An Alternative Approach to Conserving Digital Images into the 23rd Century

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Re-thinking methods for Museums, Galleries and Institutions to Archive their most vital images and documents as resized hard copy ink jet artefacts to increase likelihood of their survival into the 23rd Century in a format that is easy and inexpensive to achieve.

*Conservation. Archiving images and documents. Pigment ink jet printing. Digital storage and retrieval.
Baryte acid free papers.*

1. INTRODUCTION

The best archiving practice for Silver Gelatine prints and negatives from the early beginnings of photography to contemporary images, is very well established by Curators worldwide. Many Victorian photographers were, in their own time, concerned to take steps to avoid the fading of their photographs, although this was simply as part of their normal commercial practice. The fact that dyes in post-war colour negatives and transparency films would begin to fade in a mere 50-70 years, even in controlled conditions, was probably less anticipated by photographers of their particular era.

The vast majority of the world's digital image files are presently stored outside of professional archives, ensuring that their makers will be very lucky indeed if they can still be accessed and viewed in a mere five or ten years hence. We may therefore conclude that, while many millions more photographs are taken nowadays worldwide, our grandparents colour negatives of the 1970's are likely to out-live most of our modern digital pictures while our great grandparents family albums of black and white prints from the 1870's, may last longest of all three.

Mike Seaborne and Graham Diprose are researching the idea of selecting and then sending our most vital art-work, digital photographs and documents forward into the 23rd Century, as ink jet print 'artefacts' rather than digital data, reducing them in size, and later recovering them with minimal loss, using either high resolution camera or scanner technology,

We are not claiming that this should be instead of archiving digital data on Raid disks, but in addition, as a vital form of insurance that the image or document will survive. While not everything can, or should be saved in this way, at least WE get to select what is sent forward in this way, WE would get to choose what should be archived. Otherwise we are left to hope that our grandchildren's sons or daughters will be equally discerning when it comes to job clearing a few Terabytes more space on the Museum's creaking servers in 2099 and deciding what has to go.

2. THE DIGITAL PRINT DEBATE

We are all very indebted to the work of the Wilhelm Institute for its research into the fading of silver, dye based and digital images. Over the past twenty years, it has meticulously mapped the expected longevity of a silver based colour print against the development of new ink jet, dye and pigment technologies.

A very simplistic summary would be that ten years ago, the life of digital ink jet prints was around a third of a darkroom colour print. Somewhere about five years ago, both technologies could claim about one hundred years life, given careful storage. Now certain combinations of acid free ink jet papers and pigment inks, can lay claim to a possible life of over 250 years, or maybe even longer for a monochrome image made up mainly from carbon based black inks, printed onto acid free Rag and Cotton papers.

To this day, the fine art market for photographic prints, particularly in the US, appears to remain extremely sceptical that ink jet prints can be longer lasting than silver- gelatine. However, the raising of this debate has led to a number of technologists and scholars suggesting that ink jet prints may be the safest way to archive digital images into the distant future. Unfortunately, up until now, this has looked like a massive and prohibitively expensive task and has received little support. The dilemma is that most of the digital data archiving and migration alternative proposals look equally as hair-raising.

3. DIGITISING THE IMAGES TO 'SAVE' THEM

Many of us are aware of, or have bid for, funding to 'digitise' existing photographs and art work to 'save' them for posterity. At least, this usually achieves the other major role of archiving, namely to offer much wider public access, either for museum and gallery visitors or, online. The National Lottery funding of English Heritage's 'Viewfinder' project and website is one excellent example, from many thousands world-wide, that allow massive collections to be explored from the comfort of our own arm-chairs, or even on the move, using our shiny new tablets. <http://viewfinder.english-heritage.org.uk/search/basic.aspx>.

One of the Viewfinder photo essays is based on Graham Diprose and Jeff Robins documentary project "...in the footsteps of Henry Taunt ", the Victorian Photographer who first made guide books to the River Thames. Our website is <http://www.henrytaunt-footsteps.co.uk/>

The catch is that many archivists remain concerned that there is a fair chance that the original print or artefact will still be around, long after the digitised file that was designed and funded to 'save the image for posterity, is long gone.

4. SO WHAT CAN POSSIBLY GO WRONG?

Raid technology remains excellent and digitised files can be stored on several servers in different parts of the world. So it would be wrong to say that many Conservationists are not making their very best effort to preserve these virtual, digital files. However, we live in very uncertain times. Extreme Weather Events, Earthquakes, Power and Water Shortages, risks from the effect of Sunspots and Solar Flares and Cyber Attacks on a countries Economic and Cultural Centres, are no longer the stuff of Science Fiction, but in our everyday news.

