops of #1 & #3 chemistry in a 1:1 ratio.
  - 16gt #1 (ferric ammonium oxalate)
  - 16gt #3 (lithium palladium)
  - Substitute the following as a drop-for-drop replacement for #3
    - #4 (sodium tungstate) - Makes the image warmer, more towards sepia brown

      Note: add the drop count of this #4 second after #1, stir, and let it sit a minute or two before adding #3 and #6, preventing an unwanted precipitate.
    - #6 (gold chloride) - Makes the image cooler, more toward grey blue
- Add 1gt Tween 20 10%. This step is very much paper dependent
- Mix the solution well with the stirring stick
- Coat the paper the best way you know how
- Paper drying time

    - Paper may be ready for use in as little as 5 to 10 minutes after coating, producing neutral tonality approaching B&W Silver Gelatin in tonality.
    - Dry enough so as not to ruin negative.
    - In a dark area (eg: a paper safe), let the paper air dry for 5 minutes, then 5 more minutes with moving air.
    - Paper should be a bit floppy and dull sounding when flexed (gently), not crisp and rigid. Lower moisture in the paper results in a warmer final print, higher moisture results in a more neutral tone. Too much moisture can ruin a negative.
- Important Note from Ziatype inventor Richard Sullivan: "Too much coating will cause grain and splotchiness in the print. This is due to the printing out nature of the process. The printed out portion will mask any sensitizer underneath the exposed layer, and if tiny particles of the top layer flake off, the bottom layer will not be exposed and show as white grain. There is no gain in dMax obtained by heavy coating."

Exposure

With a standard UV light box, 5 minutes is a good starting point. The print is fully exposed when highlight and shadow details of the image have expected density. As a print out process, Ziatype is one of the few processes that displays a "what you see is what you get" (WYSIWYG) final exposure. Image density will increase slightly in dry down.

Processing

Ziatype: Practical Processing Sequence

Process Step	Time
Initial Water Wash	5 minutes
Citric Acid 1.5% (optional)	5 minutes
Hypo Clear (preferred) [std B&W working soln]	5 minutes
Water Wash	20 min

Once exposed, the image is easily cleared and washed by agitation in plain, slightly acidic, water for 5 minutes, optional 1.5% citric acid solution for 5 minutes, preferred 2.5% hypo clear solution for 5 minutes, and a final plain water wash of 20 minutes. The citric acid and hypo clear baths are used to clear out any remaining iron sensitizer chemistry from hard to clear papers. As with other Siderotype processes, Ziatype has a slight dry down density increase, taking upwards of 12 hours to come to its own.

2.7.4. Toning

- Ziatype was designed to allow color and contrast to be chemistry controlled. True by most accounts, humidity does play a role in cool vs. neutral vs. warm tonality. A neutral toned image will result with a 1:1 mix of solution #1 ferric ammonium oxalate and #3 lithium palladium on paper let dry for 5 to 10 minutes in a 50%rH environment. The addition of a drop of glycerine will allow the dried paper to retain some moisture for a longer period of time before use while still producing neutral tones. The drier the paper the warmer the tones from the 1:1 standard emulsion mix.
- Replacing the #3 lithium palladium solution with the #6 gold solution drop for drop will result in a cooler image. The more gold added, the less palladium used, the cooler and more contrasty the final image will be. As more gold replaces the palladium, tonality moves into the grays, blues, and purples.
- Replacing the #3 lithium palladium solution with the #4 tungsten solution drop for drop will result in a warmer image. The more tungsten added, the less palladium used, the warmer and less contrasty the final image will be. As more tungsten replaces the palladium, tonality moves into the warm sepias. Mix the super saturated #4 tungsten in first before palladium to prevent precipitates.
- Per Bostick & Sullivan: A print made by replacing lithium palladium with gold chloride and sodium tungstate in a drop ratio of 2:1:1 may produce blue/black split tones. An 8x10 print for example might use 16 drops of #1 ferric ammonium oxalate, 8 drops of #3 lithium palladium, 4 drops of #6 gold, and 4 drops of #4 tungsten.
- The tonal winners to date:
  - Neutral/Cool/Neutral: 88% Pd, 12% Au
  - Neutral/Warm/Neutral with pleasing contrast: 66% Pd, 17% Au, 17% W
  - In a paper safe, 5min air dry then 5min fan dry with 7min UV exposure

2.7.5. Lessons Learned

- A standard B&W Silver Gelatin characteristic exposure response curve is pretty darn close, a slight blowout of highlight details and slight crushing of the shadows. We can do better as shown in the Ziatype specific response curve presented.
- Humidity is a pretty big lever, even as the Ziatype chemistry design has reigned in effects of this parameter. As the humidity in the paper drops, the final image moves towards warmer sepia tonality. If there is a need to control humidity, the controls at your disposal are to relocate your studio to a more humid environment, like, say, Santa Cruz CA. In drier areas you can expose the paper when just dry enough not to damage the negative. A third option is to re-humidify the paper (via sonic ~~screwdriver~~ humidifier for example) after drying and just prior to exposure, again taking care to not over humidify where negative damage may take place. Glycerin is your friend is this regard to help retain moisture in the paper.
- Humidity plays a role in exposure time and image quality as well. We have seen exposure times jump from 6min at 60%rH to 18min at 32%rH. At the same time, the quality of the

image is lesser resulting in underexposure, grainy highlights, and muddy shadows. The Ziatype process relies on an amount of humidity for the UV POP process to take place and without it simply can not proceed, even if forced with exceedingly long exposure times. Given this, best to keep the working environment above 50%rH where only paper moisture affecting coolness / warmness of the image itself is to be considered.

- The drop for drop of #6 gold chloride both increases the coolness of the image as well as increases contrast of the image. This contrast increase is slightly at the expense of detail loss in both the highlights and shadows, so try not to overuse this cooling agent.
- Drying times of 20 to 120 minutes should result in similar image warmth of the final printed image. Drying times of 5 to 10 minutes should result in the most neutral printed images. The use of glycerin helps to keep the papers fibers moist, resulting in consistently neutral images from paper that was dried over a 120 minute period.
- Use of Chromate Solution #2: Loss of mid-tones and crush of shadows & highlights as expected when contrast boosting chromate chemistry is used with these Siderotype processes. It is poisonous. Don’t go there - this stuff ruins everything.

2.8. B&W Silver Gelatin

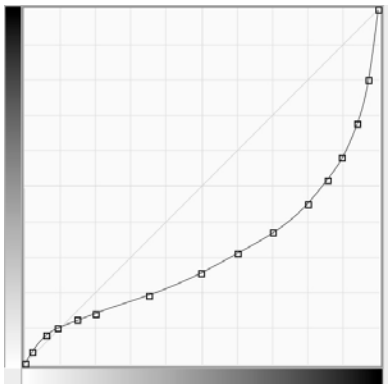
Refer to LegacyPro online materials regarding their eco•pro processing solutions, product definition and use guidelines.

2.8.1. Overview

Special Edition Art Project uses eco-friendly B&W Silver Gelatin chemistry from LegacyPro. Their chemistries, Paper Developer, Clear Stop, Neutral Fix, and Hypo Wash are all of low toxicity, low oder in the darkroom, and no compromise to photographic quality.

2.8.2. Sensitivity

The B&W Silver Gelatin develop out process is light sensitive across the broader visible spectrum, becoming less sensitive as it approaches the longer red wavelengths. The entire process must be carried out under dim “red” safelight. Typical exposure times vary greatly pending the negative, paper, whether the print being made is a contact print or an enlargement, and the class and configuration of enlarger being used. All said and done, exposure times in the 10-20s range are typical.



