# A Reassessment of Past Colour Collotype Printing Achievements as a Model for Current Digital, Archival Printing Practice

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## Abstract

Colour collotype "at it's best", according to Kirby (1988) "is sufficiently good enough to reproduce both artwork and colour photography with a quality that truly approaches original in tone and hue".

By examining some of achievements and precedents set by the now near defunct collotype industry, this paper will outline some of the principles pursued by the Centre for Fine Print Research at the University of the West of England, Bristol, for the creation of high resolution, archivally stable, digitally generated artists prints.

In adapting the use of current colour management systems and continuous tone output techniques, the research has successfully demonstrated a means of producing digitally mediated images in fully pigmented colour on Ph neutral papers through the traditional collotype medium. This route has enabled some of the unique extended colour separation and retouching techniques once employed exclusively by the collotype industry to be re-created digitally. While this combination of old and new contributes to the limited variety of fully archival printing techniques currently available for museum quality printing, it also indicates how, by assimilating these techniques and forgotten standards, digital printing devices may also be designed to extend upon current standards of quality.

The paper will define the unique characteristics of collotype, explain its non-standard colour printing techniques and describe how they may be re-created digitally. It will also outline how such working methods may be applied to assist contemporary digital printing practice.

## Introduction

The use of digital technology as a tool for generating works intended to fulfil the traditional role of the 'original' fine art print, poses a number of questions of both a philosophical and technical nature for fine artists, collectors and curators.

The idea of the 'original' print is a concept that first appeared at the end of the nineteenth century[1] and continues to hold currency even now at the beginning the 21st century. Its definition could possibly be located in the idea that; like the painter or sculptor, the print based artist uses the unique qualities and the craft of his/her printing medium to generate an original image. This is contrary to the idea that a prints only function is for imitating an image that has first been created in another medium. The original print, like its distant cousin the reproduction, is also produced in multiples however, usually as a limited edition which is personally signed and numbered by the artist. This allows the piece to be distributed more widely than a single work such as a painting. Original prints often exchange hands for large sums of money and many museums and individual connoisseurs hold extensive and varied collections. Over the years to ensure their continuing value and longevity, a tradition of using various printing materials to meet high archival standards has been encouraged by curators, maintained by artists and distributed by specialist art suppliers and paper merchants.

As with all forms of fine art, the conceptual and technical boundaries of print continue to evolve rapidly. Over the last decade or so, digital image generation methods have taken precedence over many of the autographic and photographic techniques previously used as tools for the creation of original prints. While undoubtedly offering an unparalleled ease of use and creative flexibility, it is often the mode of output that limits the artists ability to access a fully comprehensive range of print qualities established through pre-digital, fine art practice. This is perhaps mainly due to the commercially based design of this technology and its adherence to mainstream industrial standards and needs.

Although fine art print practice is flexible enough to assimilate and work creatively within these set parameters, this paper aims to outline how some of the advantageous qualities developed within the context of pre-digital, fine art print practice may be regained and integrated to expand current digital practice.

### Archival Stability, Surface and Colour Quality

Firstly, with regard to archival stability, there has long been a tradition within the field of fine art print for using highly pigmented inks and a wide variety of ph neutral rag based papers. While it is true that the question of stability in both paper and inks continues to be addressed in the

field of digital printing, developments so far tend to cater for an aesthetic common to photography where the surface and texture of the printing substrate remains relatively neutral and imposes little influence on the physical quality of the image. From a print based artists perspective however, the range of archival papers currently developed specifically for optimising the colour quality of digital printing, limit the access to an aesthetic dimension once gained through the use of textured mould made papers with analogue printing techniques. Although this issue continues to restrict the scope of digital printmakers, there is another a more subtle problem which also limits the nature of production. This relates to the working modes and colour reproduction techniques dictated by the current parameters of imaging technology.

One of the major differences between analogue and digitally assisted production for artists revolves around the dislocation of the images initial creation from the actual physical process of printing. In other words, no longer does the printing process play as active a role in moulding the character of the image during the works initial realization. Traditionally the original fine art print has been produced through a combination of matrix creation (from autographic and/or photographic source material), proofing and re-working until the image finally satisfies the intentions of the artist. This approach often imparts a unique physicality to the image and becomes an intrinsic part of the work. With the digital method, this process is undertaken digitally, onscreen through the use of software. Although the physical qualities of many of the previously manually based procedures can be simulated, the virtually inferred physicality of the image can only be imitated as a two dimensional illusion at the printing stage. Further to this, for either photomechanical or digital printing, the original image must undergo an additional synthesis through a CMYK colour separation process (and in the case of the photomechanical print, a halftone screening process) further removing it from the vitality and logic of its onscreen conception.