Any of us who have ever suffered from a hard drive failure on a home computer or losses of data from a server failure at work, will already be very aware of the ultimate fragility of our very virtual, digital

data. Even if we store our valuable Tiff files across many raid disks and servers in different corners of this planet, there is no guarantee that technology will not have moved on to the point where they are totally unreadable by the unimaginable digital imaging hardware and software of 50 or even 25 years time. New Gold CD-Rs may have a 100 year life, but will there be disk readers in 50 years time?

Very few Museums are tempted to save their valuable server space by using LZW Compression, simply because they believe that it may not be readable or supported in 25-30 years time.

Formats such as Jpeg 2000, once hailed as a breakthrough, are now long gone. An Adobe 'In Design CS2 file' is very unlikely to open into Adobe CS5, let alone CS10. While most of the world's Museums and Gallery's favour un-compressed Tiffs, we already are hearing very strong arguments for storing data as Raw files and moving towards this format for manipulation through non destructive editing; and, also using Raw formats for digital archiving. Whether any Raw format, such as Adobe DNG, becomes a world standard or not, this illustrates the problems of sending digital images two hundred years into the future as pure data.

5. CAN YOU SERIOUSLY TRUST YOUR GREAT GRANDCHILDREN?

To send digital data files into the 23rd Century will require 7-8 generations of our grand-children to select 'Our Project', from the limitless number that will have been archived since and that will be vying for the same server space. How can we be sure that the Paintings, Photographs and Design Artwork, that we consider to be significant to conserve in 2011, will have any relevance to our children's grand-children in a hundred years time? They might however, have been seen in a different context and of massive interest to our grand-children's great grand-childrenexcept, of course, they will have been cleared off of the servers to make more space, long before that.

Even if we take a very conservative and linear view of future developments in technology and assume that there are no more than two radical changes in file formats per generation, our present image data files are likely to need to be migrated and re-archived in technologies utterly alien to our comprehension, some 15-20 times between now and the start of the 23rd Century.

We will also need to hope that data storage resources will increase exponentially as the years pass, while costs of manufacture, transferring files and data maintenance all will need to plummet. Otherwise how can we continue to afford to archive

our 2012 London Olympics images when much of the interest has waned or been superseded by the new images from more interesting contemporary events taken in the year 2199.

There is a considerable danger in assuming that Museums will have the funding to buy all this extra digital storage space and to pay staff to manually migrate our pictures over and over again, when in 2011 many, or dare one say most, are already looking very economically fragile?

The conclusion is that vast swathes of our 2011 projects, history and culture are going to be consigned to the 21st Century digital trash can. Equally as likely is that they will face a slightly more lingering and no less horrible death, as the last hardware readers of a long outdated format cease to function, long before any migration can occur.

6. PROBLEM, WHAT PROBLEM?

At least most Museums and Galleries are very aware of the problems of archiving digital files. One doubts that this issue is even 'on the radar' of many Multi-national Companies, World Governments, Financial Organisations or parts of the Legal Profession. Vital documents such as ninety nine year property leases, thirty year loans or mortgages, or Government Trade or Peace Treaties are probably all run out on the office Deskjet, oblivious to the bleak chances of survival of either their printout, or digital files. We have all pulled some previously important old fax out of an envelope to find that it has totally faded away.

An organisation may have superb firewall security, but that does not mean that mechanical or magnetic Gremlins cannot attack from within, even if their IT dept. do manage to keep the ever more inventive external hackers out of their servers.

7. LEARNING FROM OUR PAST

The archivists of Tudor England or Renaissance Florence would be very heartened by large amount of artefacts, paintings, documents and later, books, that have been carefully passed down from the care of one generation to the next, for us to enjoy and study today. Inevitably, there have also been many major losses to wars and revolutions. We should also consider that many important works now require major restoration because of a poor original choice of pigments, varnishes, paper or other media, or simply through bad storage. However, the fact remains that every Museum Curator is surely much more confident about how they will archive real 'artefacts' to send forward two hundred years, than how they will achieve the same goal with any of our virtual digital data files.

8. ARCHIVING PROJECTS AS INK JET PRINTS EXAMPLE 1 "...IN THE FOOTSTEPS OF HENRY TAUNT"

In September 2007, Graham Diprose and his colleague, Jeff Robins were invited by English Heritage (National Monuments Record), Swindon, to archive their new digital photographs of the River Thames, taken from the exact same location as those of Henry Taunt 125-150 years previously.