Papers: Manufactured B&W fiber and resin materials

B&W Silver Gelatin characteristic exposure response curve

B&W Silver Gelatin: Input / Output															
0	7	15	26	37	51	76	102	128	166	204	217	232	240	250	255
0	51	82	107	123	140	161	176	190	206	219	224	230	235	247	255

Note: Chart shows density % and table shows ‘light’ values used for curve creation

2.8.3. eco•pro Chemistry Preparation

eco•pro Chemistry Preparation

eco•pro Chemistry	Dillution	Practical Mix	8x10 Prints per Mix
Paper Developer	1:9	100ml / 1L	60
Clear Stop Bath*	1:31	~ 30ml / 1L	10
Neutral Fixer	1:4	200ml / 1L	90 (45 each of Fix1 / Fix2)
Hypo Wash	1:19	50ml / 1L	50
* Citric Acid 40% concentrate equals 1.24% via 1:31 dilution			

Developer solution may be used repeatedly for upwards of 60 8x10 prints per liter of working

developer at 1+9 dilution. Fluid loss due to carryover of the developer solution into the developer wash or stop bath is really the limiting factor for requiring replenishment.

2.8.4. Processing

eco•pro Practical FB & RC Processing Sequences

Process Step	FB Paper	RC Paper
Developer (1:9)	60-120s	60-120s
Stop Water Rinse	30s	30s
Fix #1 (1:4)	30s	30s
Fix #2 (1:4)	30s	30s
Water Rinse	1 min	—
Hypo Clear (1:19)	5 min	—
Water Wash	10 min	2 min

Processing temperature for the developer should be between 64°F/18°C to 81°F/27°C, while we have seen a range of 68°F/20°C to 75°F/24°C produce very consistent results.

Per Eastman Kodak and other manufacturers we employ a two-stage fixing process where the first fix performs the heavy lifting and the second assures the paper is fully fixed. When the first fix is exhausted it is recycled and the second fix is promoted to first. A fresh second fix is then prepared.

eco•pro Preferred Processing Sequence (details)

Material	Neutral Fixer		Rinse	Hypo Wash	Wash	Fixer Capacity*	
	Dillution	Time				Archival	Commercial
Film	1:4	2-5 min	—	—	4 min	25	25
Film	1:4	2-5 min	1 min	3 min	3 min	30	30
RC Paper	1:4	1 min	—	—	2 min	30	80
RC Paper	1:7	1.5-2 min	—	—	2 min	30	80
FB Paper	1:4	1 min	1 min	5 min	10 min	50	60
FB Paper	1:4	1 min	5 min	10 min	5 min	40**	60**

* Fixer capacity is indicated as the maximum archival processing standard for the number of 80 square inch materials in each liter of working strength fixer.

** Ilford Sequence

2.8.5. Lessons Learned

- Minimum developer temperature is critical. Below the standard working temperature of 68°F, development of the image takes longer than the standard 90-120s, below the lowest working temperature of 64°F, the image really does not come into its own, struggling against cold developing chemistry.
- Multigrade contrast filters are your friend. Truly. Use them. Using Ilford contrast filters 00-31/2 reduce by one stop the amount of light striking the paper. Filters 4-5 reduce yet another stop versus having no filter in place. When using multigrade filters, use the #2 or 21/2 filter for a neutral contrast. Split contrast processing is the way to go with multigrade papers – expose with a low contrast filter to get highlights where they should be, then exposure with a high contrast filter to get the shadows where they belong. Mid-tones will sort themselves out.
- Always characterize new papers. No guarantee that two boxes of the same type or size of paper will have the same exposure behaviors.

2.9. B&W Film Development

2.9.1. Overview

Special Edition in-house photographic film and paper processing chemistry used for B&W silver gelatin is made by LegacyPro, called eco•pro. The eco•pro film developer is essentially XTOL, a safe developing agent related to Vitamin-C, made of the same chemistry, same developing schedule, and same reference material as Kodak's discontinued XTOL.

2.9.2. Filmomat Film Processor

Per run, the Filmomat sequences through 500ml of chemistry per process step. Each of chemical tanks A, B, and C can be cycled per film process program. Tank B is temperature controlled via water bath so contains the temperature sensitive developer chemistry. Tank C is used for the fixer and tank A for the final water wash. Film development capacity is defined by the film canister itself. The 35mm/120 roll film canister will accept 2x reels at 35mm, or 1x reel at 120. A single reel can hold 2x rolls of 120 or 1x roll of 220 film. The 4x5 sheet film canister will accept 6x film sheets.

2.9.3. Chemistry Preparation

eco•pro Film Chemistry Preparation

eco•pro Chemistry	Dillution	Practical Mix	Capacities*
Film Developer	1:1	250ml / 500ml	One-shot
Clear Stop Bath	N/A	N/A	N/A
Neutral Fixer	1:4	200ml / 1L	25 (verify efficacy every 4x rolls)
Hypo Wash	N/A	N/A	N/A
Photo-Flo	Drop count	10 drops / 500ml	One Session

* Fixer capacity is indicated as the maximum archival processing standard for the number of 80 square inch materials in each liter of working strength fixer (80in^2 == 1x 35mm/36 or 1x 120 or 4x 4x5 sheets).

eco•pro Film Developer: Mix 1:1 prepared eco•pro full strength film developer with water to produce desired amount of working strength solution. For example, 250ml full strength developer into 250ml water to produce 500ml of developer working solution. Developer is used one-shot at 500ml per run of the Filmomat processor.

eco•pro Clear Stop Bath: N/A - eco•pro chemistry does not require a chemical stop bath. 3x 30 second water rinses are sufficient to neutralize the developer chemistry.

eco•pro Neutral Fixer: Mix 1:4 eco•pro neutral fixer concentrate with water to produce desired amount of working strength solution. For example, 200ml of liquid fixer concentrate into 800ml water to produce 1L of fixer working solution. Fixer is used until exhausted at 500ml per run of the Filmomat processor. LegacyPro eco•pro neutral fixer is documented to provide archival properties for 25 rolls of 35mm/36 or 120 film, or 100 sheets of 4x5 film per liter of fixer working solution. At this capacity, 1L of eco•pro Neutral Fixer will support the full packaged 5L mix quantity of eco•pro full strength Film Developer mixed 1:1 into working solution to provide for single shot development of 20 rolls of film at 500ml / processing run. To be extra cautious always check fixer for exhaustion every 4x runs of development.

eco•pro Hypo Wash: N/A - eco•pro chemistry does not require a clearing agent if fixer is used per prescribed parameters. eco•pro guidance calls for a 4 minute water wash in lieu of a clearing agent when fixer is use to a maximum capacity of 25 rolls per liter or equivalent of working solution.

Kodak Photo Flo 200: A wetting agent used to displace wash water from the film to minimize water spots, drying marks, and speed drying time. Typical mix is 5-10 drops per 500ml water.

2.9.4. Processing

Practical Filmomat Processing Sequence

Process Step	Timming
Pre-Soak	1 min
Rinse	3x at 30sec each
Developer (1:1)	Time/Temp Film Specific
Rinse	3x at 30 sec each
Fix (1:4)	4 min
Rinse	3x at 30 sec each
Water Wash	5 min
Process Complete	Remove film from canister
Photo-Flo	Separate container, 1 min with slight agitation

First and foremost, follow the Filmomat user guide and film canister loading sequence outlined in the Filmomat documentation. Failure to do so will result in poorly developed film and potentially a broken film processor. Nobody wants to be the cause of either.

The B&W Film developing schedule with the Filmomat using eco•pro chemistry is exceptionally robust and accurate. Developer time and temperature should be obtained by referencing the Massive Film Development Chart at DigitalTruth. The eco•pro recommended fix time is between 2 and 5 minutes while the final wash time is recommended at 4 minutes. Opting on

the longer side of these to 4 minutes and 5 minutes add archival margin to your film without adding much to the overall developing time. The initial pre-soak and rinse clears away any emulsion safety coating dyes before the development cycle. Some users dismiss these two steps as unnecessary, but we have seen dyes from the coating clear out with just the initial pre-soak, so the added rinse assures no remaining dye is present before the development cycle begins.

Once the processing sequence is complete, remove the film spindle & reel from the canister and place it in a separate container containing Photo-Flo for the film's final wash. Soak the film while still on its reel for one minute to displace the residual wash water with this wetting agent. Remove film from the reel and lightly squeegee the film, w/o damaging the fragile emulsion, hanging the film to dry in a low traffic and dust free area.

