# Dealing with Photographs in a Digital Age

Highland Family History Fair

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## Executive Summary

The "Digital Age" has radically changed photography (mostly for the better). We can get better results, and we can share photographs in ways that were previously not possible. Embracing the benefits of digital photography presents at least a couple of challenges: bringing yesterday's analog (film-based) photographs into the digital realm, and optimizing the sharing and preserving of our (now digital) photographs. This course will (1) present a survey of the benefits and challenges of digital photography, (2) discuss strategies and techniques for scanning our older photos to make them digital, (3) explore printing options, and (4) present workflow suggestions for minimizing frustration and maximizing efficiency and preservation of our digital media (including photographs and video).

## Introduction

This class is an updated version of "Scanning, Printing, and Preserving Digital Photographs", which I have taught the previous 3 years at the Highland Family History Fair and in community workshops. This update was precipitated by (1) the significant advances in the technologies available, and (2) the fact that certain challenges are becoming more prevalent with more people owning digital cameras. After years of clinging to the increasingly futile quest to cover everything in a single class, we will now focus more deeply on fewer aspects of digital photography — aspects which are most relevant in the family history context. Because some of the previously covered material is no longer presented in this class, I am building up the tutorial content on the www.YoSemiTek.com website to help fill in the gaps.

## Benefits and Challenges of Digital Photography

The digital photograph has become the new normal form for photography. As a photographer and a computer scientist, I saw this coming many years ago, but it happened faster than even I predicted. Last year I stopped using film completely — even for my professional work. Because film is nearly obsolete, many of the rules of photography have changed, and it is worth noting how these changes affect us — particularly as we strive to incorporate digital photography into our family history efforts.

When in digital form, a photograph is very amenable to computer-facilitated alterations. As Sterling Sudweeks demonstrated in recent years at this fair, defects such as scratches, stains, color-fading, and tears can be repaired very easily and convincingly with average

home computer and software technology. A digital photograph can be stored in very little physical space, and can be replicated at essentially no cost to family members and friends. Digital photographs can be quickly shared through web sites and e-mail, and we can even have picture frames which automatically cycle through the display of multiple images.

With digital cameras, we are able to take pictures without concern for costs of film and processing (so we can take many more photos), and we can get immediate results — adding to our satisfaction and confidence in knowing right then and there that we got the picture we wanted. The costs of digital cameras has come down to the point that an overwhelming majority of new cameras purchased today are digital, and the leading camera manufacturers have stopped making film cameras. The form-factors for digital cameras have also changed to become much more convenient (including pocket-sized, or built-in to our cellular phones). The resolution (ability to record fine details) of digital cameras has steadily increased to well beyond what we could achieve with film in a similarly sized camera.

Along with all these benefits come some challenges with the digital realm. First, we're not archiving our photographs. Not that all printing is archival, but we are printing a smaller percentage of the photographs we're taking; an unprinted digital picture can be much less likely to survive for future generations than a printed picture. Second, we're struggling to organize our digital photographs; yesterday's shoebox full of photos has become today's stack of CDRs or hard drives full of photos. Third, gaps in our understanding of the underlying technologies involved often result in lower image quality (and satisfaction) than we could get with film. Fourth, many of us are straddling a fence separating the analog (film-based) and digital realms, with sizeable collections of photographs on both sides of the fence.

While the benefits of digital photography will (for most of us) outweigh the challenges, we still need to deal with the challenges. The next three sections of this document address a few of the major challenges we face.

## Bringing Older Photos into the Digital Realm

Because of the benefits of having our photos in the digital realm, we often turn toward scanning technology (or services) to make digital files from our hardcopy prints. Scanners have been around for many years. Some of the flatbed scanners have become quite cheap (as well as inexpensive), but most are able to produce some excellent results when applied to "digitize" our older prints and slides.

Scanners have two types of resolution that are important to consider: (1) spatial resolution (usually expressed in DPI (dots per inch)), and (2) color resolution (usually expressed as bit-depth).

