Continuous Tone Alternatives to Halftone Through Historical Reflection

Andrew Atkinson
Centre for Fine Print Research, Univ. of the West of England, Bristol, United Kingdom

Abstract

Halftone printing has been developing in a linear manner since the inception of photography. The process of refinement has taken it from one level to another producing increasingly fine results principally by using higher resolution screens. Yet in spite of this focus and success, or perhaps because of it, the concept that has produced all this technology is rarely traced back to its roots, which are, in fact, pre-photographic.

With the acceptance of a digital imaging paradigm the question of whether or not halftone is the best or even the only way to think about image representation becomes pertinent. Through historical investigation it is possible to find other concepts in processes and means that were developed contemporaneously with the nascent halftone photomechanical processes.

An alternative concept to the halftone is introduced, that of translucent photographic relief, and practical applications and means are suggested that are sympathetic to digital production.

The Context of the Early Halftone

Halftone was present from the beginning of photography. The earliest surviving photograph is not an image captured with a lens, but a reproduction of an etching, a method which functions through the use of a grid of lines, spaced and weighted to generate tones in an inexact but conceptually identical manner to the modern halftone dot.

This is the heliotype of Cardinal D'Amboise, 1826, but Niépce had created heliotypes as early as 1822.[1] Heliotype is a very early photomechanical process, which uses the light sensitive properties of bitumen of Judea, which hardens as it exposed, allowing a solvent based developer to reveal an image, which is ready to be etched. The image was created using the original etching as a positive.

Cardinal D'Amboise, 1826, Niécephore Niépce.

It was a similar notion which led William Henry Fox Talbot, the British claimant to the throne of photography, to devise the use of a muslin screen, and later a sheet of ruled glass, as the first patented halftone method.[2] Later on, from the mid 1860's to 80's, patents were filed for developments of this principle, and halftone images started to appear in newspapers. In 1886 Frederick E. Ives patented the crossline screen in the US, and Georg Meisenbach did the same in 1882 in Europe, announcing the arrival of the mature technology.

Yet, during this initial period of photography there were other competing paradigms of photographic imaging. The Woodburytype, invented by Walter Woodbury, exemplifies one of the most successful alternative conceptualizations of photographic production.

Walter Woodbury

Walter Woodbury was born in Manchester in 1834, took up photography in 1851, and traveled variously around the Antipodes and Far East before returning home to Manchester in 1862 where he began the experiments that would lead to the Woodburytype. The invention's first patent was filed 1864 and granted in 1865, where it was announced to English reading photography enthusiasts in The British Journal of Photography.[3] He had great enthusiasm for the invention but unfortunately its premature exposition quickly led him to bemoan its lack of commercial success.[4] Yet he still had faith in the process, applying for patents to mechanize it in 1867[5]; for applications into watermarking in 1867 and 1878[6]; for magic lantern use in 1872[7]; and for the stannotype process in 1881[8]; He also invented a colour form of the process in

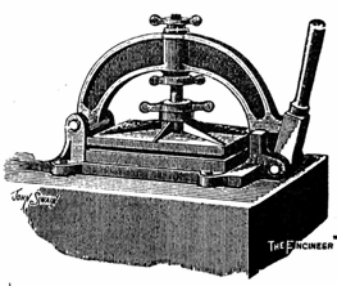
1875 called variously stenochromatic printing[9] and photochromes,[10] and this was the first photomechanical colour print process. The Woodburygravure, which Woodbury never really perfected,[11] was a final attempt to fit his process into the mainstream of printing.

The Woodburytype

The concept that the Woodburytype used so effectively was that it 'translated the two-dimensional tonal gradation present in a photograph into a three-dimensional model in gelatine.'[12] Whereas the structuring principle of the halftone is to be found *across* the surface, the Woodburytype (and others, see below) used the *depth* of the ink to represent photographic tonality.

In schematic form, the Woodburytype used the properties that dichromated gelatine possesses when exposed to light. Light hardens sensitized gelatine, and simultaneously renders it insoluble in water. Thus, when a sheet of sensitized gelatine is made and exposed, a photographic negative renders the low-lights of the image hard whilst retaining the solubility of the highlights. This is then washed out in near boiling water leaving a contoured sheet of gelatine where the shadows are proud and the whites are receded. This gelatine matrix is hardened and embossed into a sheet of lead, requiring a phenomenal amount of pressure. It is this that makes the printing matrix.