3. Chemistry of Light Sensitive Emulsions

In the mid-1800s, Sir John Frederick William Herschel discovered the (ultraviolet) light sensitive properties of certain organic iron compounds found naturally within the plant kingdom – coining the name Siderotype for these general processes, salts of iron mixed with vegetable acids. UV light transforms the light sensitive iron portion of the chemistry into a form of iron that can then react with a metal salt to produce the final image in that salt's metallic state. With the help of his friends Dr. Alfred Smee, Anna Atkins, William Henry Fox Talbot, and Louis Jacques Mande Daguerre throughout the 1800s, they together solidified the bedrock of photography as we know it today.

3.1. Siderotype and Silver Gelatin Comparisons

Light sensitive iron and process specific metal salts used for Siderotype print emulsions and support chemistry needed to fully realize a final print within the SEAP facility. Silver Gelatin is included for process completeness.

Process Chemistries

	Cyanotype	New Cyanotype	Vandyke	Argyrotype	Ziatype	Silver Gelatin
Iron Sensitizer:						
Ferric Ammonium Citrate (green) (A)	X		X	X		
Ferric Ammonium Oxalate		X			X	
Metal Salt:						
Potassium Ferricyanide (B)	X					
Ammonium Ferricyanide		X				
Silver Nitrate			X			
Silver Sulphamate				X		
Lithium Palladium Chloride					X	
Silver Halide						X

	Cyanotype	New Cyanotype	Vandyke	Argyrotype	Ziatype	Silver Gelatin
Contrast Enhance:						
Potassium Dichromate			X	X		
Ammonium Dichromate					X	
Processing:						
Sodium Sulfite Triethanolamine (developer)						X
Citric Acid (stop/clear/wash)		X	X	X	X	X
Sodium Thisosulphate (fix)			X	X		
Ammonium Thiosulfate (fix)			X	X		X
Potassium Sulfite (wash)			X	X	X	X

Iron Sensitizer and Metal Salt

Metal salts used for photographic purposes tend to hover around iron itself to make Prussian Blue images, silver to produce a sepia brown, platinum / palladium (Pt/Pd) alone or in combination to produce neutral to warm, and gold which produces neutral to cool tones. The generalized reaction process is UV Light + ferric salt (iron(III) of ferric ammonium citrate or ferric ammonium oxalate) yields a ferrous salt (iron(II) compound of its predecessor) which then reacts with the metal salt of choice, reducing that metal salt to its metallic state, forming the photographic image. So, you have UV Light + Iron(III) yields Iron(II) + Metal salt yielding Metal photographic image.

Contrast Enhance

Contrast enhancement using chromates are not recommended. Use of potassium or ammonium chromate when working with noble metal salts (silver, gold, Pt/Pd) results in a higher contrast image – and a little goes a very long way. The standard 1.25% chromate solution is often re-diluted to 10%, 25%, and 50% of its 1.25% starting point. Use of these chromates for contrast control (contrast enhancement really) will increase contrast of your

image by limiting the full tonal range, losing mid-tones along the way, increase graininess within the print, and finally increasing standard exposure times for a final image. At the end of the day, your final print is compromised on several fronts while only providing a preview of what a higher contrast image would look like. You are better served by building a digital negative to realize the final appearance of your image. Chromates are poisonous and known aggressors to the environment. They simply have no place in a darkroom.

Processing

Siderotype processing steps are generally the same for all processes, differing slightly with the number of steps and chemistry used. The processing steps for Silver Gelatin are well prescribed and inviolate.

Given the prescriptive nature of Silver Gelatin lets start here for a quick feel for the development process

- Develop
- Stop
- Fix
- Wash

After print exposure to light, the development step is where the latent (ie: non visible) image becomes manifest. Once the image has been developed out, the next step is to stop the development process via a 'stop' bath of either a dilute (citric) acid or plain water pending the overall process chemistry being used. Once the development process has been neutralized, the fixing step will lock down the silver image and toss out unused silver within the paper. This step is where the silver image becomes stable against light and where the print begins to become archival in nature. The final step, wash, is where all residual fixer and development chemistry is washed out of the paper fibers. Generally this is a two or three step process where a short water rinse takes place first, then a longer clearing bath occurs where fixer and process chemistry are thoroughly removed, then a final archival water wash to remove all of the clearing chemistry.

For all of the Siderotype processes, the flow is as follows

- Clearing wash
- Fix-if-needed
- Clear-if-needed
- Wash

The important distinction of Sideotype processes is the lack of a developing stage (Kallitype and Pt/Pd processes being the exception) since the image is 'printed out' (POP) under the UV light source rather than 'developed out' (DOP) like Silver Gelatin – the image becomes manifest during exposure. The first wash is to remove all of the unexposed sensitizer from the paper, washing out unreacted iron salts (iron(II) that did not bind to a metal salt), leaving the permanent image embedded within the paper's fibers. In all cases it is important to remove all of the unused iron less it remain and essentially rust the image away over time. The fix-if-

needed step is for Siderotype processes containing silver – the silver metal needs to be fixed into the image and become light insensitive less it fall apart due to oxidation (again, rust). The clearing stage is used to clear the residual metals from the paper as a whole. The final wash is to thoroughly clean the paper from all traces of remaining chemistry not attached to the final image, making the print archival in nature.

3.2 Cyanotype

Chemistry Makeup, Safety & Handling

There are two primary chemicals that constitute the traditional A/B Cyanotype formula, mixed together in equal parts from their A & B stock dilutions, to form the working sensitized emulsion: Part A - Ferric Ammonium Citrate, and Part B - Potassium Ferricyanide.

Neither of these primary chemicals poses a health or environmental risk, individually or when combined, and can be safely handled by children under supervision. Ferric ammonium citrate, Part A, is generally found on the health supplement market and is only a bother if it grows mold in-situ. Potassium ferricyanide, Part B, is a stable non-poisonous compound used in blueprint imaging processes.

Ferric Ammonium Citrate (Part A): Once mixed into solution, it has a propensity toward mold growth. This moldy yuk is not a detriment to the chemistry, but is not wanted in your mixed emulsion either. Any mold is easily strained out of solution via several layers of cheesecloth or coffee filters, yielding a clean Part A solution for your photographic exploits. Preventing mold growth is simple enough by adding a few crystals of crystalline Thymol or a few drops of a typical over the counter pharmaceutical fungicide like the oily Undecylenic acid, all of which sit on the surface of the solution to do their job.

Potassium Ferricyanide (Part B): The other half of the A/B sensitizer formula, responsible for the final Prussian Blue iron image. Potassium ferricyanide is not a toxin as its cyanide group is strongly bound to its iron counterpart and is not free to behave as a poison. It is however slightly dangerous as a skin and eye irritant and should not be ingested or inhaled.

Classic A/B Cyanotype Sensitizing Formula:
Stock Solution: Part A

Substance and Formula Quantity for 500ml

- 400ml water
- 100g ferric ammonium citrate (green type)
- Add water to make a total solution of 500ml
- Wait 24 hours before use for mixture to ripen

Stock Solution: Part B

Substance and Formula Quantity for 500ml

- 400ml water
- 40g potassium ferricyanide
- Add water to make a total solution of 500ml
- Wait 24 hours before use for mixture to ripen

3.3. New Cyanotype

Chemistry Makeup

Chemicals for Preparing New Cyanotype Sensitizer

Substance and Formula Quantity for 100ml

- Potassium ferricyanide K3[Fe(CN)6] 10g
- Ammonium iron(III) oxalate (NH4)3[Fe(C2O4)3].3H2O 30g
- Ammonium dichromate (NH4)2Cr2O7 0.1g

Safety & Handling

Due to the overall complexity of preparing the sensitizer, the SEAP recommendation is to purchase New Cyanotype as a finished, high shelf life, single-bottle solution sensitizer. Caution must be noted, however: New Cyanotype as a finished single-bottle sensitizer solution is of moderate toxicity and should not be used around children. A slightly acidic wash bath is desirable in the processing of New Cyanotype, so best to use a 4% citric acid bath (2min) after initial rinse (3min) and before final soak (20min). For specific needs and application, the New Cyanotype process serves its station well.