With spatial resolution, we're looking at the ability to capture fine detail, which is especially important when we want to (a) make a print (a copy of the original), or (b)

enlarge the photo (or a portion thereof). How much resolution do I need? To answer this more precisely would require a discussion of line screen frequency, image detail frequency, and output resolution — all topics beyond the scope of this class. Instead, we can use certain guidelines to help us in determining how much resolution we should strive for. Generally, we would like to get 300 dpi (dots per inch) of data in the final (desired) output image for hardcopy prints, and 72 dpi of data for online (e-mail or web-based) presentations of our images. But that 300 dpi figure doesn't automatically translate into needing 300 dpi in our scanner. In fact, the requirement on the scanner may be much higher. We can illustrate this in an example:

Consider that we have a 4"x 6" original photo that we want to digitize (scan) and make into a print. If the final print we want is 4" x 6" — which is the same size as the original — then all we need is 300 dpi from our scanner. On the other hand, if we want to make a print that is 8" x 12", then we need to scan our 4" x 6" original at 600 dpi, producing an image that has 2400 x 3600 pixels so that when we stretch that image to twice its current size (from 4"x 6" to 8" x 12"), those 600 dpi will be stretched into having 300 dpi in the final print. Conversely, if we had started with that same 4" x 6" original and only wanted a 2" x 3" print, we would need to scan the original at 150 dpi, producing an image that has 600 x 900 pixels so that when we compressed the image gown to one-half its original size, we would have 300 dpi in the final print. If we had started out with a smaller-size photo (say 2" x 3") and wanted to go to an 6" x 9", we would need to scan the original at 900 dpi, producing an image that has 1800 x 2700 pixels, so that when we stretch the image to three times its current size (from 2" x 3" to 6" x 9"), those 900 dpi will be stretched into having 300 dpi in the final print. For tiny images or 35mm slides, we can often use resolutions as high as 4000 dpi.

Note that with the arrival of higher resolution digital cameras (with more megapixels of resolution), you may get by without a scanner by just using your digital camera to "take a picture of a picture". For example, an 8 MP (Mega Pixel) camera (with a resolution of 3504 x 2336) can nearly make an 8" x 12" picture at 300 dpi. Thus, anything you can take a picture of could be turned into a print up to 8" x 12". With macro lenses or close-up filters, you can easily produce 8" x 12" digitized photos of originals much smaller than the final 8"x 12"

Color resolution refers to how smoothly the scanner can respond to (and record) differences from one color to the next. Normally, 24-bit color (8 bits of resolution (for each R, G, and B (Red, Green, and Blue))) can produce a smoothly toned photograph without any visible blocks of color. However, a low-contrast photo may have tones that all lie within a fairly narrow range, and you would like to expand that range in the final print. In such cases, you won't be using all 24 bits of color information when scanning the photo. Then, when you go into a program like Adobe Elements or Photoshop and want to spread out the tonal values (to increase the contrast), you will see blocks of color emerge in the final (contrast-expanded) image. For this reason (to enable contrast adjustment), you want the highest color resolution possible with the scanner.

Two more features of a scanner are worth mentioning. The first is how it connects to your computer. If it uses USB (version 1.1), then your scanning times will be very long. You should look for USB 2 and/or FireWire (a.k.a. "IEEE 1394" or "iLink"). The second feature is Digital Ice. This is a technology licensed to certain scanner manufacturers (and usually only put in their highest models) which provides scan-time correction of dust and scratches, as well as remarkable correction for color-faded originals. You can get by without Digital Ice, but for all the time it saves in Photoshop, I won't buy another scanner without it.

## Printing Options

When we want to produce an hardcopy print of a digital image, we can choose to use our own computer, software, and printer, or we can choose to use an out-of-home printing service.