To print a Woodburytype liquid gelatine is lightly tinted with black ink[13] and poured into the prepared lead mould, which sits on the bed of the press. An especially treated paper is placed upon the press' platen and a light, level and flat pressure is exerted.

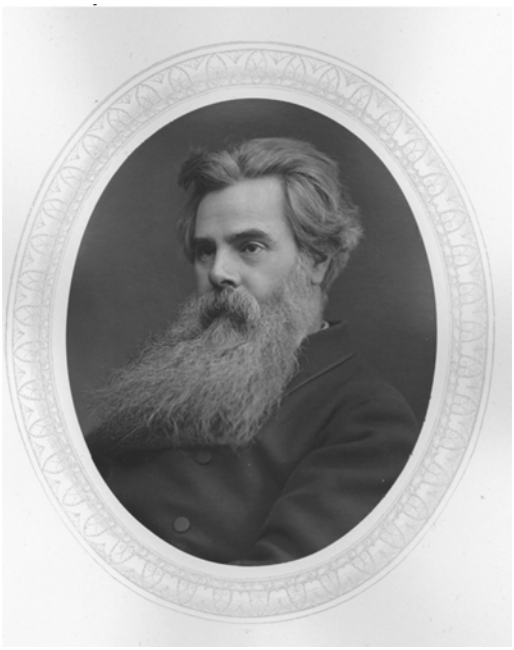


Woodburytype press

The Woodburytype's Successes

It is important to emphasize that this concept of a translation from photographic tonality into a three dimensional relief was not isolated to one man's idiosyncrasies but was a substantial paradigm within the early practices of photography. Although the Woodburytype is not the earliest example of this notion it is in many its most successful: it was the process which was most successfully integrated into industrial production and it was frequently named the most beautiful of all photo-mechanical processes.[23] It also spawned a genus of processes making it a pivotal process in this alternative history, and informs a model of practice that can be used currently.

In posterity, it is most renowned for the images in 'Street Life in London' 1878[14] and the successor 'Street Incidents' 1881,[15] by photographer John Thompson and writer Arnold Smith, which were early examples of social photography and very popular in their day.[16] Another significant publication was that of 'Treasure spots of the World' edited by Woodbury himself and containing 28 Woodburytypes in 1875.[16] Woodburytypes were often quite small, in 'Street Life in London' they average 2.5" by 4" (6 by 10 centimetres). 10" by 12" (25 by 30 cm) pictures were certainly being published in 1870, and the Woodburytypist Braun of Dornach was of the opinion that a 20" (50cm) print 'might be produced without insurmountable difficulty', given sufficient demand to warrant the capital investment,[17] which was then achieved by the American Photo-relief Co., at the latest by 1880.[18]



Example Woodburytype

The most notable Woodburytype printers were: in the UK, Woodbury's own Woodbury Permanent Photographic Printing Company; Waterlow and Sons, a large facility which employed more than 150 people; The Autotype Company, inventor of the carbon print[19]; the renowned French publisher Goupil who published 600,000Woodburytypes a year;[20] M. Braun of Dornach, Switzerland; in the US John Carbutt's American Photo Relief Co. and T.H. Allister;[21] and later Joseph Eder, the photographic historian; Gustavo Re in Teletz, Russia and Heimsoeth & Co. in Köln.[22]

Identified Variations of the Processes

The Woodburytype family of processes is described as a method that creates a tonal image from a contoured relief. It constitutes 12 variations of the Woodburytype. There are seven processes that result in 'photographic' images on paper. These are Woodburygravure; Heimsoeth & Co.'s method; stannotype; 'photochromes'; Autotype prints; Pouncy's process; and photogalvanographs. There are also five methods which result in photographic images of a different aesthetic, on or embedded into other types or uses of support: photo-filigrane; photo-lithophanes; cameotypes; photoceramic reliefs; and a miscellany under the rubric of 'the use of alternative substrates.'