3.4. Vandyke Brownprint

Chemistry Makeup

There are three primary chemicals that constitute the Vandyke formula, mixed together to form the working sensitized emulsion: Solution A – Ferric Ammonium Citrate, Solution B – Tartaric Acid, and Solution C – Silver Nitrate.

Of these primary chemicals only silver nitrate poses a health and environmental risk. Ferric ammonium citrate, Solution A, is generally found on the health supplement market and is only a bother if it grows mold in-situ. Tartaric acid, Solution B, is an organic acid added to foods, occurring naturally in grapes. Solution C, silver nitrate, must be treated with respect.

Ferric Ammonium Citrate (Solution A): Once mixed into solution, has a propensity toward mold growth. This moldy yuk is not a detriment to the chemistry, but is not wanted in your mixed emulsion either. Any mold is easily strained out of solution via several layers of cheesecloth or coffee filters, yielding a clean Solution A for your photographic exploits.

Tartaric Acid (Solution B): The second third of the Vandyke sensitizer formula, responsible for assisting the ferric to ferrous chemical reaction under UV light and assisting with the reduction of the silver salt into silver metal at the image forming stage. It is however slightly dangerous as a skin and eye irritant and should not be directly ingested or inhaled.

Silver Nitrate (Solution C): The final third of the Vandyke sensitizer formula, responsible for the resulting sepia brown silver image. Silver nitrate is both an oxidizer (can supply oxygen to a fire) and a caustic (can cause skin burns). It can cause blindness if it comes in contact with your eyes. If solid silver nitrate comes in contact with the skin, a chemical burn may result. Wash the area with cold water followed by soap and water. Treat any wound in the same manner you would treat a heat burn. When dilute solutions of silver nitrate are spilled on the skin a brown to brown-black stain results. The color is due to silver metal bound to skin proteins and cannot be washed off. While there are chemical methods to remove these brown stains, the best procedure is to just let them wear out.

Vandyke Brownprint Sensitizing Formula:

Substance and Formula Quantity for 100ml

Solution A

- 33ml water
- 9g ferric ammonium citrate (green type)

Solution B

- 33ml water
- 1.5g tartaric acid

Solution C

- 33ml water
- 3.8g silver nitrate

In a darkroom under subdued incandescent light, add Solution B to Solution A, and stir to ensure it is homogeneous. Slowly add Solution C to the combined mixture of Solutions A and B, stirring the mixture while Solution C is being added. A precipitate may or may not form. If a precipitate should form, disregard it. Store the resulting sensitizer in a brown bottle in a dark room and let it cure for a few days before use.

Safety & Handling

Given the toxic nature of powered silver nitrate, the SEAP recommendation is to use a prepared Vandyke Brownprint solution, thus avoiding the hazards of creating the sensitizer from scratch. The working solution, however, should be considered poisonous due to its silver component – commensurate safety and handling procedures should be used. The solution is stable at room temperature and will have a shelf life of at least 1 year from the date of purchase in it's kit form.

3.5. Argyrotype

Chemistry Makeup

The primary chemistry constituting the Argyrotype formula is the unusual silver sulphamate, along with the standard Siderotype iron salt ferric ammonium citrate. Silver nitrate is not used in this formulation, replaced instead with silver sulphamate allowing for the primary benefits over the VDB and Kallitype processes. Silver sulphamate is created in-situ in a lab type environment via sulfamic acid and silver oxide, plus the other constituent chemistries that make up the complete Argyrptype working solution.

Safety & Handling

Due to the difficulties of obtaining and manipulating the raw chemicals, SEAP recommends purchasing the ready made Argyrotype sensitizer solution. Argyrotype is a silver bearing chemistry and should be treated as other silver based chemistries, possessing a health and environmental risk and must be treated with respect where commensurate safety and handling procedures are used. The solution is stable at room temperature and will have a shelf life of at least 1 year from the date of purchase in it's kit form. The cost of the Argyrotype formulation is slightly higher than Kallitype and almost double that of VDB. Argyrotype's benefits however far outweigh it's cost premium.

3.6. Ziatype

Chemistry Makeup

The primary chemistry constituting the Ziatype process is the standard Siderotype light sensitive iron salt ferric ammonium oxalate (solution #1) and the palladium metal key to Ziatype lithium palladium chloride (solution #3, aka lithium chlorppalladite). The remaining (optional) Ziatype chemistry is ammonium dichromate (solution #2) for contrast control, sodium tungstate (solution #4) as a tonal warming agent, potassium chlorate (solution #5) for contrast control, and gold chloride (solution #6, aka hydrogen tetrachloroaurate) as a tonal cooling agent. Mixing of the sensitizer is a simple matter of drop-counts into a small mixing dish (we use a small ceramic/porcelain hot teabag tray) using a drop count chart to give a rough indication of chemistry ratios for neutral, cool, warm, contrasty, etc. emulsion to be spread onto the print media (eg watercolor paper). The general rule is 1:1 mix of #1 and #3. Then, replace drop by drop of solution #3 with #4/#6 to warm/cool the resultant image.

Safety & Handling

We have discussed the use of chromates for contrast control at the beginning of this chapter, and as noted, SEAP does not recommend its use in these collective processes. When the Ziatype solution #2 is used however, it is on a per-drop basis, and even then, the dilution may be reduced significantly from the prepared 5% solution provided in the Ziatype kit. The standard Siderotype light sensitive iron salt ferric ammonium oxalate (solution #1) is considered a low hazard in aqueous form at the levels of concentration used in the Ziatype process. Lithium palladium chloride is a very rare compound, not in general use in industry, and there is

no available toxicity data. Per Bostick & Sullivan determination, this palladium lithium salt is only very slightly more poisonous that the palladium salts used in the standard Pt/Pd palladium printing process; that is to say, treat the Ziatype chemistry as you would other silver or noble metal based chemistries – with respect where commensurate safety and handling procedures are used. Sodium tungstate and gold chloride (solutions #4 and #6) should be treated as above. Potassium chlorate (solution #5) is not considered a toxin / poison if / when used a drop at a time in Ziatype kit provided concentrations.

3.7. B&W Silver Gelatin

Refer to the LegacyPro on-line materials for product overviews, practical use, and safety details regarding their eco•pro processing solutions.

Appendix A: Emulsion Care & Feeding

Photographic Light Sensitive Iron Salts

Decomposing like all good organics, light sensitive Ferric Ammonium Citrate and Ferric Ammonium Oxalate iron compounds used for Siderotype printmaking processes will self-destruct. Sunlight, heat and time are all aggressors of a good iron based light sensitive emulsion. The results of this decay will be various forms of a fogged print - inability to clear to paper white, highlight staining, precipitation of precious metals before emulsion application. All bad for happy printmaking.

Bad Ferric Ammonium Citrate, Part A of Cyanotype, results in staining areas of no exposure and fogged highlights. Bad Ferric Ammonium Oxalate, Solution #1 of Ziatype, is similar to the Cyanotype failure mode of staining and fogging while including precipitation of the metals used in the process - palladium, gold, tungsten - resulting in metal particulates forming in the emulsion before even being applied to the paper substrate.

Corrective action for these two processes, Cyanotype & Ziatype, is the inexpensive replacement of their respective mix-in light sensitive ferric components. For Ziatype, there is no need to replace the expensive precious metals, and to be thrifty with Cyanotype the inexpensive potassium ferricyanide (Part B) is perfectly useable. Corrective action for Vandyke Brown, New Cyanotype, and Agryrotype is more complicated as the light sensitive ferric compounds are pre-mixed into their respective one-part emulsion solutions. When these chemistries fog, a full replacement of the chemistry is required. Cost-wise, not great for Vandyke Brown ($0.40 / 2ml) but spendy for New Cyanotype ($1.44 / 2ml emulsion) and Argyrotype ($2.40 / 2ml emulsion).

Bostick & Sullivan authored a concise note about the behaviors of Ferric Ammonium Oxalate:

https://www.bostick-sullivan.com/articles/ferriccoalate.html

The punch line:

Coat a small sheet, dry and develop without exposure. If a grey tint or stain remains after clearing, then the Ferric Ammonium Oxalate has gone bad.