We became concerned that there was a risk that Taunt's original Silver Gelatine Photographs, already archived in cool dry acclimatised conditions, would outlast our new digital Tiff files by many decades. We were able to convince Mike Evans, Head of Archives at E.H. NMR, to also take our project as Ink Jet Prints as well as data files. This was one of the first times that EH had agreed to archive digital photographs as ink jet prints.

Figure 1: Strand on the Green, Henry Taunt (1878) and Graham Diprose & Jeff Robins (1999)

We were sponsored for materials by Fujicolour UK (Museum Art Baryte Fibre Based Paper) and also by Hewlett Packard (With the permanent loan of an HP Z3100, 12 Pigment Ink 24" wide printer.) The Wilhelm Institute estimated that this combination of inks and paper should have an archival life of well over 250 years, for our colour images. Back in 2007, this was a considerable breakthrough, as many high quality ink-jet printers and other paper media of the day, were predicted as unlikely to achieve a life of a half, or even a third as long.

9. ARCHIVING PROJECTS AS INK JET PRINTS

EXAMPLE 2 “LONDON’S CHANGING RIVERSCAPE”

Figure 2: Panoramas of Wapping from 1937, (PLA) and 2008 (LFRP)

In 1997, Mike Seaborne, Charles Craig and Graham Diprose formed London’s Found Riverscape Partnership, in order to make a contemporary documentary record of the Port of London Authority’s original continuous panorama of both banks of the River Thames from London Bridge to Greenwich captured in 1937. We shot on 6x17cm Fujichrome Colour Film in 1997, as this was considered one of the most archival films available. In 2008, LFRP were invited by the PLA to make a new digital photographic version of the project, to celebrate their centenary in March 2009.

Once again we were faced with the dilemma of having to archive our digital files alongside existing Silver Gelatine prints,, which despite some slight fading in places, were still very likely to outlast our contemporary digital images.

The 1937 panorama consisted of B & W prints of around 10 x12 inches on thin ‘airmail’ type paper. These were mounted on linen, to make up fourteen sections for each riverbank, each about 2.5 metres long. We decided to ask the PLA to sponsor us to make an exact replica of the 1937 panorama, both in lengths of sections and in matching locations. We then printed on the HP Z3100 on Hahnemühle 188gsm Photo Rag and replicated the way that the 1937 panorama folded, by cutting and mounting our digital prints, using archival dry mounting linen.

Once completed, the new 2008 panorama was placed in blue leather folders, to match the 1937. It was then handed over as a complete ‘package’ to the Curators of the Museum of London in Spring 2009, as one of the PLA’s centenary events. Website: londonschangingriverscape.co.uk

10. PROJECT METHODOLOGY 1 - IMAGE

No doubt, many Curators might read this paper and feel that that it is all very well if you can get English Heritage, The Port of London Authority, Hewlett

Packard and Fujicolour UK to support the expensive production of an ink jet print archive. While they may see the advantage of making high quality ink jet print ‘artifacts’ to send forward in time, obviously this would not be economical or viable storage-wise for most archives.

We have therefore explored the idea of reducing the size of images to about a half or a quarter of the original, so that more images can be fitted onto a sheet of paper. This would also reduce storage space. These images could then be scanned or photographed back into whatever format of digital file is current in a couple of hundred years time. While they may not necessarily be a perfect replica of the original or digital data, if those data files have been lost, then at least this project offers hope that a useable, reproducible, image will have survived.

The choice of digital printer was simple, as we had our HP Z3100 and the Wilhelm Institute remained consistent throughout 2009-10 for giving it better archive longevity with a range of specialist baryte papers, than most printers using dye based inks.

The choice of paper media was much more complex and hence a number of different samples were tested. We correctly suspected that if the paper had a texture, this might interfere with the image retrieval and sharpness of the dot resolution in the overall result. We asked Fujicolour UK for a 24” roll of their Fine Art Fibre Baryte Matt 310 gsm and also initially tried a Harman Crystaljet Lustre RC paper, to explore how the paper surface affected the sharpness of the dots and dot bleed.

We placed 4, 8 and 16 images (monochrome and toned) from the Museum of London’s PLA collection, on a sheet of A2 paper, so that they were sized up to approximately A4, A5 and A6 respectively.