The Woodburygravure

This was a late attempt in the 1880's by Walter Woodbury to incorporate his invention into the increasingly mechanized print workflows. 'A Manual of Photography' describes it as 'to cost and beauty this process holds its own with any of the other processes.'[24] Essentially the Woodburygravure is a Woodburytype printed onto a transfer paper, which is then transferred onto the pages of the intended book. The advantage is that it appeared more integrated into the book and type could be printed on the same the paper, although not at the same time, and the print still had to be trimmed prior to transferring. Woodburygravures were never very successful on large commercial scale, the process simply appeared too late, although they adorn the aforementioned book and there are other examples.

Heimsoeth & Co.'s Method

A reworking of the Woodburytype process such that it was not necessary to take an impression in lead but that it was possible to use the gelatine relief directly. The problem is that even after swelling the gelatine could be hydrophilic. To prevent this from happening, the still delicate washed out gelatine is immersed in an emulsion of soap, oil and water, lightly brushed and then rinsed in pure water. The gelatine is now much more lithophilic and thus will not only not absorb the water from the gelatin during printing, but doesn't need the repeated greasing that the traditional invention did. Because the final print is indistinguishable from a traditional Woodburytype it is impossible to positively identify examples. According to one article, 'A New Modification of Woodburytype,' Heimsoeth & Co did go to the trouble of patenting the modification.[25]

The Stannotype

Similar to Heimsoeth's invention this 1878 process invented by Woodbury uses a gelatine relief directly for printing. Instead of oil separating the gelatine matrix from the gelatine ink it uses a sheet of thin tin. This tin is run through an intaglio press with the gelatine relief and the two are left together to print.[26] Bar this, the process is the same as the Woodburytype.

Photochromes or Stenochromatic Prints

Stenochromatic prints are coloured prints that utilize a Woodburytype key block.[27] They were invented in 1875 but don't seem to have made it into regular use and it was said in 1884 in Hodson's Guide to Illustration 'to have believed to be abandoned.'[28] Nadeau is more specific and mentions problems with registration.[29]

As described in 'A Guide to Early Photographic Processes,'[30] Léon Vidal developed the photochrome printing process as a method of colouring photographs. The process was not a colour process in the modern sense of colour separations but a colouring process where a single negative would duplicated and different areas would be blocked out of the negative to give, in some cases, twelve areas of different colours. These would be printed lithographically with a Woodburytype key block.

Autotype Process or Carbon Print

Woodbury acknowledges this process as the direct antecedent of his process.[31] Carbon prints are created from tinted dichromated gelatine, thinly spread onto a sheet of paper, and exposed directly to a negative, rendering the image's exposed dark areas insoluble. The remainder is washed away in water revealing the image. Because this process has to be repeated each time carbon prints are laborious to create in large numbers, which is the prime distinction of the Woodbury invention to this process.

Luis Nadeau has written a useful guide to carbon printing, which serves to provide a modern analogy to the historic process, and is useful in considering a contemporary form of the Woodburytype process.[32]

Pouncy's Process

Pouncy's process of 1858 by John Pouncy is a relative of the Autotype process but never it seemed to have secured any success for itself. It harnessed the same inherent qualities as Niépce's heliotype: the action of light upon bitumen, which renders it insoluble in turpentine.[33] The unexposed areas were dissolved revealing a tonal image on paper, and although Thomas Sutton, editor of Photographic Notes, continued to support it through his writing,[34] and although it received recognition in the 1856 race for the permanent print,[35] it never achieved prominence, unlike for example, Poitevin's collotype process which won that same award.

Photogalvanograph

This is an early example of a swelled gelatine process that preceded both the carbon print and Woodburytype. Paul Pretsch invented the photogalvanograph in 1854, and even was Roger Fenton head of the Photo-Galvanographic Co.'s photographic department, but it soon went out of business (in 1858). The photogalvanograph used a swelled gelatine matrix to emboss a gutta-perch mould giving the characteristic contoured relief. This was then coated with graphite and electrotyped to produce a copper printing plate.[35]

"The Use of Alternative Substrates"

The first Woodburytype patent says how the process can be printed, 'upon Albuminous, Vitreous, Metallic, or Other Suitable Materials,' although this claim is common for many processes of this time.[36] An example application would be that of Woodbury applying his process to make 'magic lantern' slides for his sciopticon camera, or, making opal-glass images,[37] and of course, the Daguerrotype used copper sheets.

At the early stage of photography, paper was not the default substratum, although much of it was done on it. opal-glass was very popular and photography was found on a lot of different materials.