Cyanotype and mold growing in Part-A Ferric Ammonium Citrate: Best solution is adding a few crystals of Thymol to the mix. The crystals will not dissolve and will make the sensitizer smell like mothballs. Good luck finding it - there are a few online sellers at eBay & Etsy that sometimes carry it. Thymol is not something Bostick & Sullivan nor Photographer's Formulary tend to cary.

Good emulsion hygiene:

1) When not in use, store all emulsion chemistry in a cold dark place. Not exactly the Traveling Wilburys song, but close.
2) When in use, work under low light away from UV sources. No fluorescent bulbs. No bright incandescent. Just dim warm light, enough to work by. No need for red/amber safelights, a 25-40W yellow bug light for a small space would be perfect.
3) Cyanotype Part A, Ferric Ammonium Citrate, will grow mold. It just will. No harm, no foul, it's just a pain you don't want mixed into your emulsion. Skim it out with a pick, filter it out with moistened cheesecloth (our favorite) or covfefe filter (meh), or prevent it all together by adding a fungicide (eg Thymol) to the storage bottle thus terminating it with extreme prejudice.
4) Even with a fungicide, mold will grow in a dropper if stored with the Ferric Ammonium Citrate sensitizer. So, cap only on the amber storage bottle, no cheating by storing with a dropper.
5) Silver based emulsion mixes must never be stored in plastic bottles or with plastic droppers. The silver will quickly plate out onto the plastic and render the emulsion impotent.
6) Silver based emulsions should never be stored with glass dropper caps either. Silver will eventually plate onto the glass dropper, diminishing the effectiveness of the solution. Silver does not seem to plate onto the sides of glass amber bottles, so there is some oddity in behavior between the glass storage bottle and glass droppers. Store in amber bottle with cap only, no dropper.
7) Ziatype chemistry seems compatible with both plastic and glass dropper caps for all chemistry solutions, stored in glass amber bottles. Ferric Ammonium Oxalate, Solution #1 of Ziatype, will go bad over time. We have not determined if storage with a dropper cap plays into this failure mode.
8) Avoid returning extracted chemistry into its storage bottle. No need to risk inadvertent contamination. Always draw just what is needed, dispose the extra.
9) Always rinse and clean extraction tools before drawing liquids. Make sure the dropper or pipette is clean before each use.
10) Always clean the mixing bowl and mixing tool before mixing up the solution for coating. No need to contaminate the few milliliters of liquid just before application.
11) Always clean the application tool (brush, rod, etc.) after applying emulsion onto the intended substrate. Make sure all previous emulsion has been thoroughly washed off and out.

Appendix B: Process References

Photographic Processes

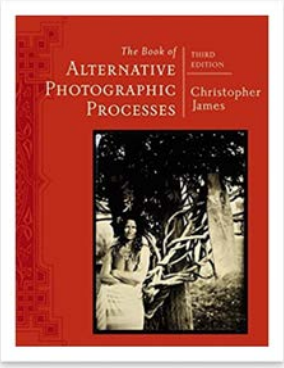
- Alternative Photography
  - Historical photographic methods
- Bostick & Sullivan
  - Siderotype Process Kit Instructions
- Mike Ware
  - Alternative Photography
  - The Traditional Cyanotype Process
  - The New Cyanotype Process
  - The Argyrotype Process
- Sandy King Photography
  - Photography & Resources
  - Vandyke Brown - A Method for Making Permanent Prints in Gold Metal
- Wynn White
  - Vandyke Notes
- Richard Sullivan
  - Ziatype: A palladium and gold printing out and development system
- Christina Z. Anderson & Carl Weese
  - The Ziatype Process
- Digital Truth
  - DigitalTruth Photo - eco•pro B&W Chemistries
  - Massive Film Development Chart (use XTOL for eco•pro film developer in chart)
- Kodak Alaris
  - AJ-3: How to Process and Print Black-and-White Film
- Ilford Harmon Technology Ltd
  - Processing B&W Paper (RC paper)
  - Processing B&W Paper (FB paper)
  - Contrast Control with Multigrade Papers
- Jeff Warden
  - Split Grade Printing

Chemistry of Light Sensitive Emulsions

- Bostick & Sullivan
  - Photographic Chemistry & Safety Data Sheets
- Fotospeed
  - New Cyanotype & Safety Data Sheets
  - Argyrotype & Safety Data Sheets
- Digital Truth
  - DigitalTruth Photo - eco•pro B&W Chemistry & Safety Data Sheets

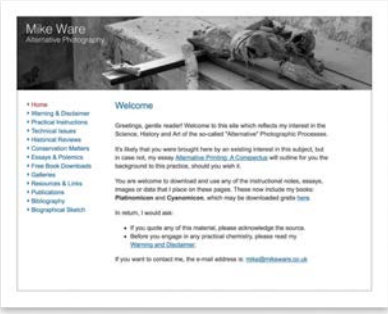
Appendix C: Photography References

Principal References

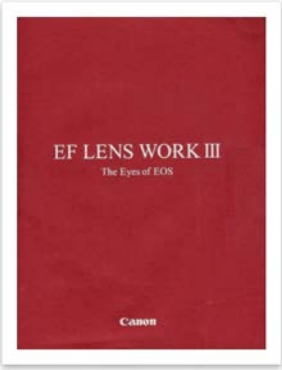


[The Book of Alternative Photographic Processes]
Christopher James, 2016, 3rd Edition
Written by internationally acclaimed artist and photographer Christopher James, THE BOOK OF ALTERNATIVE PHOTOGRAPHIC PROCESSES: 3rd Edition is the definitive text for students and professionals studying alternative photographic processes and the art of hand-made photographic image making. This innovative Third Edition brings the medium up to date with new and historic processes that are integrated with the latest contemporary innovations, adaptations, techniques, and art work

[Jill Enfield's Guide to Photographic Alternative Processes]
Jill Enfield, 2013, 1st Edition
As technology advances in the world of photography, a passionate crowd of professionals, students, and hobbyists is returning to the darkroom in search of a more authentic, handmade feel to their art. Jill Enfield's Guide to Photographic Alternative Processes shows how to do just that. Packed with stunning imagery, how-to recipes, techniques, and historical information on the evolution of processes



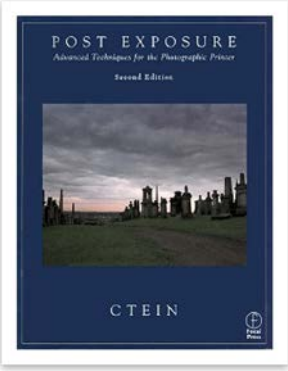
[Dr. Mike Ware - Alternative Photography]
Mike Ware's 'Alternative Printing: A Conspectus' is a good place to start, leading to his practical, technical, and historical treatises. Michael J. (Mike) Ware (born 1939, Bromley) is a chemist and photographer, known for his work in alternative photographic processes, earlier methods of printing photographic images that were succeeded by the more common silver-gelatin used today.



[Canon Lens Work]

While Canon lens specific, Lens Work is an excellent reference to camera lenses in general. The illustrative examples and photographic techniques for the full range of lens focal lengths make this series the go-to reference for determining and using the best lenses for your particular photographic vision.

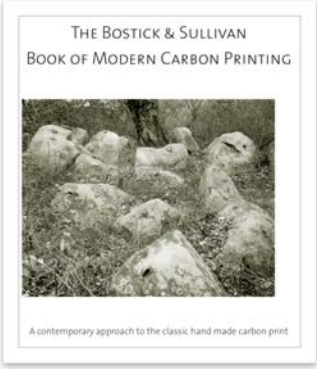
Light Reading (2011 - 1854)



[POST EXPOSURE - Advanced Techniques for the Photographic Printer]

Ctein, 2011, 2nd Edition

Ctein has over 30 years of experience in this field and not only is he one of the few remaining dye-transfer printers but is also regarded, by Kodak no less, as one of the best printers. Step-by-step, detail by intricate detail, Ctein takes us from the very beginning of the photographic process, to the most advanced and sophisticated techniques as no other author ever has. This book provides detailed procedures taking the image from exposure to the making of the fine print in both black and white and color.



