

# Digital Photo Restoration & Black and White Carbon Pigment Printing Elverhoj Museum

By Paul Roark

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Old photographs are fascinating on several levels. For some the age of the photo and the extent to which it is “distressed” – faded, stained, scratched, and otherwise physically damaged – become a major part of what they like. Artists will often take a modern photo and intentionally damage it to give it that “old photo” look. I do the opposite.

For the Elverhoj Museum’s<sup>1</sup> photo history project, the most interesting part of the old photos is what they show. They are images from the past; the closest we can come to time traveling back to a previous era. So, not unlike my contemporary black and white landscape photos, where I try to give people a window into a B&W reality, I’ve tried to make these restorations windows into Solvang’s past. We want these windows to the past as clear as possible, and we want them to stay that way for many years.

Original old photo



Digitally restored print



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<sup>1</sup> See <http://www.elverhoj.org/>

## **A. Scanning**

The process of digital photo restoration and preservation starts with a scan of the old photograph.<sup>2</sup> Ideally, we would like to start with a pristine negative and scan it at a high enough resolution to capture all the image information that it contains. However, in the real world, those original negatives are rarely available. The best images we started with in the Elverhoj photo restoration project appeared to be contact prints of 5 by 7 inch negatives. A good contact print, where the negative is pressed against printing paper and not enlarged, has the advantage that there was only a single (and very old) lens between the original scene and the print we were able to scan. At the other end of the spectrum, some of the source materials we had to work with were poor scans of prints that were probably made with an enlarger that was out of alignment and used a poor lens. But, even there, the image content may be so compelling that, with the defects minimized, the image softness by itself does not seriously alter or distract from the feeling conveyed by the final reproduction.

Many scanners have some image editing options available in the scanner software. Most of these editing options are best left to Photoshop<sup>3</sup> after the scan is completed. With the scan the goal is simply to capture as much information from the photo as possible.

The settings below may be in an “Advanced” menu. Typically scanners and printers have an initial menu that is very simplified.

### **1. Resolution**

Among the variables on most scanners is the resolution for scanning the original. Most scanners can go beyond what is really needed, and large files are difficult to work with and store. So, what is really needed?

#### **a. Film – use the top optical resolution**

While I’m not inclined to want to overdo the resolution, films can hold very high resolutions. With my 4000 dpi<sup>4</sup> Nikon film scanner, I almost always scan at the top optical resolution, and I’m still losing information relative to what is on the film. Flatbed scanners are generally not nearly as sharp as dedicated film scanners at the same alleged dpi. So, use the scanner’s full optical resolution for films, but do not “interpolate.” That can be done later and better if more pixels are needed. Know what your scanner’s top “optical” (true, un-interpolated) resolution is and use it for films. If the resolution turns out to be higher than needed, image size can also be reduced in Photoshop, while also checking to see that no image detail is being eliminated.

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<sup>2</sup> Note that preserving the originals is also important. I make a few suggestions in that regard later, but the details of that field are beyond this project.

<sup>3</sup> Adobe Photoshop is the industry standard image editing software. Competing products can be very good also. I usually recommend Photoshop Elements for those who want to avoid the cost of the full program. Elements has most of the important tools contained in the more expensive program.

<sup>4</sup> “Dot per inch” – more accurately “ppi” or pixel per inch, but most use the “dpi” abbreviation for both.

## b. Paper Prints

The enlarging paper I've tested can hold at most about 25 line pairs/mm. To capture this amount of information a scanner resolution of at least a theoretical 1250 dpi is needed – 1600 is probably a good setting for the very best prints. In reality, however, I've found that 600 dpi usually captures all the information that is contained in most old photos.

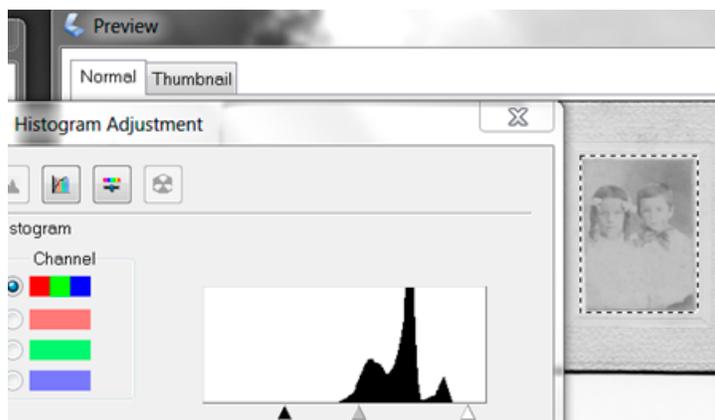
## c. Work back from print size

If you know what the final print size is going to be, another approach is to simply work back from the print size. There is little reason to have a file that is larger than is needed to make a good print.

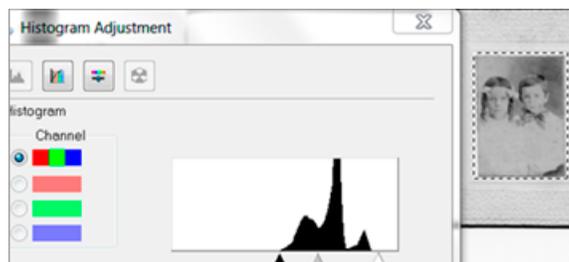
Epson printers have a native resolution 720 dpi, but 360 dpi is the effective limit of what most people can see in a normal print. I usually don't bother with files over 360 dpi at display print size, but I do use the full 720 dpi for small, glossy prints of high quality images.

## 2. Histogram/Levels

One of the controls in the scanner preview is the "histogram" tool. By using this tool the white and black points of the scanner range are set to the range of densities that is present in the image to be scanned. This setting and the scan that results will have the effect of increasing the contrast of a faded photo. Of course, it also increases the contrast of the dirt and defects in the image, but that will be dealt with later. The scanner auto-exposure settings often do a very good job if the image is properly selected in the preview, but be sure by checking the histogram.



After the histogram is set, a faded image already looks noticeably better.



Leave a little space above the apparent highlights for spectral highlights that might be too small to see on the scanner preview.

If the image is a color image the scanner may allow each color to be set independently. This can offset the differential fading of the color layers and restore not only contrast but correct color rendition. If the scanner does not have this ability, Photoshop does, and a 16 bit/channel bit depth will give enough information to do this without visible steps in the gradient.

### **3. 16 Bit Depth**

Most scanners today allow one to set the bit depth up from the standard 8 bits per channel (256 levels of gray) to 16 bits (over 30,000 gray levels).

