Helena E Wright

Photography in the printing press: the photomechanical revolution

Introduction

From this vantage point, at the beginning of the twenty-first century, it is difficult to imagine the impact of photography at the time of its invention. Its subsequent influence on visual communication and cognition is acknowledged as fact and taken quite for granted. Photography has been credited with 'redefining the nature of artistic expression and information transfer',[1] yet this iconographic revolution actually was accomplished largely by means of the medium's widespread reproduction. The development of various photomechanical technologies, culminating in the screened halftone, transformed both the production and the perception of photographs.[2] The rise of mass media, incorporating this pictorial vocabulary into journalism, film, television and now the Internet, has changed forever the way the world communicates. Today's visual culture has its roots in photography, but owes its pre-eminence to the dissemination of photography's syntax into other media. That phenomenon – the photomechanical revolution – actively pursued internationally from the 1840s, is the topic of this paper. Its material evidence is recorded in the remarkable collection of photolithographer J W Osborne (1828–1902), donated to the Smithsonian Institution in 1888.[3]

In 1857, less than 20 years after the invention of photography, Lady Eastlake observed:

> Photography has become a household word and a household want; [it] is used alike by art and science, by love, business, and justice; is found in the most sumptuous ... and dingiest [surroundings] ... in the pocket of the detective, in the cell of the convict, in the folio of the painter and architect, among the papers and patterns of the mill-owner and manufacturer, and on the cold brave breast on the battlefield....
>
> Where not half a generation ago the existence of such a vocation was not dreamt of, tens of thousands ... are now following a new business, practising a new pleasure, speaking a new language, and bound together by a new sympathy.[4]

Indeed, photography must have seemed like a miracle. Its invention in 1839 promised a new era of realism and immediacy in the making and disseminating of pictures. Art, science, and commerce all would

be served by this exciting new medium. Important paintings, scientific discoveries, manufactured products, flora, fauna and one's own family could be captured and preserved. Truth and beauty, no longer fleeting or intangible, could be held in the hand or hung on the parlour wall, in full tonal representations.

Despite the obvious benefits of photography, its remarkable aesthetic qualities, and its broad acceptance in society, it lacked certain properties. The direct positive processes – the daguerreotype and the ambrotype – produced unique single images. Each had to be exposed in the camera and encased. W H F Talbot's negative-to-positive paper process could reproduce multiple copies from an original negative, but it was slow and its detail not as sharp as that of the daguerreotype. The development of the collodion wet-plate negative in the early 1850s led to the rapid proliferation of photographic prints on paper, but these too had their faults. Producing multiples required sunlight and chemical action for each additional image. The resulting photographs had to be trimmed and mounted individually. They could not be printed along with type for use in books or periodicals, and they often faded.

In order to establish photography's place in the culture as a versatile and viable method of visual communication, it was necessary to find a way to print photographs mechanically, that is, with permanent, non-fading printer's ink from one matrix, in a format compatible with typographic printing, and to eliminate the need for mounting. As a response to this challenge, each of the existing printing methods was employed in search of a solution, and pigmented photographic processes – carbon and platinum prints – also were developed.[5] These attempts demonstrate numerous instances of trial and error, different approaches to specific aspects of the quest. All of the photomechanical processes were in development in Europe by the 1850s, and most were introduced into the United States by the 1860s.[6]

Pictorial printing in the mid-nineteenth century

Before the development of the photomechanical processes, the options for reproducing pictures included engraving, etching, lithography and photography. These techniques, representing relief, intaglio, planographic and chemical systems, were the four primary means of pictorial reproduction in use in the first half of the nineteenth century.

Relief printing, from a raised surface, included metal and wood type for books, periodicals and posters; wood engravings and metal cuts for illustrations and inexpensive pictures; and combinations of type and cuts for job printing such as bill heads, tickets and advertising cards.

Intaglio printing, from the incised surface of a metal plate, included steel and copper engraving, etching, aquatint and mezzotint. These processes were used primarily for reproductions of paintings and other works of art, for book and periodical illustrations produced separately from text, and for maps, currency and music.