The home-based approach, while not generally economically justifiable, is very popular because of the convenience. The best color prints are coming off of inkjet printers. These have sold extremely well during the last few years and have become quite inexpensive. It is the $10,000/gallon ink that these printer manufacturers sell you where they make their money. Still, the convenience of having your own color printer is often a strong enough reason to buy one. When buying, consider getting one that uses pigment-based ink (instead of dye-based ink). The pigment-base ink is considerably more archival (sometimes over 100 years' fade resistance) than dye-based ink (sometimes as low as a few months' fade resistance). Pigment-based printers are more expensive than their dye-based counterparts, as are the pigment-based inks. For family history and archiving purposes, the extra expense is well justified. Epson used to be the only manufacturer of pigment-based consumer printers, but lately Canon and HP have joined Epson in making available pigment-based printers. When selecting paper, going with the printer manufacturer's paper (especially one of their higher-end papers) can be a good choice for maximizing image quality and the fade resistance of the print. The manufacturers' papers are often engineered to match well with their inks. The use of other high-end papers can often be successful after doing some color calibration.

With out-of-home printers, you can save a lot of money. 4"x6" prints have been made available for as little as 9¢ each. Most often with out-of-home printing, you are looking at a chemical photo process (instead of inkjet). That's not necessarily bad, but the paper and processing used will strongly determine how archival the resulting prints will be. Fuji Crystal Archive can achieve better than 60 years of fade resistance, which is about as good as it currently gets for color chemical processes.

## Tuning Workflow to Optimize Sharing and Preservation

How you work with your digital photographs can have tremendous impact (for good and bad) on your stress level, quality of results, ability to share, and ability to preserve your photographs.

When using a digital camera or a scanner, you often have a choice over the image format used to store your images. JPEG is extremely popular (often the default format available in a camera) largely because of its great compression ratios; it is common to have a JPEG take as little as one-tenth as much space as a similar TIFF (uncompressed) image. With such compression ratios, you get more pictures on your memory cards and onto your hard drives and CDRs. Unfortunately, that compression ratio comes at a couple of costs which are often painful to bear. First, JPEG uses a "lossy" compression technique. This means that, once compressed, a JPEG cannot be restored perfectly to a previous version of your image. Everytime you open, modify, and save a JPEG, it is recompressed and degrades farther from the original. Second, JPEG has visible compression artifacts. This will often occur near boundaries between areas of lots of detail and little detail (for example, a leafy tree top against a blue sky), and can look like a ghost of the edge of the detail showing up in the area of little detail. For these reasons, JPEG should be avoided for photographs you care about; TIFF or RAW are often better choices.

In most cases, the best results when working with digital photography will involve your computer and image-editing software. Many of the editing operations you may perform are destructive in nature (they cannot be reversed). For this reason, it makes sense to save a copy of the digital image before you work on it. This way, if you accidentally do something that is not very undoable, you will have the original to fall back on. Then, periodically, as you are about to perform a destructive edit operation, save another version of your file so you have something to come back to. If you're using RAW as your image format, there are new software applications (Apple Aperture and Adobe Lightroom) that allow you to make extensive changes to your image while preserving the ability to revert back to the original state. You should still not work on the original, but at least you won't have to make as many copies thereafter as you perform edit functions on your images. Aperture and Lightroom both offer excellent tools for managing many large collections of images.

There is a powerful (and dangerous) tool available through many different image editing programs: unsharp masking. This tool can make prints that are slightly soft (out of focus) snap back into sharper focus. That's powerful! The dangerous parts of this tool are (1) it can be overused (used with settings that are too strong), and (2) it can introduce new artifacts into your image, and subsequent edit operations will often accentuate these artifacts. When using unsharp masking, zoom your photo up to 1:1 resolution (a pixel in the image is represented by exactly one pixel on your display) so that you can see in great detail what the tool is doing to your image, and make sure that unsharp mask is the last operation you apply to your image.

Once you've done the editing to make your photo look its best, you'll want to share it with others. E-mail can work very well for this if your photos are small (the file size is low). If the file size is large (and/or you have many of them), you may place some strain on your e-mail provider as well as your connection to the Internet. And, most importantly, it can place a strain on the e-mail provider for your recipients. Here is where JPEG with its 10:1 compression ratio can be useful. Another technique, frequently

employed by online photo-sharing services, allows you to upload your photos to their site and then send e-mail links to friends and family. The links are fairly small (in terms of data storage size) and thus not presenting a burden on either your or your recipients' e-mail providers. These links allow the recipient to view the photo in a web browser.