The Photo-Filigrane

Again, an invention of Woodbury's[38] which this time would use a positive film to create a photo-gelatine relief which was then passed through an etching press (or equivalent) with a sheet of dry paper on top. The result was that the higher parts of the relief would compress the paper making it more transparent than the lower relief (and consequently thicker paper) areas. It created an effect like a photographic watermark or a photo-lithophane.

Cameotypes

Cameotypes are a photographic version of ceramic cameos that have long existed. The examples held at Ohio State University follow the tradition of a blue background and uses very translucent white clay for the surface. The surface has a relief and the thickness of the relief corresponds to the tonality increasingly towards white. Walter Ford of the Ford Ceramic Co. and of the American Encaustic Tile Co. seems to have done most of the experiments in these applications.

'The application of photography in ceramics' is a survey article written by Michael Ford for 'The Bulletin of the American Ceramic Society' in January, 1941.[39] The article details six processes including Poitevin's dusting process and the Du Motay's early substitution process. The processes that are relevant here are described as 'relief processes' and are broken into three genres: 'coloured glaze'; 'porcelain cameo,' and 'translucent types.'

Only the cameotype is described here as the 'coloured glaze' process is close to Cartlidge's and 'translucent type' is analogous to 'photo-lithophane.' The dichromated gelatine relief is not impressed into lead, but used as a mould from which to cast a plaster relief. It is from this method that all these processes are founded.

With porcelain cameotypes a porcelain slip is poured into the plaster mold, and is left to cast for a few minutes. The superfluous clay is scraped off to make the relief level and perfectly smooth. Onto to this leveled surface coloured slip is poured, and drained; then backed up with a third porcelain body for support, and allowed to dry until it releases from the mould. Fire the piece until complete vitrification.

The first slip becomes highly translucent and picks up the tone of the second coloured layer, rendering both a photographic relief and a tonal image.

Photo-Lithophanes

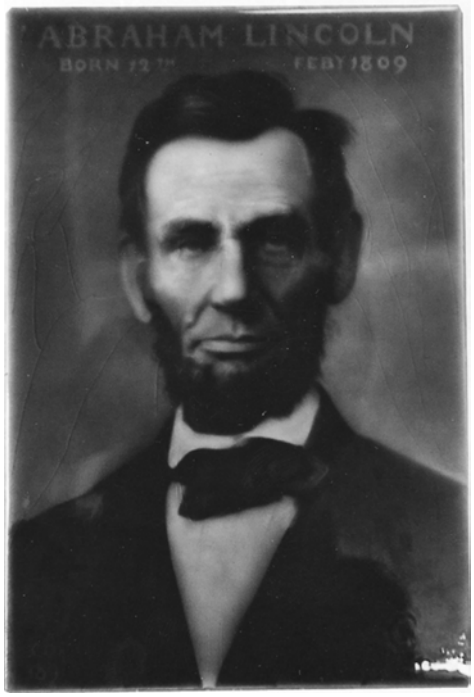
This is a process by which a porcelain relief is created which is translucent and holds a photographic image. A gelatine negative is used to create a plaster into which clay tiles can be impressed. These are fired and the translucent properties of this clay will allow for an image to be seen akin to photo-filigrane. Alphonse Poitevin seems to be the first to experiment with it in 1855.[40]

Translucent types in 'The application of photography in ceramics' article[41] are created from making a plaster from the relief and then second plaster from that, so to create the same relief as the gelatine. Onto this, porcelain is formed 'by any method desired,' dried, and fired to complete vitrification.

Photo-Ceramic Reliefs

The process uses a plaster cast from a deeply contoured gelatine relief to create a flat tile that can then be glazed with highly translucent glaze. The translucent glaze translates the depth of the relief into tones. These are principally the creation of George Cartlidge of Staffordshire although a very similar process was developed in Ohio. Again these are the work of Walter Ford and Michael Reed. The process first appeared at the turn of the 20th Century and Cartlidge made the tiles until the 30's. Analysis of the tiles held at Stoke Pottery Museum revealed that they were created with a swelled gelatine process.