It is the possibility of discovering a more direct and flexible link between the actual making and printing of a digital image that has become one of our concerns at the Centre for Fine Print Research. The approach we have adopted to examine ways of solving this problem has been to look back at print history and re-assess former high quality printing approaches to see if they can offer possible solutions. Our aim has consequently been to devise methodologies for testing any significant discoveries and translating them for use in a digital context.

Of the techniques we have examined, one stands out as possessing many of the qualities currently sought by high end digital print producers. Ironically the processes main commercial function has been for the creation of exceptional quality reproductions however, many aspects of its approach lay beyond the boundaries of current practice.

**Collotype: History and Process**

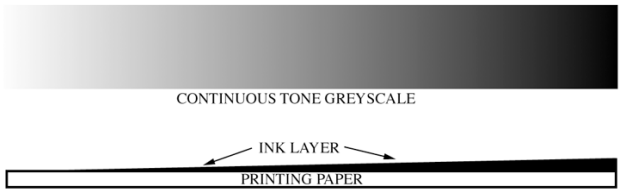
Collotype was one of the first photomechanical printing processes to be developed. It was invented in the mid-nineteenth century and pioneered the detailed photographic illustration of many important scientific and fine art publications of the time. During the 1880's the process was soon eclipsed by the rapid development of faster, and cheaper photomechanical techniques such as letterpress and offset lithography. From then on collotype was largely relegated to specialist markets such as the field of high quality, limited edition, fine art reproductions.

*Collotype landscape printed circa 1930 by Waterlow & Sons Limited, London.*

The main factor setting collotype apart from the majority of mainstream printing processes of the 20th century, was its ability to print highly detailed images without the use of a halftone screen. It was for this reason, despite its reliance on skilled craftsmen and its limited speed and output, that it survived commercially until the latter part of the 20th century. Since the late 1970's though, improvements in the quality of high output, offset lithography fatally eroded the collotype industry.

To briefly summarise the working principles of the technique, collotype could be classed as a planographic medium bearing close similarities to lithography. The printing matrix consisted of a substrate such as a glass or aluminium plate. Initially this was coated with a layer of liquid gelatine, light sensitised with a bichromate salt (ie potassium and/or ammonium). and dried in a special low temperature oven . After curing for several hours at around 50 degrees centigrade (122 degrees farenheit), the plate was then ready to expose.

Prepress artwork for collotype was produced with continuous tone negative sheet film. This was placed over the plate and exposed to strong UV light. During exposure, light passed through the negative causing the bichromated gelatine underneath to tan in proportion to the tones of the image. The clearest areas of the negative (corresponding to the darkest tones of the image), allowed light to penetrate and harden the plate's thin gelatine layer the deepest. The translucent mid tones however, allowed lesser degrees of light to pass through, thus hardening them to depths in proportion to their tone.




*The relationship between the collotype tonal scale and its ink application.*

*Spreading a glycerine fountain solution over the gelatine coated collotype plate- Lichtdruck Kunst Leipzig.*

After exposure, the plate was rinsed with cold water until all the bichromate had dissolved clear of the gelatine. Before being placed on a press for printing, the now air dried plate was flooded with a fountain solution of glycerine and water, allowing the gelatine to absorb moisture in proportion to the amount of light hardening received. As a consequence the non-image areas absorbed the most, while the light hardened image areas absorbed the least ie the fully hardened shadow absorbed almost none, the deep tones a small amount and the lighter tones larger amounts. At this point, after the plate had been fully soaked and the excess glycerine blotted from its surface, it was placed on the press and a thin layer of greasy ink rolled over its surface. As with lithography, the ink was totally rejected by the moist non-image areas and attracted by the hardened grease loving image areas. However, unlike lithography, the mid-tones -which were neither fully hardened nor fully moist- were able to attract ink in proportion to their tone. Consequently, with several passes of a roller, an image could be inked with a full range of tone and printed under pressure onto paper.

Instead of the ink being of a uniform thickness, as in a halftone print, it was transferred to paper in varying thicknesses. A close examination of the inky surface of a collotype print reveals a fine random grain texture caused by the 'reticulation' or wrinkling of the gelatine which occurs during the curing of the plate. This in conventional printing terms corresponds to a resolution of around 1200 lpi.[2]

## The Development of Colour Printing

Although collotype was used extensively for printing in black and white during the nineteenth century, its potential as a colour-printing medium rapidly emerged with scientific developments in photographic colour separation techniques during the 1890's. One of the keys to collotypes success as in this field centred around its ability to print in continuous tone without the use of a regular halftone screen. Until the development of multi-angled halftone screening, collotype was one of the only mediums able to overlay red blue and yellow layers to print a full colour image without producing moiré interference patterns. Herman Vogel, the pioneer German colour scientist, was able to prove his colour theories initially through the collotype medium, thus paving the way for its use with other printing processes.