Planographic printing, from a flat surface, included lithography (on stone) and zincography (on metal). This process also was used to reproduce works of art and illustrations separately from type, and for advertising, commercial work, maps and, increasingly after mid-century, for colour reproduction.

Photography comprised two chemical methods, both introduced in 1839. The direct positive processes, as the name implies, produced unique single images, exposed directly on metal or glass, without a negative. As individual plates, the daguerreotype (on silvered copper) and the ambrotype (on glass) had to be encased, and they were limited in size and format. While the camera could copy paintings or plans, and record objects, buildings or landscapes, these two processes came to be used primarily for portraiture. Talbot's negative–positive process was more easily adapted to a variety of reproductive formats, especially after the introduction of collodion wet-plate negatives in the 1850s. Beyond the familiar family album of card-mounted photographs in various sizes, paper photographs had many uses, such as advertising, decoration, teaching aids and travel souvenirs. They could be inserted into books and journals, but it was a cumbersome process, as each one had to be exposed, chemically developed, dried and mounted. Talbot's *The Pencil of Nature*, the first book illustrated with photographs, was produced in parts between 1844 and 1846. It took months to print the thousands of 'sun pictures' necessary to illustrate the article on the Talbotype that appeared in *The Art Union* in June 1846. And fading remained a problem: William Stirling-Maxwell's *Annals of the Artists of Spain* (1847), illustrated with Talbot's photographs, included an offer to replace faded prints with fresh ones as necessary.[7]

The problem of fading attracted the attention of a French patron of the arts, the Duc de Luynes, who offered medals and prizes for improvements in photography, including both photomechanical and permanent photographic prints. A competition was announced in 1856, but the prizes were not awarded until 1859, after much deliberation by the Paris Photographic Society. No single process won out, although the work of Alphonse Poitevin received a gold medal as the underlying basis for achievements in both sections. Paul Pretsch and Charles Nègre received silver medals for photomechanical work; John Pouncy won for gum printing, and Henri Garnier and Alphonse Salmon for their pigment process.[8]

Several successful methods were developed in response to this impetus. J W Swan's carbon transfer process, the most widely adopted, used a pigmented tissue layer that was exposed and developed, and then reversed and mounted on a paper base. Patented in 1864, his process was sold and used across Europe. In London, it was licensed to the Autotype Company, so named because the process reproduced an artist's work without the need for an intermediary like an engraver. On the Continent, the firms of Adolf Braun in Dornach and

Hanfstängl in Munich both used it for their specialisation: reproducing works of art. The carbon process produced rich, dark images, full of sharp detail, very suitable for images of cathedrals, sculpture and paintings. However, it was slow and very labour intensive, not the universally applicable, reproductive method so keenly sought.[9]

The goal of many publishers at the time, both artistic and commercial, was to reduce the time, labour and expense involved in making a plate and producing an edition that combined pictures and text. Wood engraving, the most common method of illustration, required the skills of numerous designers and cutters to produce the blocks on schedule for books and illustrated papers. Even after the introduction of photographically transferred designs onto the wood blocks, engraving remained an arduous and time-consuming task. Often the blocks were subdivided and distributed among several engravers to speed completion. In copper and steel engraving, used to produce fine-art framing prints and plates for luxurious illustrated books and annuals, image quality took precedence over speed, but contracts with engravers involved literally years of work. Lithography, while faster and cheaper than engraving, still required the separate skills of the draftsman and printer, and its presses were not type compatible. Carbon prints, while beautiful and permanent, retained the drawbacks of photographic developing and mounting. Reproductive etchings also were fast, and were becoming more popular than traditional line engraving, but the possibility of producing a printing plate with the aid of photography, without the intervention of the artist, was eagerly pursued. Whether relief, intaglio, lithographic or photographic, the range of available media did not suit publishers' needs for speed, cheapness or image quality, especially for tonal images that could be printed in relief along with type.