### **4. Color v. Grayscale**

Unless the image is stained, scanning a black and white photograph in color/RGB<sup>5</sup> mode usually accomplishes nothing but increasing the file size. (Prior to scanner support of 16 bit depth, RGB was sometimes used as a substitute way to capture more gray levels.)

Today, the main reason to scan a B&W photo in RGB mode is to remove stains. These are often a different color than the rest of the image. This color differential can be useful in removing the stain. One of the RGB channels may not show the stain at all or barely, and the color of the stain can also be used to select that area by color range, which can then be treated separately.

### **5. Save as Tiff file**

Tiff file types are the most widely supported and do not compress the image. A file format like Jpeg compresses the file and will cause image information to be lost.

## **B. Image Editing-Retouching**

Once the image is in a digital form, the work of restoration, for me, is mostly aimed at maximizing the extent to which viewers can see and appreciate the original image information. This requires minimizing the distractions caused by the damage to the old print. One might compare the process to washing a very dirty window so that viewers can see more clearly what is on the other side. If the process is compared to music restoration, the job might be characterized as maximizing the signal-to-noise ratio.

Most of the images in this show have been enlarged considerably. Many of the original prints were, for example, postcard-sized. While some of the old prints looked quite nice when small, upon enlargement the defects in the old prints become much more noticeable and distracting. Typically old emulsions have micro-cracking and other surface defects that may have been too small to be visible before

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<sup>5</sup> Photographers generally work in the “Red, Green, Blue” primary color space. On the other hand the printers use CMYK – cyan, magenta, yellow and black ink, the complements of RGB.

enlargement. However, these very numerous small scale defects become obvious when enlarged and distract us from the lens-formed image information. Reducing the distracting “noise” while still showing an appropriate natural image structure and texture – film grain and paper base – is part of the job.

This image texture is sometimes helpful. The very old images were taken with orthochromatic film. This type of black and white film, which was all that was available in the early years of photography, was sensitive to blue and green light only. It pre-dated the “panchromatic” B&W film we used in the latter part of the 20<sup>th</sup> century. With the older films the skies were very often totally overexposed and “blown out.” In these cases, the texture of the old paper can provide a pleasing rendering of what is, on the film, a totally blank white sky.

Photoshop is the primary image editing software (“tool box”) that I use to retouch and otherwise clean up the images. While it has some powerful tools in it, there is no simple “photo restoration” button one can push. Most of the restoration work is a modern form of manually retouching the image. The Photoshop “filters” that remove small spots and scratches cannot distinguish the valid image information from the distracting noise. So, they have to be used very sparingly and applied selectively.

Some of the primary tools and methods I use are outlined below.

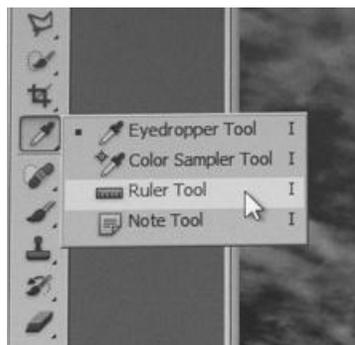
### **1. Straighten the Horizon and Do an Initial Cropping of the Image**

Often images are rotated such that, for example, the horizon in the photo is not level or vertical lines slant. There are at least 2 methods of correcting this problem.

#### **a. Ruler - Straighten Method**

With Photoshop CS5 a quick method of leveling an image was added to Photoshop. This approach is particularly quick and easy if there is an obvious horizon line or vertical edge in the image that you can use as a guide. Usually in the old photos I was working with in the Elverhoj project there were no such obvious lines; so I’ll use a seascape shot as an example. The steps are as follows:

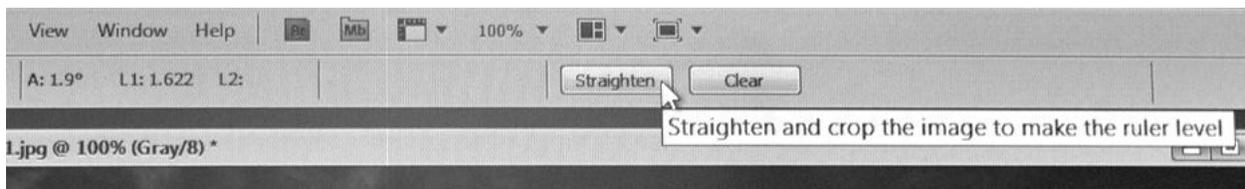
At the left Photoshop tool box, right click on the Eyedropper tool to reveal the options, which include the Ruler tool. Select this one.



Place the ruler cross-mark on the horizon (or vertical) reference, hold down the mouse button, and draw a line along the reference edge.



After the line is drawn with the Ruler tool, press the “Straighten” button at the top of the Photoshop screen.



Photoshop will straighten the horizon (or vertical line) and crop the image appropriately.

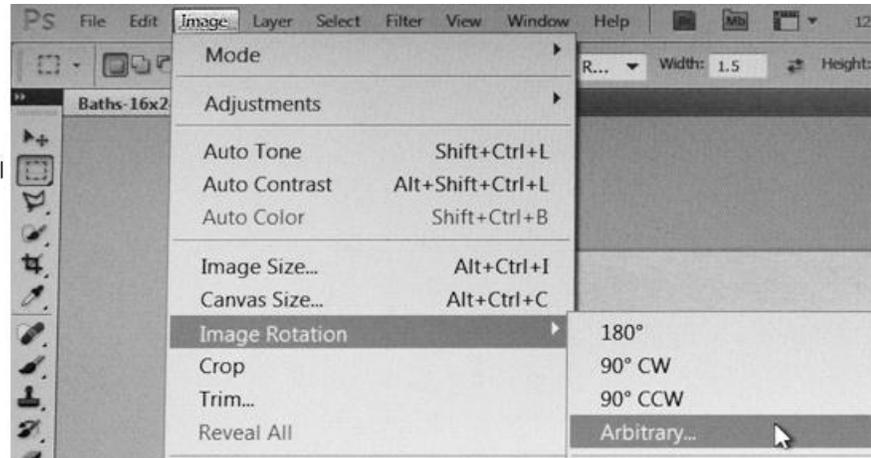


Note that this tool is not available on versions of Photoshop earlier than CS5. For earlier versions, the Image Rotation method, below, must be used.

#### **b. Image Rotation Method**

This is the traditional method to get the horizon straight (Image>Image Rotation>Arbitrary). The amount of rotation needed is trial and error. Try one setting and if it is not right, “undo” (Edit>Step back) the rotation and try again. See the screen grab below.