Although much of Vogel's work was centred around the three colour approach (due to its perceived economical viability), he also recognised that the spectrum could be divided even further.[3] With the translation of the three colour system for halftone printing, the maximum amount of colours able to be printed without the risk of moiré interference became fixed at four. This has essentially remained the standard since.

## Collotype Colour Practice

While all other forms of commercial print were physically restricted to the reproduction of full colour images in 3 or 4 colours, collotype printers were able to print beyond these barriers. They were able to choose the number of colours needed to accurately match the colour quality of the original image and of course the budget available for the task. During the 20th century with further refinements to output consistency, it became clear that the medium was ideal for producing the most accurate of reproductions. For high quality facsimile reproductions- especially paintings, prints drawings and historical documents, up to ten colours were frequently used. As a testament to their quality, collotype folklore is full of stories about prints such as watercolour reproductions and drawings being accidentally mistaken for actual originals -often with disastrous consequences.

The common procedure for creating these works was for the prepress to be copied directly from the original. Therefore many of the leading collotype houses had facilities for safely storing valuable artworks. One of the leading collotype printing establishment, the Arthur Jaffe Heliochrome Co, N.Y even went as far as installing a gallery camera in the basement of the National Gallery in Washington.[4]

Originals would be placed on the camera and a range of colour filters would be used to separate each colour before recording them directly onto negative panchromatic film. The number and colour of the separations made was dependent on the analysis of the colour key of the work. Most of these however, stemmed from an initial three colour set which was further supplemented to achieve hues not able to be precisely matched through the tricolour gamut. To accommodate extra separations and calibrate the negatives to suit the process, they were extensively masked and retouched by expert craftsmen.

Plate exposures were then calculated to match the qualities of each individual negative and the printing characteristics of the coloured printing ink used for reproducing each colour layer of the print

Because of the nature of its printing characteristics and its use as a high quality printing processes, collotype inks were made exclusively from high concentrations of pure pigment mixed with heavy, linseed oil varnishes. This very stiff ink allowed the printer more scope in adjusting the inks viscosity to individually match the printing characteristics of each image. It also ensured the prints archival longevity.

**The Integration Of Digital Imaging With The Collotype Process**

In searching for ways to implement new approaches for artists to create prints in hardcopy from digitally generated artwork, an initial reassessment of the collotype process appeared to offer valuable advantages. In comparison to the range of photomechanical processes traditionally appropriated by artists from the printing industry, the technique suggested that;

- a far more detailed image quality could be achieved through the use of the manually operated studio based equipment commonly accessible to artists.
- the mode of colour production also appeared to offer more flexibility and accuracy over current standard four colour halftone methods.
- through examining a range of collotype prints, that a broad range of fine art papers were suited for use with the process and could be printed using highly light stable inks.

To test these possibilities, it was necessary to re-create the traditional process and then assess how a complementary digital image generation approach could be developed. A considerable amount of time was first spent on learning the process and adapting it for fine art studio conditions. To do this, skills had to be interpreted and developed from 19th century technical literature. Later during the course of the research, the discovery of a working collotype studio in Leipzig, Germany (Lichtdruck Kunst Leipzig) also greatly assisted the development of suitable practical insights into the medium. The main hurdles in retaining collotypes unique characteristics when adapting it for use with current digital image generation centred on the location of a suitable type of pre-press output. A more flexible digital colour separation technique was also required to take advantage of collotypes non-standard, multi-layered colour printing capabilities.

## Film Output

One of the main obstacles in retaining collotypes continuous tone printing characteristics through the digital route was found in locating suitable digitally generated prepress films. Although very finely screened halftone images could be obtained from conventional image setters, the use of these films in conjunction with collotype were unable to allow its traditional, rich inking densities to be achieved. For this reason, a search outside the realms of prepress output was undertaken. Two sources were eventually located. These were found within the field of digital photographic output; one for the production of continuous tone photographic transparencies, and the other for wide format, continuous tone backlit display media. In order to use both these sources as colour separations, CMYK, DCS files were created and each individual colour layer printed onto film. Of the two methods, the wide format approach using a Lightjet Printer in conjunction with Fujiclear film proved to be the most successful. Individual separations could be output as high resolution negatives to the size required. Their tonal range could also be calibrated digitally to specifically match the ideal density range required for collotype.