Both relief and intaglio engraving are essentially line art, although certain techniques such as aquatint and mezzotint, or the use of closely spaced dots and crosshatching, produced tonal effects. The mixed-process engraving, employing an etched ground with mezzotint, aquatint, stipple and line additions, was widely used for better-quality illustrations and framing prints at the time photography was introduced. Its velvety surfaces and subtle shading with lights and darks had conditioned the aesthetic outlook for a generation, privileging tone over line. Lithography, which came into wide use during the 1820s, employed scraping, tints and washes, in addition to crayon delineation on the stone, to provide tonal effects.[10] Photography's superb tonal range and relatively immediate results from nature offered certain advantages, both aesthetic and technical, over the visual vocabulary of engraving and lithography, and it was these features that experimenters with the new photomechanical media hoped to capture in ink.

The introduction of photomechanical processes

Sylvester R Koehler, the Smithsonian's curator of graphic arts in the 1880s, identified the critical innovation that photomechanics brought to the field of pictorial representation. 'The block or plate which is to produce the print is wholly or partly the result of the chemical action of light,' he said, while 'the print itself is the product of the press, a mechanical contrivance.'[11] Thus, in making a plate for photomechanical printing, the chemical action of photography could be applied once, exposing the image photographically onto a specially prepared support that then could be inked and printed mechanically, over and over, to produce permanent images.

In the 1850s and 1860s, photographers and printers developed a number of photomechanical processes, applying photographic imaging to the production of plates by more or less traditional means – photo-relief, photogravure, photolithography – along with some new ideas such as the Woodburytype and the collotype. Early successes were incremental, and at first they achieved the most effective results in small press runs. The primary difficulty in achieving a true tonal reproduction was maintaining image quality in an edition large enough to meet publishers' requirements.

The earliest attempts focused on intaglio methods, printing from an incised or etched surface – what came to be known as photogravure.[12] Koehler identified Joseph Nicéphore Niépce's experiments with heliography of the late 1820s (Figure 1) as 'the earliest investigation of the effect exercised by light upon asphaltum, with a view to the production of intaglio plates'.[13] Working before the invention of photography, Niépce sensitised a metal plate with asphaltum (bitumen of Judea) and exposed it to sunlight under an engraving that had been oiled to render it transparent. The asphalt hardened, except under the lines of the image. The plate then was etched in acid, with the asphalt acting as a resist. Once the lines of the image had been bitten into the plate, it could be inked and printed as an etching.

Niépce, and later his son Isidore, worked in partnership with Daguerre to experiment with fixing and reproducing images. In about 1840, after Daguerre's process had been announced, several scientists independently attempted to etch daguerreotype plates for intaglio printing. Donné in Paris and Berres in Vienna were among the first; two early plates successfully etched by Fizeau (Figure 2) were included in the multi-volume *Excursions daguerriennes* (Paris: 1840–44), but this line of enquiry did not continue after 1850.[14]

Talbot also experimented with etching methods as he sought ways to provide permanent photographs for illustration (Figures 3 and 4), and here, again, he was a leader. His photogravure process, which he called 'photoglyptic engraving', used a gelatin layer, sensitised with bichromate of potash, to coat a steel plate. The gelatin hardened when exposed under a positive, and once the unhardened gelatin was

Figure 1 Joseph Nicéphore Niépce, portrait of the Cardinal d'Amboise. This 1827 portrait of Cardinal d'Amboise, after Briot's engraving, is recognised as the first photomechanical reproduction, even though it pre-dated photographic experiments. The NMAH copy (GA 3473) is one of the four impressions taken from the plate in 1864. It was received from the museum at Chalon-sur-Saône in 1890.

Figure 2 Henri Fizeau, etched daguerreotype.

washed away, the resulting image could be etched and printed. Talbot's 1852 patent describing this use of sensitised gelatin formed the basis for a majority of the new plate-making methods that followed, and his early understanding of the need for a grain or screen to hold the ink also influenced the development of the screened halftone, which will be addressed later.[15]

Austrian inventor Paul Pretsch called his technique photogalvanography (Figure 5). He also exposed bichromated gelatin plates, but he washed the resulting images in cold water, causing the gelatin to swell. This produced a reticulated image in delicate but graduated relief, which could be electrotyped. These electrotype plates could be prepared for either relief or intaglio printing, but at this early stage the latter was more successful. Pretsch's publication, *Photographic Art Treasures* (London: 1856–57), was printed from intaglio plates. While he successfully reproduced the tonal values of photographs, a good

Figure 3 William Henry Fox Talbot, mimosa leaf.