Finally, you will want to preserve your photographs for future generations. Unless we reduce our digital photographs to hardcopy, paper-based prints — where we know what to do to preserve them for generations — digital photographs will have to be stored onto some digital media. The storage media for digital photography and other digital/computer data are most often magnetic (tape, floppy disc, Zip disc, hard disc) and optical (CD, DVD, and magneto-optical). Magnetic media is not particularly good for long-term storage as the magnetic fields tend to fade (or bleed), and are vulnerable to radiation, magnetic fields, heat, and oxidation. Optical media can be much better than magnetic media, but it still isn't archival; the CDRs and DVDRs that we "burn" on our home computers have a lifetime ranging from a few months (especially if we label them with Sharpie pens) to a few years. Magneto-optical discs, once regarded as the best long-term choice, had an estimated life of 25 years. We're nowhere close to being able to preserve digital photographs as long as paper-based media. Technology preservation ought to be as big a concern as media preservation. Digital media are generally not "human readable" (that is, viewable with our eyes and without the aid of technology), digital photographs are currently technology-dependent. It does us no good to preserve digital photographs if we don't have the technology available to "play" that media.

If we are serious about preserving our digital photographs, we have a few choices. First, we can punt altogether and just make a set of really nice hard copy prints, using the most archival paper and processes available (such as pigment-based inkjet) and then distribute the prints to different locations (including outside of your house, such as to friends and family, safe-deposit boxes, etc.), keeping each such print in a cool, dark, and dry location (and avoiding polyvinylchloride bags and covers). This loses all the malleable properties of having had the photograph in the digital realm, but at least the final result can be preserved according to techniques we've developed over many generations. Second, we can use a digital photograph archiving service. There is at least one company that will continually renew its storage of your digital photos by putting them onto magnetic tape each day and putting that tape into a granite vault; there is cost involved, but at least the data should be available into perpetuity. Third, we can employ a data migration strategy. Periodically (well before data corruption can occur on our chosen media), we should copy the data to the then-latest and greatest technology — even if it ends up being on the same media that the last version was on. This ensures that our data is moved to fresh media before corruption can occur, and it ensures that our technology (to read or play) the data remains relatively current. For CDR and DVDR, I recommend doing that periodic update every 2-3 years.

## Resources and Additional Information

### Scanner and Printer Manufacturers:

www.epson.com
www.canon.com
www.hp.com

Continuous Inking Systems:

www.inkjetart.com
www.mediastreet.com

General (and detailed) information on inkjet printing, including papers, printers, and inks:

www.inkjetart.com

Excellent Text on Digital Printing:

Harald Johnson, Mastering Digital Printing, Cincinatti, OH, Muska & Lipman Publishing, 2003. ISBN 1-929685-65-3. (See also newer 2nd Edition!)

Excellent Text on Workflow for Digital Photograph:

Ken Milburn, Digital Photography Expert Techniques, 2nd Ed., Sebastopol, CA, O'Reilly Media, Inc., 2007. ISBN 0-596-52690-3.

Excellent Text on Editing Digital Photographs:

Stephen Johnson, On Digital Photography, Sebastopol, CA, O'Reilly Media, Inc., 2006. ISBN 0-596-52370-X.

Independent Lab Testing Paper & Ink Fade Resistance:

www.wilhelm-research.com/

Slightly Dated Reference on "Archival" CDR's:

www.silverace.com/dottyspotty/issue12.html

Reference on Phthalocyanine:

www.mam-a.com/technology/cd/organic_dyes.html

Source of "300-year" CDR (I'm skeptical):

www.delkin.com/delkin_products_archival_gold.html

Sources for Taiyo Yuden DVD-Rs:

www.meritline.com
www.supermedia.com

Sources for Inexpensive Online Printing:

www.costco.com (click on "PHOTO CENTER")
www.samsclub.com (click on "Photo Center")
www.familyart.myphotomax.com

Personal Site for Sharing/Blogging Information on Photography:

www.YoSemiTek.com