[Bostick & Sullivan Book of Modern Carbon Printing]

Richard Sullivan, 2007-2010, 1st Edition

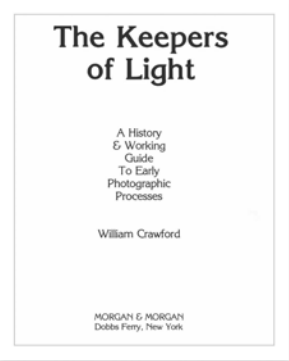
This book goes over carbon printing methods in great detail and is good for anyone wanting to learn about carbon printing.

Photographic Possibilities

Robert Hirsch & John Valentino, 2001, 2nd Edition
Robert Hirsch, 2009, 3rd Edition
Photographic Possibilities provides a reliable source of techniques and ideas for the use of alternative and contemporary photographic processes that photographers have come to depend on. Professional photographers and advanced students seeking to increase their skills will discover modern and classic methods of creating and manipulating images. This practical guide integrates technical methods with the aesthetic outcome.

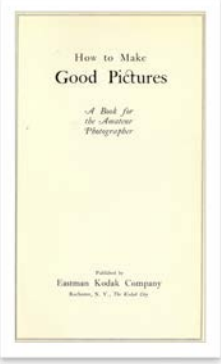
Judy Seigel's excellent writeup titled "Sense & Sensitometry"

The World Journal of Post Factory Photography, 1998, Issue #1
Kindergarten simple description in great detail on how and why light sensitive emulsions do not react linearly during exposure, and how best to compensate with a negative specific to the emulsion and paper combination being used.



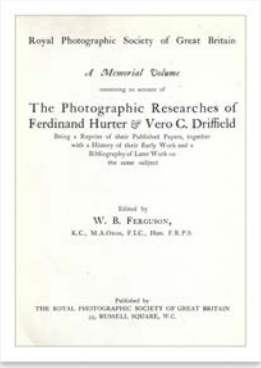
The Keepers of Light

William Crawford, 1979, 1st Edition
Combines a history of the development of photography with guidelines for mastering the photographic print processes which the great nineteenth and twentieth-century pioneers of photography themselves employed



How to Make Good Pictures - Kodak

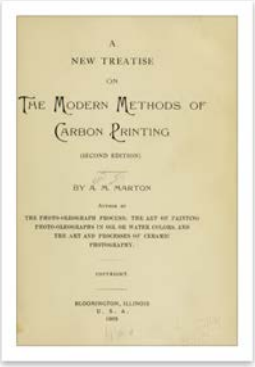
Eastman Kodak, 1922, 12th Edition
"How To MAKE GOOD PICTURES," the title of this book, explains its mission. We can only add that in it all photographic processes have been reduced to the simplest form consistent with good results complex theories or untried experiments have not been introduced. We have given prominence to the Kodak system of picture making because time has demonstrated its supremacy for the producing of good results in the simplest way.



The Photographic Researches of Ferdinand Hurter & Vero C. Driffield

Edited by W. B. Ferguson, 1920

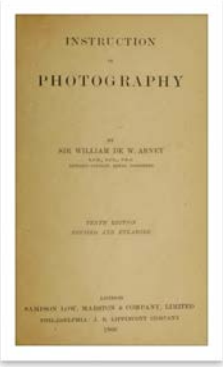
A Memorial Volume containing an account of The Photographic Researches of Ferdinand Hurter & Vero C. Driffield. Being a Reprint of their Published Papers, together with a History of their Early Work and a Bibliography of Later Work on the same subject.



Modern Methods of Carbon Printing, 1905

A. M. Martin, 1905, 2nd Edition

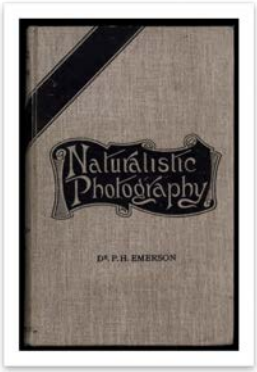
The great advantages and supremacy of the modern carbon process in its present state of perfection, is now universally recognized by the profession, the world over. In the following pages, I will try and give the result of many years of practical experience ; and that of other workers whom I have come in contact with during my long career as a professional carbon printer.



Instruction on Photography

Sir William DE W. Abney, 1900, 10th Edition

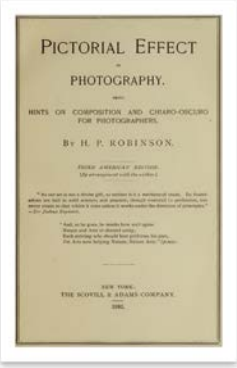
A few remarks are necessary, by way of explanation of some of the changes that have been made in this edition. The gelatine process having so firmly got possession of the photo- graphic public, it has been awarded the place of honour in the description of negative-making processes, relegating the description of the wet process to a more subsidiary position. Certain omissions in some almost obsolete processes have become necessary to keep the pages within reasonable limits, and to make room for various new chapters.



Naturalistic Photography

Dr. P. H. Emerson, 1899, 3rd Edition

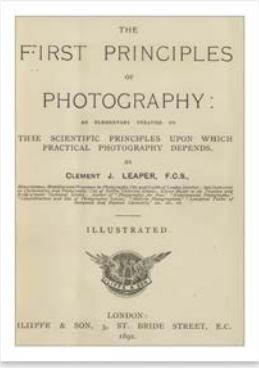
The withdrawal of the second edition of this book, some years ago, is too well known to dwell upon. The reasons for the retraction have been fully given in a paper read before the Photographic Society of Great Britain and herein reprinted; and in the same paper it is clearly stated what portions of the original work were discarded and what retained. Those portions retained and expanded form this third edition now published for the first time in New York — they having been previously run through the pages of the Photographic Times.



Pictorial Effect in Photography

H. P. Robinson, 1892, 3rd Edition

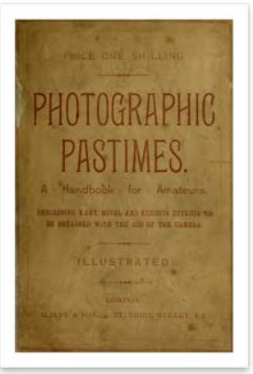
Mr. Robinson's first, and, in the opinion of many, his best, book on photographic art, has long been a standard work in this country. With these brief prefatory remarks, we issue this new American edition of Pictorial Effect in Photography, containing all the original illustrations, for the benefit of the photographic fraternity in this country, confident that it will meet with a wide and appreciative reception.



The First Principles of Photography

Clement J. Leaper, 1892, 1st Edition

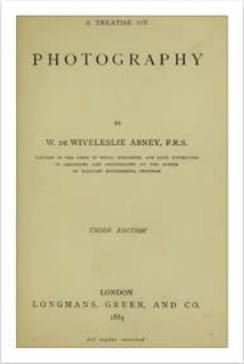
In the following pages, I have embodied the substance of the course of lectures on photography annually delivered by me since 1882, first at the Dublin Mechanics' Institute and latterly at the City of Dublin Technical Schools. In my treatment of the subject, I have in the main followed the admirable syllabus of the City and Guilds of London Institute, and to students preparing for the Institute's Examinations in Photography I believe this work will be of special service.



Photographic Pastimes

Hermonn Schnauss, 1891, Translated from the German 2nd Edition

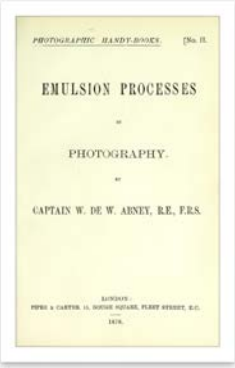
A handbook for amateurs describing many novel and curious effects to be obtained with the aid of the camera.



A Treatise on Photography

W. de Wiveleslie Abney, F.R.S., 1885, 3rd Edition

The aim of this book is chiefly to give a rational explanation of some of the different phenomena to be met with in Photography ; and with this to give sufficient practical instruction to enable the student to produce a landscape picture which shall be technically good, and at the same time to be of use to him if he make photography an aid to research. In regard to the theories which the author has enunciated, it is believed that experimental evidence completely justifies their adoption.


PHOTOGRAPHIC HANDY-BOOKS. [No. II.