Rectangular Marquee Tool

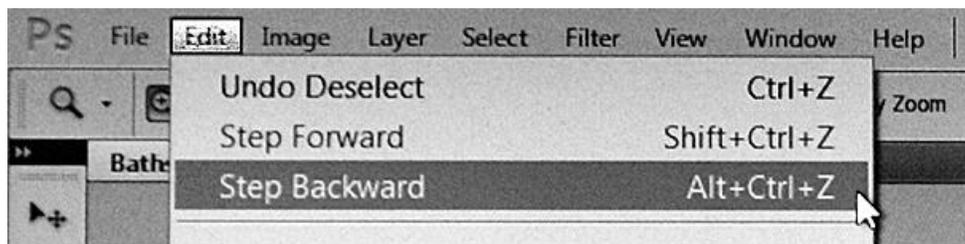


### c. Initial Image Crop

After getting the image rotation correct, an initial crop of the image is a good idea. Use the “Rectangular Marquee Tool”, dragging it across the image to select the image area you want to keep. If a specific proportion is wanted, this can be set by selecting a “Fixed Ratio” for the selection tool. Once the image area is selected, crop the image (Image>Crop).

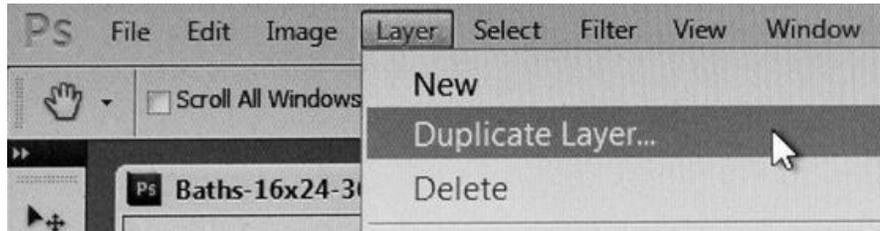
I usually will not crop the image again unless it needs to be sized for a print. The reason not to touch the size, rotation, or crop parameters again is that as I work up an image I save interim working copies. If one of my changes turns out to be a mistake, I can go back to a previous version and recover information from it to correct my mistake. If the image size, etc. have not been changed, one image can simply be copied and pasted onto another. They will be completely aligned layers then that are like the duplicate layers discussed below. This makes it very easy to transfer information from one layer to another.

For those not familiar with Photoshop, a very basic tool that is used constantly is the PS equivalent of “undo.” This is “Edit>Step Backward.” Above it is “Step Forward.” With these 2 tools you can go back and forth to be sure the effect you just applied is a good one, or not.



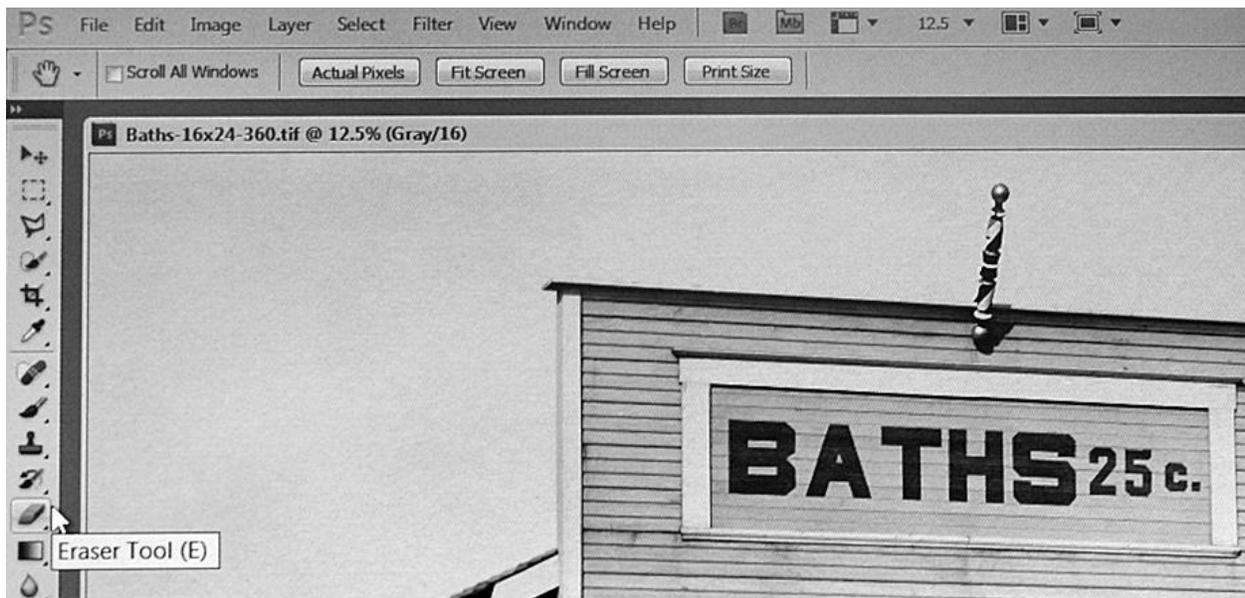
## 2. Duplicate Layers

Because most tools and effects are best used selectively, I often make a duplicate layer to work on. (Layer>Duplicate Layer)



The effects are then applied to the lower layer. This might involve sharpening, softening, curves, or any number of other effects.

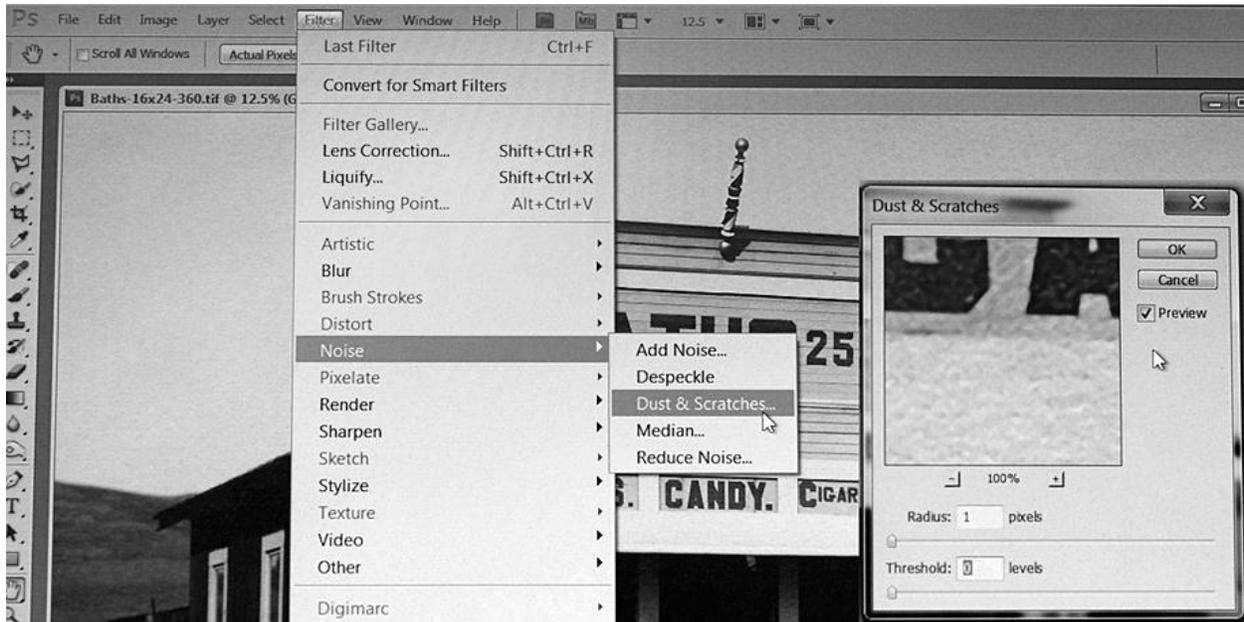
Once the effect has been applied to the lower layer, the top layer is made the active one and the effects on the lower duplicate layer are applied completely or incrementally in small steps via the “Eraser” brush. This “erases” the top, active layer and exposes the layer with the change.