Figure 3: PLA Collection images 16 up on A2

English Heritage NMR. were kind enough to allow us to experiment with their collection of digital files from Henry Taunt’s originals and we interspersed

these with our modern colour photographs. This was to explore if a full colour image reproduced less successfully than a toned or pure B & W one.

Figure 4: English Heritage Taunt and “...in the footsteps of Henry Taunt” 16 up on A2

However there was a problem, that even when using a very good magnifying loupe, it was difficult to discern which paper gave the sharpest dot, or the best quality image, to retrieve and enlarge back to A4 from the reduced A5 or A6 prints. We decided that we needed to find a much more measurable criteria for our future experiments.

11. PROJECT METHODOLOGY 2 – TYPE

We were also interested in the possibility of archiving vital business documents using ink jet technology. Initially, we fed 64 and 96 pages of a new photographic textbook that Graham Diprose and Jeff Robins are presently writing for Thames & Hudson, from Word files, into Photoshop, laid up using Contact Sheet. When printed out, even on the 128 A4 pages per A2 sheet, it was still possible to use a strong magnifying glass and read the text.

Figure 5: 64 sheets of A4 up on A2 on Harman Gloss, with and without Photoshop sharpening

By chance, some of the text had been highlighted in colour and it was immediately apparent that, to a considerable extent, this visibly reduced the

legibility of that type. We discovered that by converting the Word files to Pdf and using Adobe Acrobat to lay out our pages, we could get a much sharper vector based image, than the pixel based Photoshop Contact Sheet we originally employed.

We experimented with different typefaces as well as different ink jet papers. A serif face such as Times Roman was much less legible than Century Gothic, but ideally, a very common typeface would be best for our project and Arial looked the clearest of them all. However, which paper was best, still remained quite a personal and subjective judgement and we needed a further new methodology that would clearly measure which ink dot and paper surface combination actually produced the sharpest result.

We hoped that, once we had found the ideal combinations and settings using the Type as our testing ground, we could return to printing out our photographs, confident that we could recommend the best choices of ink and paper for archiving.

By placing these tiny 64 and 96 pages of reduced A4 sheets into a good quality Epson flatbed scanner (we used an Epson 2400) and using ABBYY Optical Character Recognition software, we aimed to quantitatively measure the quality and sharpness of the dot resolution for various papers by counting the OCR words recognised and errors.

On a number of papers, such as the Harman Gloss with 64 A4's up on an A2 sheet, there were around 25 errors per page, which increased to around 50 errors in the 96 up sheet. In both cases, (but certainly in the case of the 64 up), it would still be simple to restore the document fully in 200 years by 'guessing' the correct words that were incorrect.

Figure 6: Harman Gloss OCR'd from 64 and 96 up on A2

When we looked closely at the cause of these errors, the gloss surface of the Harman tended to minimise the dot size and loose sharpness, so that the dot was under-inked and was not perfectly formed. In the case of the Fujicolor Matt paper,

there was the opposite problem, of too much dot bleed, caused, we believe by ink spreading in the Baryte (Barium Sulphate) layer of the paper.

We approached Canson Infinity, who had claimed that because their Photo-Rag Paper contained a layer of Potato Starch that prevented the ink from reaching the Baryte Layer, their paper should give us much less dot bleed and a sharper result. They kindly offered us a roll to test with the Z3100 and this indeed proved to be the case, giving us by far the best result so far. The 96 up showed about 30 minor errors but the 64 up was almost faultless.

Figure 7: Canson Infinity Photo Rag 96 up and 64 up on A2 showing much more accurate OCR

We did also test Somerset Rag (uncoated) paper at 64 up using a 600dpi Office Laser printer, in order to ensure that for type on a page, using the Z3100 workflow would still give us better results. At 64 up there were almost more errors than correct text while at 96 up, very little of the text at all, read back on OCR. Hence this avenue is not presently a priority, although we do both feel that there may still be time well spent to explore this workflow further.

12. PROJECT METHODOLOGY 3 – BACK TO IMAGES AGAIN

Now we had established that Canson Infinity Photo Rag gave us the best results with the HP Z3100, of all the combinations tested so far, we could return to our images. We prepared a set of the PLA's monochrome pictures from our A4 files as 8 (A5) up and 16 (A6) up, on our A2 size Canson Infinity Photo Rag paper. We also repeated this again with a set of our own recent digital colour pictures from '...in the footsteps of Henry Taunt. Once printed we scanned one A5 and one A6 image from each and placed this in a layout with the original A4 image for a direct comparison.