EMULSION PROCESSES

PHOTOGRAPHY.

CAPTAIN W. DE W. ABNEY, R.E., F.R.S.

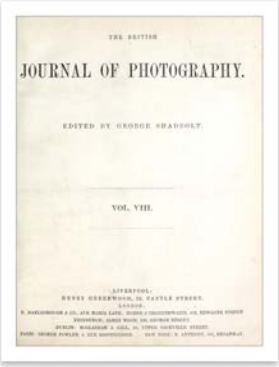
LONDON:

1878.

Emulsion Processes in Photography

Captain W. DE W. Abney, 1878, 1st Edition

It has been the endeavour of the Author to collect, in the form of a "handy-book," those Photographic Emulsion Processes which have been received with most favour by experienced workers, and with which he is practically acquainted himself; and, at the same time, to give theoretical explanations of some of the phenomena which are met with in these particular processes.


THE BRITISH

JOURNAL OF PHOTOGRAPHY.

EDITED BY GEORGE SHADBOLT.

VOL. VIII.

LIVERPOOL.

LONDON.

British Journal of Photography

Founded in 1854 to record the scientific development of a fledgling medium, these days BJP takes an international perspective on contemporary photography, focusing on fine art and documentary, and the cutting edge of editorial and commercial practices. Each monthly edition (in print and iPad) focuses on a theme, including regular subjects such as Portrait, Education, Journeys and Community.

Appendix D: Coffee Cyanotype Toning Example

So you like Cyanotypes, and you like coffee, and you have some images that are not well suited to being imaged in the Prussian Blue of raw Cyanotype. No problem! Lets make a good desert patina toned print using coffee as the tannic iron replacing the iron that makes a Cyanotype so impressively strident!

Materials:

- Fluid HP 9x12 watercolor paper. Note that this paper has an alkali buffer, mitigated by 3gt of Citric Acid 40% to neutralize this buffering agent
- Cyanotype A/B liquid from Photographer's Formulary
- Arm & Hammer Washing Soda powder (soda ash, sodium carbonate)
- Dark roast instant coffee
- Citric Acid 40% (optional extra to reduce pH and assist clearing in initial water wash)
- Tween 20 10% (optional extra to assist emulsion absorption into paper fibers)
- Hydrogen Peroxide 3% (typical household concentration)

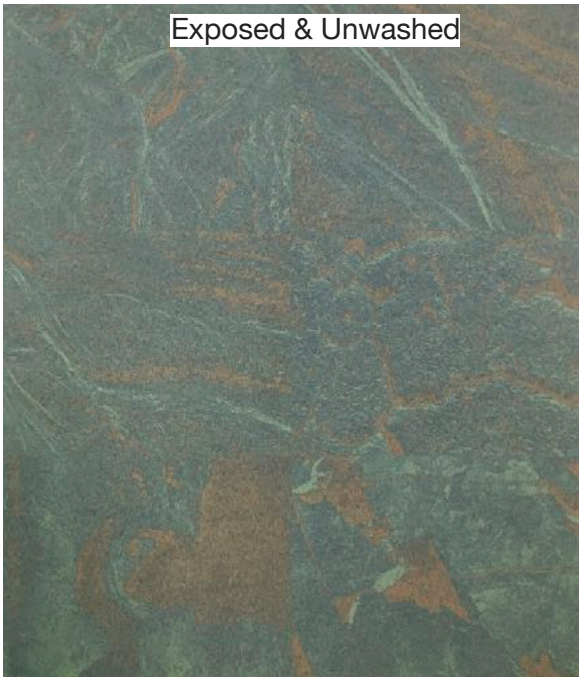
Chemistry mixes:

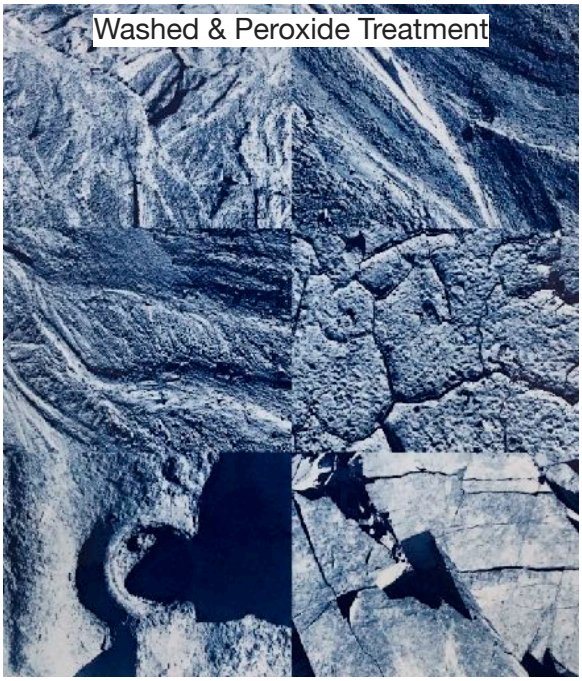
- 1.5ml each Cyanotype A & B, 3gt Citric Acid 40%, 1gt Tween 20 10%
- 60 minute dry time, 30 minute air in paper safe, 30 minute under fan in paper safe
- 50ml coffee crystals into 1L 165° water, mix well, cool to room temperature before use
- 1/4 teaspoon washing soda into 1L 165° water, mix well, use at hot temperature

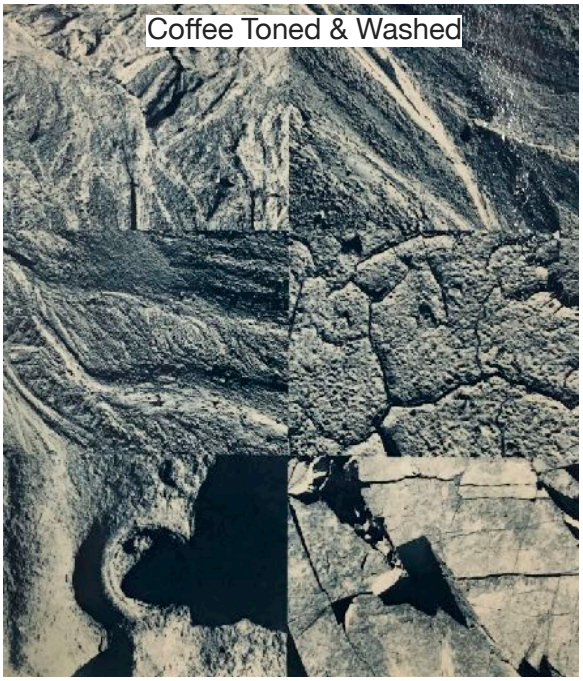
Process:

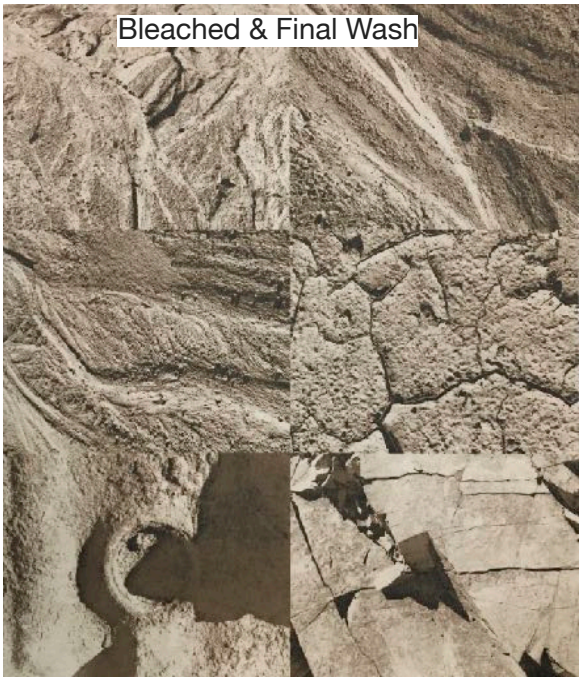
- Apply the Cyanotype A/B emulsion as best you know how, taking care not to overwork the paper
- Expose 20 minutes with a negative created with the Cyanotype characteristic exposure response
- Wash 2x in tap water on the order of 5 to 8 minutes to remove all unexposed emulsion. Wash until no more blue yellowing shows in the water, but not so much as to begin washing away the image itself.
- 3x cap-fulls of hydrogen peroxide into 1L water in flat bottom tray
- Move print to flat bottom tray and quickly develop the cyanotype until maximum density is reached, upwards of 60 seconds, before the image begins to bleach out due to this other behavior of peroxide with Cyanotype
- Wash print in tap water to stop the peroxide oxidation action (several rinses)
- Pour room temperature coffee mix into flat bottom tray and agitate for 10 minutes
- Wash coffee out of print with fresh water until little residual coffee is released into the water, upwards of 10 minutes
- Pour hot washing soda bleach mix into tray and agitate. At the 20-25 second mark, pour the bleach out of the tray for a total of 25-30 seconds bleaching action