When done the image is “flattened” (Layer>Flatten Image) and the image is saved as a working copy. I save “working” copies of the image after major changes just in case I want to go back.

## 3. Dust & Scratches

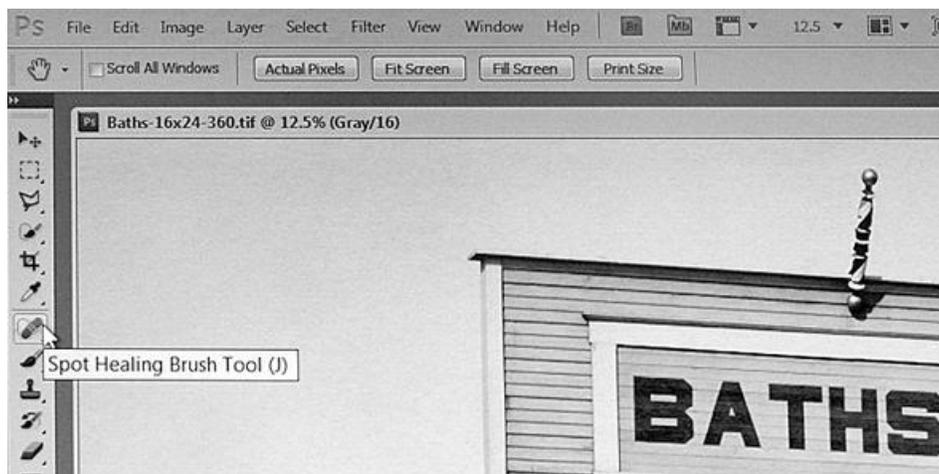
One of the fastest ways to clean up an old photo is to apply a PS filter called “Dust and Scratches.” (Filters>Noise>Dust & Scratches)



By setting the “radius” different sizes of defects are removed. I start at a radius of one on a duplicate layer and often apply that change to much of the final image. Then I apply a larger radius Dust & Scratches and apply that to only the large defect, often in the shadows or plain skies.

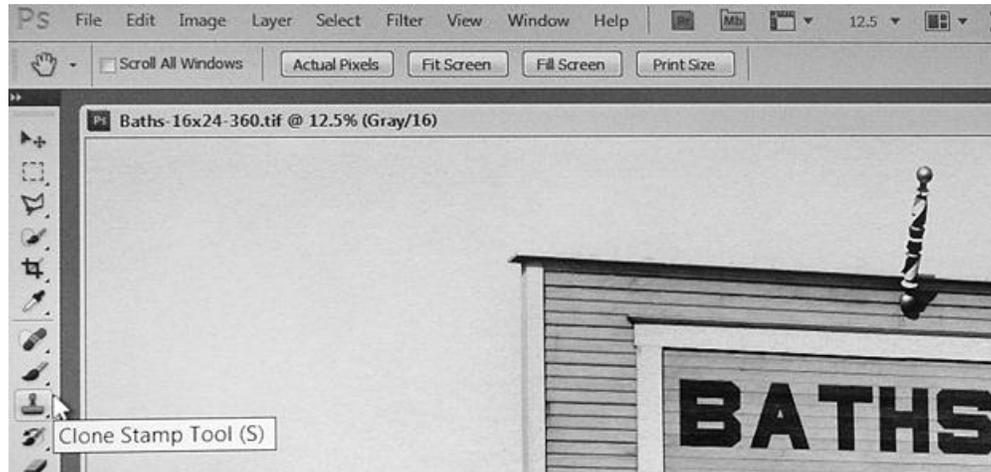
#### 4. Healing Brush

If there is a defect in a plain area or one where people are not going to notice a slight inconsistency, the “Healing Brush” does a reasonably good job of pulling information from adjacent areas and retouching the defect out of existence. However, it is a dumb tool that applies its algorithm or program formula with no understanding of what the effects might be. So, it has to be used carefully if next to an edge or details.



## 5. Clone/Rubber Stamp Tool

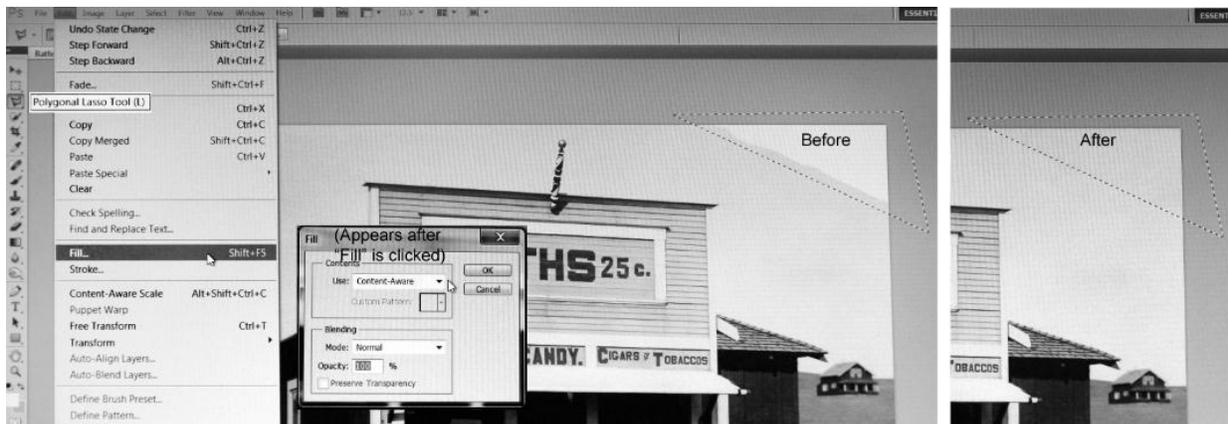
One of the most useful if slower tools is the clone tool.