George Cartlidge, C.1910, Photo-Ceramic Tile



George Cartlidge, C.1910, photo-ceramic Tile

With coloured glaze reliefs in 'The application of photography in ceramics' article a plaster body is formed against the gelatine relief and from this a pottery body may be moulded. Dried and bisque fired, a coloured glaze is applied and the piece is gloss-fired. This will render the image in 'exceptional quality of depth and softness.' The glaze spreads and levels as it is fired resulting a mirror like surface with an image hidden within it, created, like the Woodburytype only with a greatly exaggerated relief, which is embossed, rather than in bas-relief.

These processes, all sitting under a rubric demarcated by the translation of the photographic tonal range into a basrelief demonstrate that wide range of possible applications this concept has, working under a structuring principle that allows continuous tone photo-mechanical and 'photomanual' output. From this historic selection it is possible to use this variety as information towards modes of production that are digitally sympathetic.

Possibilities for Contemporary Production

The practical research which has been conducted falls under two groups: those which keep the photographic and that find digital means by which employ continuous film onto print matrices that are tonally sensitive, and those which discard the photographic element and work from a digital conception directly to print matrices.[42]

Continuous Tone Photomechanical Methods

Polymer plates have been found to be sensitive to a sufficiently long tonal range to produce continuous tone engraved prints. Research that has been conducted at the CFPR has demonstrated that the same method can be extended to create contoured reliefs.[43] The polymer plates can substitute the use of gelatine matrices, as 'masters' for creating printing matrices in other durable and porous materials, in processes such as the original Woodburytype, Woodburygravure, photogalvanograph, etc. If the polymer plate is made lithophilic then it is possible to use it directly like Heimsoth's & Co.'s method or for use creating watermarks as in the photo-filigrane.

Duratrans has been found to give sufficient density to be used as a digital continuous tone film. Specialist inkjet ink sets has also been found to provide a near continuous tone transparency which can be used in conjunction with the same plates, although they are not as dense. With sensitized gelatine the Woodburytype requires 'a vigorous negative,'[44] but with polymer plates this has not been found to be the case.

Colour can introduced without insurmountable difficulty and without a lot of the problems associated with halftone methods.[45] The registration difficulties that stenochromes suffered from can be countered with digital calibration, by creating reliefs that account for the relief created by printing prior colours.

Digital Relief Methods

CNC technologies have been employed, using ARTCam software both to mimic reliefs for the creation of ceramic tiles or other alternative substrates such as glass with the use of enamels allowing the production of highly durable imagery that is embedded into its substrates structure. Consequently it possesses a visually unique aesthetic effect derived from the Cartlidge tiles shown above. The Cartlidge tiles sit in their substrata, they are part of the tiles' physical relief. Consequently, the translucent visual aesthetic is a substantial departure from the opaque use of colourants of most current production. The image is read *in* the material, the depth of the tiles (or others) is perceptible. With cameotypes the translucency gives the imagery a subtle hue and tonal range, and a delicate positive relief in the final image.

For photographic imagery, it allows the production of much more bas contoured reliefs that can be employed for the creation of digital Woodburytypes without the need for creating separate print matrices: the matrix can be engraved directly, as a positive relief.

Conclusion

Halftone has been an incredibly successful dominant method for reproducing photographic imagery for over a century. Other possibilities that existed contemporaneously at the beginning of the growth of halftone are seldom thought of as offering viable concepts that can be harnessed for current production.

Although, most of these technologies are not yet as fine as their analogue counterparts rapid advancements are being made, unlike the stagnant and increasingly rare analogue technologies. It requires no leap of faith to recognize that

concepts uncovered here are able to find increasing sophisticated applications using current and forthcoming means.

Digital technologies can be introduced to these forgotten notions creating the possibility of the reintroduction of the byways of photographic history into current thought, with the possibility of creating new forms of imagery.