- Wash the bleach quickly with agitation in fresh water for several rinses to both stop the bleaching action
- Soak in fresh water for 20 to 30 minutes, replacing the water as it becomes brown with coffee residue



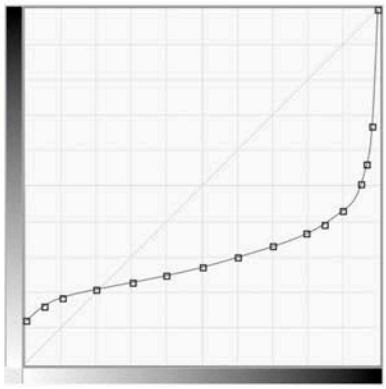






Appendix E: Exposure Response Correction Curves

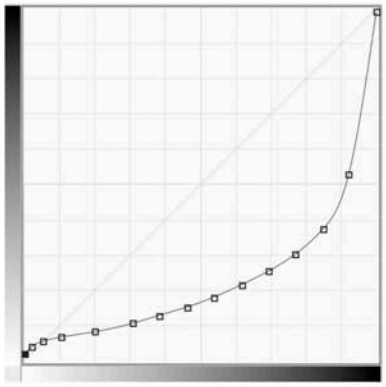
Cyanotype: Input / Output															
0	4	8	12	25	39	52	76	102	127	153	178	204	229	242	255
0	84	112	126	145	155	162	171	179	186	192	197	202	208	214	225



Vandyke Brownprint: Input / Output – VDB & VDB (dark)														
0	20	39	59	78	98	118	137	157	177	204	229	242	250	255
0	120	160	178	190	200	209	216	222	228	234	238	241	245	250
0	123	161	178	190	200	209	216	222	227	232	236	239	243	249

VDB (dark): Lighten the shadows and darken the highlights

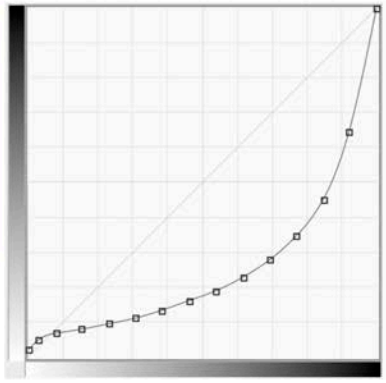
Note Shown: VDB (-) & VDB (+) had no visible impact on highlight densities



Ziatype: Input / Output – Ziatype, Zia (-), Zia (+)														
0	20	39	59	78	98	118	137	157	177	196	216	235	248	255
0	90	140	167	184	197	207	214	221	227	231	235	238	243	250
0	90	140	167	184	197	207	214	221	227	231	235	237	242	250
0	90	140	167	184	197	207	214	221	227	231	236	239	243	250

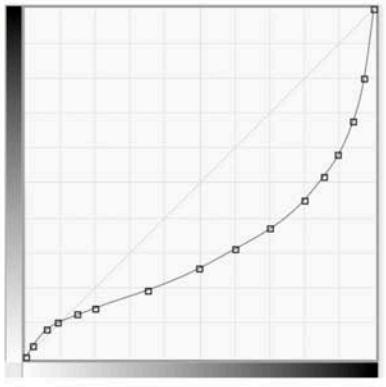
Zia (-): Darken 3%, 7% highlight densities

Zia (+): Lighten 7%, and 15% highlight densities



B&W Silver Gelatin: Input / Output – Silver & COT320 (C/V)															
0	7	15	26	37	51	76	102	128	166	204	217	232	240	250	255
0	51	82	107	123	140	161	176	190	206	219	224	230	235	247	255
0	8	25	53	73	98	112	127	144	166	189	204	217	232	244	255
0	59	114	148	162	177	184	191	197	204	212	217	222	228	236	250

COT320 (C/V): Lighten the shadows and darken the highlights based on Silver curve



Appendix F: Spill Response Procedures

These spill response procedures should be printed as a single page and posted within the workspace

SEAP SPILL RESPONSE PROCEDURES

REMEMBER: DO FIRST AID FIRST, THEN ASSESS THE SPILL – Is the Spill Major or Minor?

Minor Spill - Definition

If SEAP workers have the training, protective equipment, and spill response supplies to control and cleanup the release, and the spill is:

- Less than 1 gallon spill of a low toxicity chemical
- Less than 1/2 quart (500 ml) of a highly hazardous chemical (carcinogen, reproductive hazard, or has NFPA/HMIS health or physical hazard rating of 3 or 4)
- Not a likely release to a waterway or drain, and:
- Without an injury, chemical or biological exposure, and no fire or explosion has occurred!

Minor Spill Response

1. Notify fellow workers in vicinity of spill.
2. Secure area, by restricting access and posting signs.
3. Remove any potential ignition sources, unplug nearby electrical equipment, and ventilate the area if safe and possible.
4. Gather and review safety information on spilled chemical. Review chemical's Material Safety Data Sheet (MSDS) for a hazard assessment and other pertinent information.
5. Refer to the SEAP Spill Prevention and Response Plan
6. Locate an appropriate Spill Kit, if available.
7. Don appropriate personal protective equipment (PPE) which usually includes chemical splash goggles, gloves, apron, coveralls, or lab coat. If high splash potential exists, also wear a face shield and protective clothing.
8. Confine and contain spill. Cover spill with appropriate absorbent material. Neutralize acid and base spills prior to cleanup. Protect any sink, floor, or yard drains.
9. Clean up spill using a scoop or other suitable item and place material in appropriate disposal container.
10. Decontaminate spill surface with mild detergent and water, as appropriate. Carefully remove PPE, place non- reusable items in disposal container and thoroughly wash hands.
11. Label the cleanup waste container. Contact the onsite General Manager or Supervisor to arrange for waste disposal.
12. Investigate cause of spill and review with onsite General Manager or Supervisor. Document spill, response, and follow-up with SEAP staff.
13. Replenish spill kit or supplies.

Major Spill - Definition

A chemical spill or release involving any of the following:

- Injury, fire, explosion, or exposure to hazardous chemical• More than 1 gallon spill of a low toxicity chemical
- Over 1/2 quart (500 ml) of a highly hazardous chemical
- Unknown chemical, product, or material
- Beyond training or capability of onsite staff

Major Spill Response

1. Notify and evacuate fellow workers to a safe area. Post Spill Hazard signage or isolate the area.

DO NOT ATTEMPT TO CLEAN A MAJOR SPILL ON YOUR OWN!

2. If spill poses a fire hazard – activate nearest fire alarm. Call Public Safety at 911 and give details of spill including specific location, chemical, quantity, and if anyone is injured.
3. In case of an injury or chemical contamination:
   a. Wear PPE and move victim from spill area.
   b. If first aid trained, administer first aid as appropriate. Assist person away from contaminated are for treatment. If possible, bring chemical label or MSDS.
   c. Locate nearest emergency eyewash and sink. Remove contaminated clothing and flush affected areas (eyes or skin) with copious amounts of water for 15minutes. Use soap on skin surfaces.
4. Onsite General Manager, Supervisor, or outside personnel will respond to the spill.
5. Workers knowledgeable about the spill should provide responders with all pertinent information and MSDS.
6. The responders or designee will inform workers when it is safe to re-enter spill area.
7. Investigate cause of spill. Complete Incident Report, response and follow-up with facility General Manager or Supervisor