With this tool one can much more intelligently replace a defect in the image with what common sense tells us was under the defect. Even if the peak of a building has been chopped off by the original photographer, we can use the clone tool to reconstruct the image. Faces can also be reconstructed if they've been damaged. This is, in effect, painting with the textures, values and colors that are in the image in adjacent areas so that they'll match. It's one of the most powerful tools Photoshop contains.

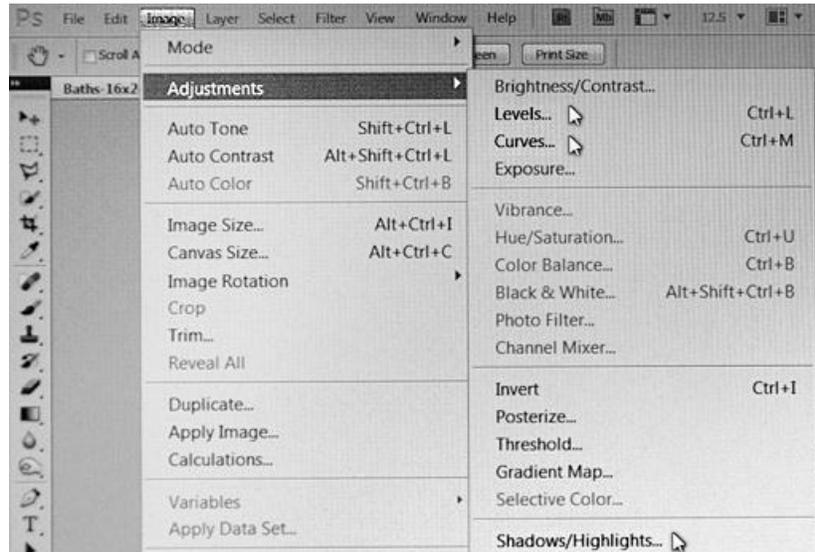
## 6. Content Aware Fill

If a large area of a plain sky, or area like dirt with detail that is mostly a random pattern, is missing, a larger version of the healing brush is the Content Aware Fill tool. (Edit>Fill>Content Aware) For example, if an area of sky is missing, first select that area with the "Polygonal Lasso Tool" in the left hand tool box of Photoshop. Then "Fill" the selected area using the "Content Aware" option. The program pulls from adjacent areas and does a reasonable job of taking care of the missing information. Many images need to be rotated to straighten horizons. Replacing missing edges where they were sky or dirt is rather easy with this tool, which is one of Adobe's latest creations.



## 7. Image Adjustments

There are several Image Adjustments (Image>Adjustments) that are basic and powerful. These change the relative lightness and darkness values of the image.



Two that might seem tempting that I recommend be avoided are “Brightness/Contrast” and “Exposure.” The problem with these is that they can push values and detail out of the image such that they cannot be recovered. Rarely, they are useful, but the danger of misapplication argues against their use in my opinion. Levels and curves can almost always arrive at the same final look without the risks of information loss.

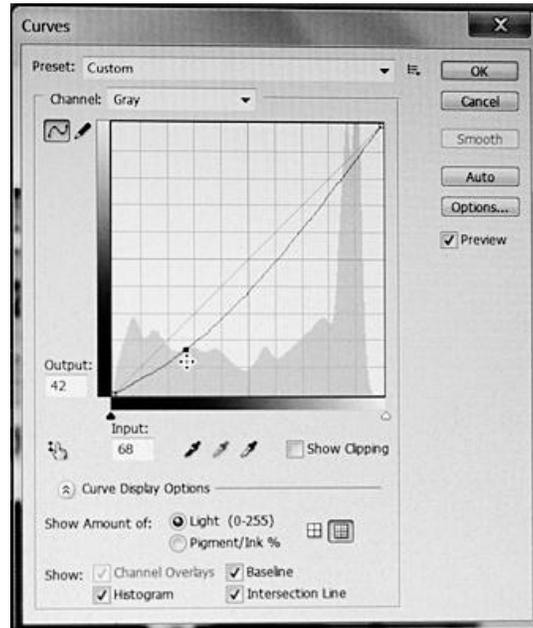
### a. Levels

In scanning the levels adjustment should have fitted the image scale into the file reasonably well, but it can be finished and done more accurately in Photoshop. One important trick is to hold down the Alt key while moving the sliders in slowly from the ends. The monitor will show when and which pixels will be eliminated if the slider is set there. So, one can move the slider in until just a very small amount of pure white and pure black are in the image. An image does need very small spectral highlights that are pure white, but they are generally held down to tiny areas – just a pixel or 2 wide. To see these on the monitor while sliding the Levels highlight marker, have the image at close to 50% magnification. At the dark end the areas of pure black should also be held down, but the size of the pure black can be somewhat larger.

### b. Curves

Image adjustment curves give us powerful tools to alter the image values. While the overall image lightness or darkness can be set by simply grabbing the center of the curve, adjusting localized areas can guide the eye to the areas of the image that are of most interest. Here again I will apply the curve to a

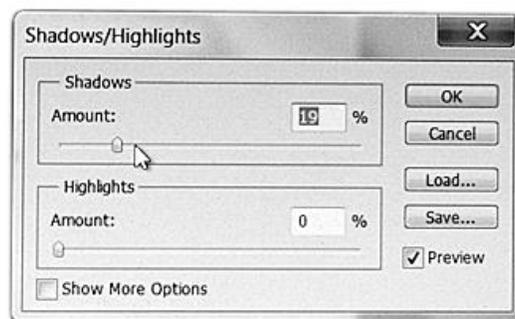
duplicate layer and then “paint in” the effect on the top layer with the eraser tool. The eye is drawn to the lighter areas and areas with more contrast. All of this is done with curves.



Curves have the great advantage over Brightness/Contrast in that information may be compressed but it is not eliminated from the image. With 16 bit image depth, if there is a mistake, there is probably still enough information left to recover the image without even having to go back to previously saved working copies.

### c. Highlights/Shadows

This can be a very useful tool for controlling the shadow and highlight densities.