References

1. Helmut and Alison Gernsheim, *A Concise History of Photography*, Thames and Hudson, 1965, pg.18-9.
2. William Ivins, *Prints and Visual Communication,* Routledge and Kegan Paul, 1958, pg.127.
3. Camfield and Deirdre Wills, *Walter Bentley Woodbury,* The Photographic Journal, Dec. 1985, p551-4.
4. Walter Woodbury, *The Photographic Journal*, March 16th, 1869.
5. Walter Woodbury, *The Photographic News*, May 24th, 1867.
6. Patent 967, March 30, 1867 and Patent 2912, July 22, 1878.
7. Patent 1563, May 22, 1872.
8. Patent 2527, June 10, 1881.
9. Camfield and Deirdre Wills. Op cit.
10. Coe, *A guide to early photographic processes*, V&A, 1983, pg.88.
11. Although there are known examples published posthumously, see: A Brothers, *A Manual of Photography,* 1899.
12. Anne Kelsey Hammond, *Aesthetic Aspects of the Photomechanical Print* in Mike Weaver (Ed.), British Photography in the C19th Century, Cambridge University Press, 1989, pg.174.
13. Other colours were also popular tints, maroons, and sepias for example. But one thing to note is that because this is pigment ink is the archival qualities are very strong. See the papers by Carinna Parraman and Dr. Paul Thirkell and Steven Hoskins elsewhere in this volume.
14. Which contains over 80 Woodburytypes and was published by Sampson, Low, Marston Searle and Rivington.
15. Published by Sampson, Low, Marston Searle and Rivington.
16. Gernsheim wrote that the books contributed to flood protections being put into place around the part of London on the Thames that John Thompson photographed.
17. Published by Ward, Lock and Tyler.
18. H. Baden Pritchard, *The Woodbury and Lichtdruck Processes Compared,* The Photographic News, August 26, 1870, pg.399.
19. Nadeau. *Encyclopedia of Printing, Photographic and Photomechanical Processes,* Atelier Nadueau, 1994, pg.470.
20. Anne Kelsey Hammond, pg.174.
21. ibid.
22. www.geh.org/ar/strip60/htmlsrc2/woodind_sum00001.html (18/09/02) Allister was active later, during the 1890's.
23. Hermann Schnauss, *A New Modification of the Woodburytype,* Penrose Annual, 1901, p143.
24. Luis Nadeau, 1994.
25. Herman Schnauss, op. cit..
26. W. H. Burton, *Practical Guide to Photographic & Photomechanical Printing*, 1892; J. M. Eder, *Die Photoglyptie, oder die Woodbury-druck*, 1897.
27. Carbon Prints were also used: Coe, op. cit..
28. J. S. Hodson, *Guide to Art Illustration,* Samson, Low, Marston, Searle & Rivington, 1884.
29. Luis Nadeau, 1994.
30. Coe, op. cit.
31. Walter Woodbury, *The Woodburytype Process, First article,* The Photographic News, September 14, 1883, pg.582.
32. Luis Nadeau, *Modern Carbon Printing*, Atelier Luis Nadeau, 1992.
33. Helmut and Alison Gernsheim, pg.18-9.
34. Anne Kelsey Hammond, pg.167.
35. Anne Kelsey Hammond, pg.170.
36. Duchochois' '*industrial photography: being a description of the various processes of producing indestructible photographic images on glass, porcelain, metal and many other substances,*' 1891.
37. Camfield and Deirdre Wills, et al
38. Patent number 967, March 30 1867 and 2912 July 22, 1878.
39. Walter D. Ford, *Application of photography in ceramics,* Vol 20, No. 1, January 1941, as presented in September 1940 at the Autumn meeting of the White Wares and Materials and Equipment divisions, in Uniontown, PA.
40. Luis Nadeau, 1994.
41. Walter D. Ford, pg.3
42. Dr. Paul Thirkell and David Huson have undertaken by the author, and this work, conducted at the Centre for Fine Print Research at UWE. Paul Thirkell specializes in C19th processes (paul.thirkell@uwe.ac.uk), and David Huson (david.huson@uwe.ac.uk) in ceramic applications.
43. Whereas a polymergravure possesses a screen either in the form of a fine halftone or stochastic dot, a Woodburytype does not.
44. Anon, *Mssrs. Waterlow & Sons' Photo-Mechanical Printing Works,* The Britisha and Colonial Printer and Stationer, April 13 1893, p4.
45. Again, see the papers by Carinna Parraman and Dr. Paul Thirkell and Steven Hoskins in these proceedings.

Biography

Andrew Atkinson completed his BA in Fine Art at the University of the West of England, Bristol in 1996. After post-graduate studies in Philadelphia he returned to study a PhD at the Centre for Fine Print Research. His thesis, due for completion this year, centres on the use of the Woodburytype as a model for digital print for fine artists. His research interests cover the investigation of photomechanical processes for fine art printmaking within.