Figure 4 William Henry Fox Talbot, mimosa leaf, enlarged detail showing screen.

deal of hand retouching was required before printing the plates, and his company lasted only a few years.

In France, Charles Nègre produced beautiful large plates of Chartres Cathedral with his photo-intaglio process, and Niépce's nephew, Niépce de Saint-Victor, published a number of illustrations in his version of heliogravure. The Viennese Karl Klic used a combination of aquatint graining on the plate and carbon tissue for image transfer, before etching. The photogravure process used today is basically as he perfected it in 1879.[16]

In photolithography, J W Osborne developed a process for map reproduction in the Australian civil service, patented in 1859, similar to that developed almost simultaneously by Col. Sir Henry James for the British Ordnance Survey Office.[17] The image was first produced on photosensitised paper and then transferred to stone or zinc for printing. While commercially successful and capable of enlargement and reduction, these processes reproduced only line work. But Poitevin and Lemercier in France, Pouncy and the Bullock brothers in Britain, and Bradford in the United States developed tonal photolithographs during the 1850s and 1860s.[18] In 1855 Alphonse Poitevin patented a

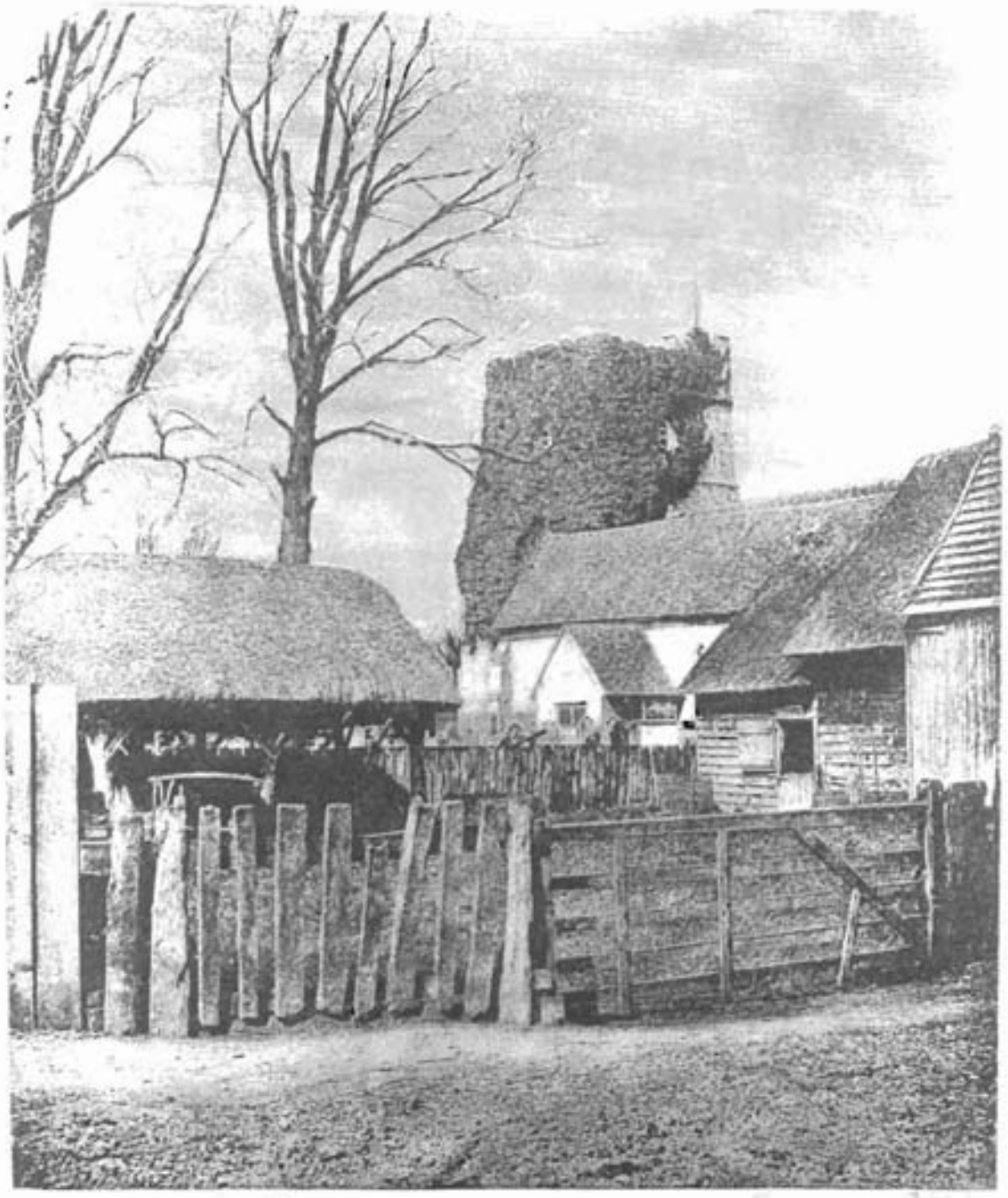

Figure 5 Paul Pretsch, Cookham on Thames.

OFFICE OF
EDWARD BIERSTADT.
PHOTO-MECHANICAL PRINTING WORKS
ESTABLISHED IN 1870.
ARTOTYPES, ALBERTYPES, PHOTOGRAPHS OF ALL KINDS PRINTED IN PERMANENT INKS.
No. 94 READE STREET.

New York, May 1. 1896

Figure 6 Edward Bierstadt, artotype letterhead.

light-sensitive bichromated gelatin coating on lithographic stone that found numerous applications for the publication of photolithographs and the related collotype process. Using Poitevin's process, Parisian lithographer Lemercier printed up to 700 impressions from a stone, and he produced illustrations for books of travel, art and archaeology, as well as larger-format prints.[19]