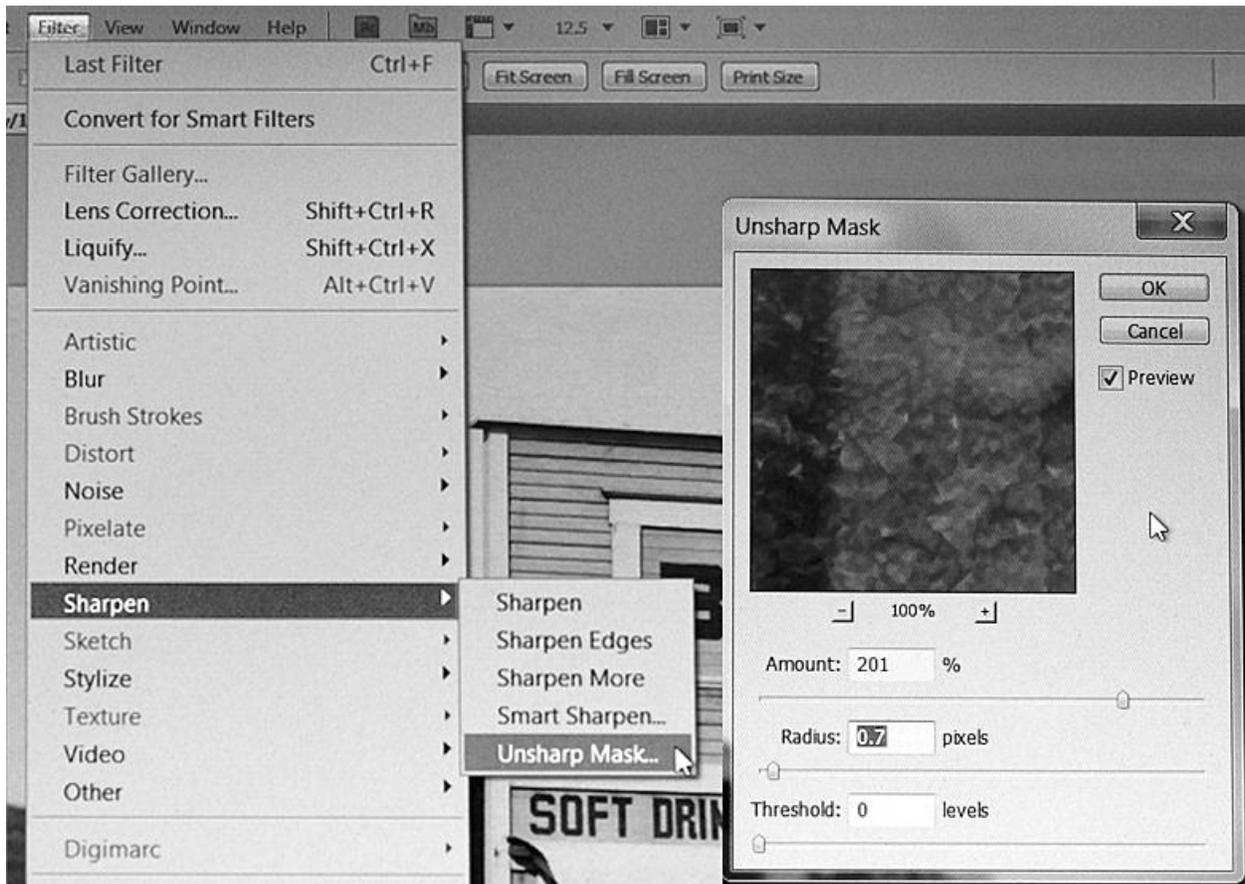


Start with the sliders to the left. The “Show More Options” gets into more complex adjustments. As with the curves, it is best to apply this to a layer and then use the eraser tool to “paint in” the effects only in the areas where it is needed.

## 8. Sharpening

Sharpening an image is one of the first “magic” tools a new Photoshop user often discovers – and over-uses. It is often best to leave this to later in the process and then apply it to a duplicate layer. Then apply it selectively and a little at a time. The problem with sharpening old photos is that it sharpens the defects and dirt as well as the significant detail.

The best basic sharpening tool is the Unsharp Mask method. The “Smart Sharpening” is a variant of this that allows one to, among other things, avoid too-bright areas and halos. However, it’s harder to use and explain. So, I’ll stick with just Unsharp Mask here.



I recommend at least the initial sharpening use a radius of 1 pixel or less. I have the image at 100% to judge how much is needed. Usually, I’ll sharpen incrementally and selectively, using the duplicate layer and eraser method. Also, to avoid over sharpening I like to have the image at 100% magnification. Sometimes I’ll apply sharpening just to critical edges and, on faces, just to eyes, and sometimes teeth and lips.

## 9. Selecting and Fixing Skies and Other Overexposed Areas – Selecting by Color Range

Often we want to apply a tool or effect just to the sky. Using the duplicate layer method discussed above often works well, but if there is a sharp boundary between the sky and image details, being able

to “select” the sky makes it easier to deal with effects close to the edges. Manually selecting a sky with the Lasso tool is very time consuming and often inaccurate. A powerful and often easier way to do it is to select by color range. To do this, use the eyedropper tool to sample the sky just above the horizon or other edge. Then in the top menu bar, click on Select and then Color Range in the drop down menu. This then selects the values that are close to the sampled one. The tool gives you the option to determine the range, and the preview allows you to see what will be selected. In a refinement of this method, one can do this in small steps across the desired boundary, saving the small selections as you go. Then these can be combined into one large selection – of the entire sky, for example.

Once the sky is selected, a number of tools and effects can be applied to just the sky. For example, the dust and scratches can be removed using a rather wide radius because there is no important detail that will be eliminated. On the other side of this, the selection can be inverted (Select > Inverse) so that, for example, the area below the sky is now selected. Then sharpening can be applied to just this area.

## **10. Aesthetic Considerations**

For me, image editing and printing are not just passive, mechanical exercises. Ansel Adams often noted that the negative was the score, but the print was the performance. Although I do not favor digitally altering image content or adding things that were not there, how the information is presented is relevant, and all retouching involves altering the image.

In the role of preserving old photographic images, the ability to affect composition is limited, but light values and contrast can be altered, as can how soft or sharp the image content is. In general, my approach is on two levels.

First, we don't notice things that do not capture our attention. While a flashing red light or motion capture our attention, in black and white still photography we don't have those options. What does work, however, is that we notice patterns and symmetry in an otherwise rather chaotic world. I call this the “macro pattern,” and it is what, in a good photograph, might cause a person to notice it across the room and go up to it to see what is going on in the picture.

Second, once the print catches the attention of the viewer, I want to keep the viewer's eyes in the photo as long as possible; I want to capture and hold the viewer. The more involved the viewer is with the photo, the more s/he is likely to enjoy it. We are information processors and we like to be involved. One advantage of B&W over color is that the viewer must, out of necessity, supply the color, or at least the color is not something that distracts. A B&W photo's lack of color gives it an automatic level of abstraction, and it is probably why many see them as more “artistic.”