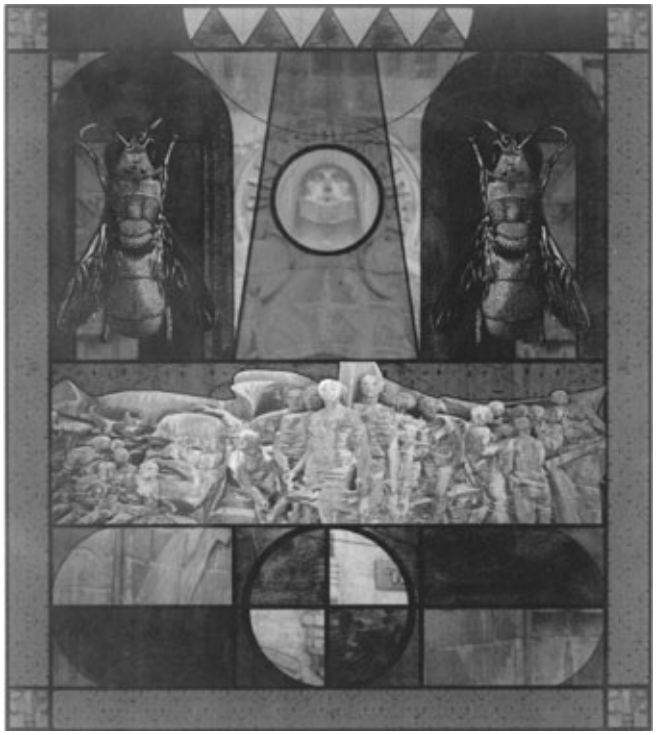
## Multiple Digital Colour Separation Methods

While standard CMYK separations used in conjunction with continuous tone output were able to adequately produce full colour collotype prints, alternatives were sought to gain the flexibility to digitally imitate the non-standard techniques traditionally used by collotype printers to extend a prints colour gamut.

A suitable solution was eventually found in the location of a Photoshop® plug in Photospot™ct, designed to produce customized separations for use in conjunction with high fidelity stochastic screening. By using this software, the flexibility of separating an image into its dominant colours in much the same way that collotype separations were attained. Any out of gamut areas could be corrected with extra plates. The work was then be separated as unscreened DCS files and output using the continuous tone media described.

This approach enabled the possibility of printing an image in much the same way as it was constructed on screen. For example, an image composed of an amalgam of elements layered together to form a composition on screen,

could be specifically separated and printed to reflect the actual layering used in its construction. Other images could be rendered to more accurately reproduce their vibrancy through the use of multiple separations.



*Paul Thirkell*, Monument. *Collotype printed in 7 colours using digital colour separations and continuous tone film output*

## The Integration of Printing Standards Set By with Current Digital Printing Techniques

While this research has concentrated rendering digitally generated artwork through photomechanical printing methods, our research at The Centre for Fine Print Research, Bristol has also sought to develop methodologies for achieving these goals through a purely digital printing route. This research is currently being conducted in collaboration with Hewlett Packard Invent and John Purcell Papers and is currently concentrating on printing a range of, pigmented ink jet inks on a wide range of artist quality, ph neutral papers. While we have found no means of producing the varying depth application of ink to match the rich inking and colour quality of the collotype, some of the high resolution ink jet printers we have tested have been able to render ink with a similar fine, random grain resolution.

To retain a quality which more accurately reproduces the artists work on a variety of traditional paper substrates, our research has centred around optimising the printing quality of existing ink jet colour modes. Therefore, to gain the necessary colour intensity and accuracy to match the quality previously gained through analogue printing methods we are currently writing colour profiles to optimise the use of a wide range of fine art papers. Our research also aims to address the possibilities of breaking beyond the confines of the standard four colour system by examining how digital printers may be adapted for printing multi-separations and continuous tone spot colours.

## Conclusion

The re-assessment of collotype and its integration with digital imaging techniques has produced valuable insights which have principally enabled an almost forgotten, high printing standard to be re-identified. While it could be seen that the development of digital printing techniques have followed a template dictated largely by mainstream printing techniques, aspects of the collotype approach offer valuable alternatives for the achievement of high quality prints. For the fine artist such approaches, when applied to digitally assisted print practice, offer a more direct link between the method of the images construction and the quality of the print. Furthermore, it allows the freedom to select from a wide range of artists papers and print in highly stable printing inks. This in effect, allows works to be created by employing cutting edge imaging technology and combining its advantages with some of the qualities and working strategies previously established through the field of fine art print.

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## Biographies

**Dr Paul Thirkell** is a Research Associate at the Centre for Fine Print Research, University of the West of England Bristol, UK. In 2000. Paul completed a PhD –'The Integration Of Digital Imaging Techniques With 19th Century Continuous Tone Printing Processes'. Since then he has continued researching continuous tone printing techniques through two major research projects. One dealing with photo-relief, continuous-tone ceramic printing and the other with collotype.

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