Figure 8: Comparison of original A4 and images reprinted and enlarged from A5 and A6 in monochrome

On the monochrome image of a ship entering Surrey Docks across Rotherhithe Street (1928) by A.G. Linney, the A4 from the A5 was excellent and the A4 from A6 was still very good and viable for most common reproduction and other likely uses.

For a colour image, we selected a photograph by Graham Diprose and Jeff Robins of Moultsford Ferry (2004). The A4 from A5 was again good enough for most reproduction, while there was some loss on the A4 from A6, which looked rather similar to a jpeg that had been resaved a few too many times. We may need to work more on this.

Figure 9: Comparison of original A4 and images reprinted and enlarged from A5 and A6 in colour from digital original

However, if the original data file had been lost, we still feel that the A4 image from the A6 print would remain very useful to future scholars and researchers. While these results are very recent, completed less than a month before this paper was written (and there is still more work to be done with both the images and the typography), the combination of the Canson Infinity Photo Rag paper and HP Z3100 printer have given us a series of very acceptable results with both monochrome

and digital colour images with considerable savings in terms of cost of printouts and storage in archive.

13. CONCLUSION

We do consider this paper and these results to be very much an ongoing process. We would hope that the next generation of pigment ink printers might give us an even better dot and sharper images when archiving A4 originals at 25% as A6's. There are also further experiments with Print Settings and perhaps other Paper surfaces yet to be explored over the next year.

However, we would conclude that it is perfectly possible to archive 8 up A5 images on a sheet of A2 paper, (or 16 up on a sheet of A1 if that is more convenient). In monochrome, we can already claim that 16 up A2 and 32 up on A1 is a viable option.

With A4 documents, the almost perfect results of 64 up on A2 (or 128 pages on A1) seem a very promising proposition, while the 96 up using the Canson Photo Rag would still provide a usable document albeit with a minor amount of interpolation and correction required.

Although we printed everything out from ink jet paper in rolls, we have concluded that it would be much safer to archive the final A2 or A1 prints with all the reduced images, by storing them flat. (The problem with the Dead Sea Scrolls was not the writing on them, but rather what happened to the media when they tried to unroll them).

There has also been recent work done on the idea that the glycol carrier in inks could migrate, over a period of time, through the base of the media to attack the surface of the print below. It might therefore be advisable to place some inert barrier paper between each sheet being archived. Perhaps a lighter weight version of the 310gsm Canson Photo Rag might allow more sheets per drawer in the archive, similar to the way that the 188gsm Hahnemühle Photo Rag allowed us to make our Riverscape 'artefacts' to a similar size and depth as the 1937 airmail paper Black and White prints.

This project has never been intended as a solution for every photograph, every piece of art-work or document in every collection or company filing

cabinet. However, by successfully reducing and resizing images with so little loss, we believe that it does become a viable route for Museums, Galleries, Companies and Governments to archive their most precious items alongside their attempts to store and migrate digital data a couple of hundred years into the future.

It will of course, be necessary to have some form of data base in order to find and retrieve these images in the future, particularly if this idea is successfully taken up. However, we believe that, from present experience, these are much more likely to be migrated cheaply from one generation to the next, than the much larger and more complex image file formats themselves. We have also, (slightly tongue in cheek), considered the necessity of running in tandem, a totally manual card index filing system, just in case the Solar Flares wipe all our hard drives clean.

Although the costs are 'up front' in printing out images in this way, there is very little expertise required, once the images and documents to be saved have been identified. Although many Curators of large archives would have hoped that the 'digital age' would reduce their need to construct new 'cold stores', in the longer term, we believe our idea to be the cheaper and safer alternative for the most important works. Perhaps some sponsors could be sought to help preserve individual archives in this way. The Port of London Authority certainly thought it money well spent, to make a new 2008 'artefact' showing their part in the regeneration of London's Docklands, for them to send down to their bi-centenary colleagues in 2109

By choosing ourselves what gets selected for this form of hard copy archiving in 2011, we have a lot more say in what our great grandchildren choose to keep or discard in 100 years time. Digital files are all too easily deleted, or can get accidentally lost. Any photographic print from 150 years ago, on the other hand, always receives our respect and all the help that we can offer it, in order to preserve it.

Nether are we saddling the Curators of 2199 with all the debts or dilemmas of what they can afford to save from our era, or deciding what they will be forced to delete, as migration costs increase from one technology to the next.