To make it easier to enter the image and keep the viewer interested, the nature of our eyes as high speed, spot scanning devices is significant. We spend a lot of time reading from left to right, and when we walk we tend to watch our step. Perhaps due to these factors, the left bottom corner is the easiest entry point for the eye. Once in the photo, the eye tends to go to the brightest, highest contrast points. By having the interesting points slightly brighter and higher in contrast, we can help the eye find them. By shading – making darker – the perimeters of the image we can help hold the eye within the image.

At the same time, these printing techniques need to be used subtly. I prefer that the viewer see only the content of the photograph, not manipulations of it.

## **C. Printing**

### **1. Inks**

Once the image files were cleaned up, retouched, enlarged, and otherwise prepared, the prints for the Elverhoj Museum's Centennial Celebration exhibit were made with an Epson 7800 inkjet printer, capable of handling 24" wide paper, fitted with specialized 100% carbon pigment inks. Unlike color inks, these carbon pigments are essentially fade free.

I've designed a number of B&W inksets that use MIS Associates' carbon pigments.<sup>6</sup> Some of these are 100% carbon, and some are a blend of carbon plus color pigments. For the best longevity, 100% carbon is the top option. Carbon is generally warm, particularly if it is glossy paper compatible. Here we wanted a warm sepia tone to convey the sense of age. So, the glossy compatible carbon was used without any color pigments being added. The combination of the carbon pigments with an acid-free, archival paper results in prints that will last many more years than the original photos.

### **2. Printers**

I use Epson printers, in part, because their piezo-electric print heads are very tolerant of different ink types and generally do a very good job with photographic printing.

I've recently set up the Epson WorkForce 1100 printer with several inksets, including 100% carbon pigments.<sup>7</sup> The WF 1100 is Epson's cheapest printer that takes 13" wide paper.<sup>8</sup> That size printer can make very nice display prints. The WorkForce printer line was designed for high speed text printing, which is one reason the 1100 is now the default printer in my home office.

On the other hand, my main photo printer is the Epson 1400 with Eboni-4 Plus ink in it.<sup>9</sup> The 1400 is an excellent and very flexible photo printer and is supported by QuadToneRip,<sup>10</sup> which is needed to print on un-coated Arches Hot Press watercolor paper and is a powerful stand-alone printer utility that allows advanced users a tremendous amount of flexibility to control custom inksets.

The 100% carbon pigment inks are discussed at length at <http://www.paulroark.com/BW-Info/>. Where longevity is a primary goal, 100% carbon is in a league of its own. For black and white printing, after 100% carbon, the next best inksets are the Epson and Hewlett Packard "k3" printers which have a black

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<sup>6</sup> MIS is at <http://www.inksupply.com/>; a list of B&W inksets is at <http://www.paulroark.com/BW-Info/Inkset-list.html>.

<sup>7</sup> See <http://www.paulroark.com/BW-Info/1100.pdf>

<sup>8</sup> Currently the WF 1100 is on sale for \$130. See <http://www.epson.com/cgi-bin/Store/jsp/Product.do?sku=C11CA58201>

<sup>9</sup> See <http://www.paulroark.com/BW-Info/Eboni-4-Plus.pdf>

<sup>10</sup> See <http://www.quadtonerip.com/html/QTRoverview.html>

and 2 gray inks (e.g., Epson 2880). The Epson, HP, and Canon pigment printers and inks are also the best for color printing where longevity is an issue.

I've recently made an experimental B&W inkset from the Noritsu-Epson inks used in the commercial "dry lab" printing market. These are like the Claria inks and are not as lightfast as the pigments discussed above. On the other hand, Wilhelm Research<sup>11</sup> claims they have a 98 year display life under glass and are good for 200 years in dark storage, which is very good and amazing in light of the fact that these inks are composed of the latest advanced dyes. The Claria printers make nice color glossy prints, but in their standard form the B&W prints are not very good. My experimental B&W advanced dye inkset looks like it'll be a winner for glossy printing, where pigments tend to have some artifacts that interfere with the image.<sup>12</sup>

### **3. Paper**

The paper used for printing makes a major difference not only in how the image looks but also how long it will last.

#### **a. Matte v. Glossy**

The two basic categories of paper are matte and glossy. Often with the best inksets these paper types require different inks. For example, most good pigment printers have 2 different black inks. "Photo black" ("PK") is needed for glossy paper. "Matte black" ("MK") is needed for matte paper. The MK will rub off the glossy paper, and the PK makes a very weak black on matte paper. The 100% carbon inkset I use most – Eboni-6 – is made from MK and is, thus, compatible only with matte paper.

All inkjet paper is coated with an inkjet receptor coating that pulls the water straight down into the coating and, particularly with good cotton paper, the paper base. This stops the horizontal spread of the ink across the paper and makes the surface of the paper dry very quickly.

Some, myself included, think the coatings are the weakest links in these papers when longevity is a concern. Laminations tend to separate and crack from differential expansion and contraction due to temperature and humidity changes. So, while Wilhelm Research rates some papers at over 300 years, my contacts with people familiar with accelerated age testing suggest that there is much uncertainty in the tests, which generally do not cycle the variables that cause the most trouble.

Glossy papers are mostly "RC" (resin coated) types. They are paper that is sandwiched between layers of thin polyethylene. The plastic allows a very smooth surface and keeps water out of the paper core. Some of the latest "glossy" types of paper are starting to use a construction more like the old wet darkroom fiber papers. All of these papers are coated, and some are much more complex laminates than the matte papers, which might, in my view, affect their longevity. RC papers got a very bad reputation in their early days in the darkroom. I continue to be skeptical of them and use them only for snapshots, where the high gloss makes an impressive image, particularly with the B&W dyes.

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<sup>11</sup> See <http://www.wilhelm-research.com/>

<sup>12</sup> See <http://www.paulroark.com/BW-Info/BW-Dye.pdf>

Some people do print on un-coated papers. My favorite in this regard is Arches Hot Press watercolor paper. It is about the only un-coated paper than can give a good, deep black (high “dmax” or maximum density). It is time tested and will probably have better longevity than any inkjet paper. It does require that a “rip” (“raster image processor”/special printer utility) like QuadTone Rip<sup>13</sup> be used to print it, and it does not print as smoothly as the good inkjet papers. However, if I were to bet on what image might still look as good as new 500 years from now, it would be 100% carbon pigments on Arches watercolor paper.

#### **b. Acid Free & Buffered**

Traditionally, and still, the number one issue with respect to longevity is whether the paper is acid free. Cotton, which is nearly pure cellulose, is acid free. That is why “rag” papers have traditionally been considered the best.

Cheap papers are made from ground-up wood. What makes wood stiff is the lignin. As lignin breaks down it produces acids which will attack the cellulose fibers. Amazingly, Epson marketed a paper called “Archival Matte” that had about the same acidity as vinegar. The current version of this paper is “Ultra Premium Presentation Paper Matte.” It can look good, but stay away from it for photos you want to last.

Paper made from wood can have the lignin removed and can be acid free. These papers are called “alpha cellulose.” Traditional wet darkroom papers were made from these. When highly calendared, they tend to absorb less water than cotton.

In addition to not having lignin in the paper, good paper needs to be buffered to counteract the airborne acids that will attack even good cellulose papers. This buffering is usually calcium carbonate. Most good inkjet papers are acid free and buffered. One of the major problems with the old darkroom paper is that even the good ones could not be buffered. The acidic chemicals used in processing would not allow it. As such, the traditional silver prints are being attacked by airborne acids and will probably not last as long as today’s carbon pigment prints on cotton based paper.

Epson Premier Art Scrapbook paper is a good example and a bargain for a paper of its archival quality. Epson claims its Scrapbook paper is its most archival paper. Its thicker sibling is Premier Art Smooth Hot Press 325. We used both papers in the Elverhoj project. Similar papers are the Epson Hot Press papers (natural and brightened).<sup>14</sup>

#### **c. “Natural” v. Brightened Papers**

Most papers contain “Optical Brightening Agents” (“OBAs”). These OBAs are dyes that absorb ultraviolet light and re-emit that energy as bluish light. They, thus, make the paper look brighter.

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<sup>13</sup> See <http://www.quadtonerip.com/html/QTRoverview.html> - Note that the Epson 1100 is not supported by QTR and cannot make a good print on Arches watercolor paper.

<sup>14</sup> The best prices for paper are usually found at [www.atlex.com](http://www.atlex.com) .

Actually, the paper is bluer and generally reflects less of the visible light spectrum than does “natural” (no OBAs) paper.

The OBAs, being a traditional type of dye, fade quickly, making the paper warm up. Some may interpret this warming as a sign that the paper is acidic and cheap, but I have seen no evidence that OBAs damage the paper; they simply fade. As such, a brightened paper will end up looking like a natural paper and may last just as long. I understand not wanting a paper to warm up, but on the other hand, I like some of the brightened paper and use a fair amount of it. Traditional darkroom papers often had some brighteners in them. One of my favorite brightened inkjet papers is Premier Art’s Smooth BW Fine Art paper.<sup>15</sup> It has a buffered cotton base that is itself quite white, and the paper gives the most neutral tone with my favored 100% Eboni-6 inkset.

#### **4. Storage of Photographic Images**

Briefly, acids and physical damage are among the top risks to old photos. The acids come from more than just poor print paper. The mounting board and wood frame may also be acidic, and acids also migrate through the air. In addition to airborne acids, gas attack can happen from oxidizers like ozone and other chemicals/pollutants. While fading is usually associated with light, the light is usually simply accelerating the oxidation.

To guard against physical damage, one thing I do as quickly as possible with a new print that is important and not immediately framed under glass or acrylic is to put the print in a Mylar or similar clear, non-outgassing bag or envelope.<sup>16</sup>

Should old photos be bagged also? Many should not be. If there is acidic paper in the print or mounting board, the bag will keep the acids in the bag that might otherwise have migrated out into the air. One book conservation article indicated that in a test books with acidic paper deteriorated 10 times faster when sealed in a bag than if they were left out in the open air.

Acids migrate through the air. As such, to protect photos in storage, they should not be in the same container or near acidic papers. Well processed darkroom prints I made in the 1980’s that were stored in a metal file cabinet that also contained some file folders that were acidic showed yellowing, starting at the outer edges of the stack of prints and migrating inward toward the center. This is a major problem with the old silver prints. They are not buffered against acids. As such, they are subject to airborne acid attack. While conservators do not like prints to be dry-mounted, those that are dry-mounted to buffered mat board appear to be aging better than those that are loose. Buffered interleaving would probably have the same protective effect.

Acid free, buffered storage boxes are available from a number of sources.<sup>17</sup> Buffered interleaving is probably a good idea between acidic prints. Buffering can damage color dyes, but unlike the acids,

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<sup>15</sup> See [http://www.premierimagingproducts.com/pm\\_smoothbwfineart.php](http://www.premierimagingproducts.com/pm_smoothbwfineart.php)

<sup>16</sup> See <http://www.clearbags.com/crystal-clear-bags>

<sup>17</sup> For many years I used <http://www.lightimpressionsdirect.com/> as a source for this type of material. In recent years they may have been having financial problems.

buffering materials do not migrate. So, unless they are in direct contact with the color materials they will not hurt them.

Having copies of precious family photos with relatives is probably the best guard against fires. Bank boxes and fire safes are also often used for the most precious old photos or the reproductions of them.

Some photographers who want to preserve their work for later generations are making books, printed with carbon inks on good acid-free paper. Being bound in a book might be about the best way to preserve a body of work, keep it together, while still making the images accessible. The scrapbooking industry is large and has a number of resources that might be useful in this regard. Note that the paper we used for part of the Elverhoj photo history project is the Epson "Scrapbook" paper. It can be purchased in 12 x 12" sizes such that both vertical and horizontal photos can be reasonable sizes in a scrapbook.

Of course photographers today also try to preserve their digital images on some digital storage medium. Many use multiple CDs, DVDs and now Blue Ray disks.<sup>18</sup> We keep one copy of the most important image disks in a bank box. We also use multiple hard disks. An external hard disk for backing up a computer is now standard practice. Some of these are such that a copy of the all the data directories in the computer can be copied to the hard disk, and it can then be stored in a bank box. However, some experts warn that hard disks need to be used every 6 months or so to keep them functioning, and all hard disks ultimately fail.

Storage and back-up of image files on electronic or magnetic media is necessary, but whether these should be considered long-term archival copies is questionable. How many 5 ¼" floppy disks have you put into your computer lately? Do you have any faith they would be any good even if you had such a drive?

I believe a photographic print is a more reliable form of archiving, and be sure to record what they photos are of on the back of each.

Nothing lasts forever, but carbon pigment images on buffered cotton paper comes as close as we can probably get, and this medium is available to us all. Don't let those old images fade away.

Enjoy.

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<sup>18</sup> Some CDs have been specially manufactured for longevity. Search for test results, not all are equal. The higher the resolution of the disk, the lower the reliability seems to be. Blue Ray is not yet accepted as archival by most.