The incremental successes of photo-intaglio and photolithographic processes for specific pictorial uses did not diminish the need for a type-compatible system, and experiments with relief methods continued. Pretsch's photogalvanography for relief blocks produced a coarse but creditable beginning, and in the early 1870s, Gillot in Paris produced relief line etchings using bichromated albumen coatings. The Canadian William A Leggo, working with George E Desbarats, combined elements of Pretsch's swelled-gelatin method with a single-line screen patented as the Leggotype in 1865. This early halftone appeared in the *Canadian Illustrated News* and *L'Opinion publique*, but it was printed lithographically, separately from the text. The letterpress printer had to wait another decade for a reliable tonal matrix.[20]

The Woodburytype, patented by Walter Woodbury in 1864, was the most photographic of the early photomechanical processes. Images were produced from pigmented gelatin, which was poured into intaglio lead moulds prepared from photographically sensitised gelatin reliefs. Although gloriously rich in detail and tone, Woodburytype prints had to be trimmed and mounted (the pigmented gelatin oozed out around the edges of the print), and the extreme pressure the moulds required both slowed production and limited the size of the finished prints. Used primarily for book illustration and portraiture, Woodburytypes appeared in John Thompson's *Street Life in London* (1877) and under licence to the French publisher Goupil, in the multi-volume *Galèrie contemporaine* (Paris: 1876–85).[21] Goupil were probably better known in Britain and the United States for their high-quality reproductions of paintings produced by the more traditional methods of engraving and lithography.

The collotype, one of the most versatile and beautiful of the photomechanical processes, also was one of the most widely used

before the perfection of the relief halftone. It became commercially viable in the hands of Joseph Albert, a Munich photographer, in about 1868. Albert perfected Poitevin's idea that the photosensitised coating of bichromated gelatin itself, with proper support, could be inked and printed like a lithograph. The reticulated grain of the gelatin captured the finest gradations of lights and darks. Albert secured an American patent in 1869 for his 'improvement in photography, method of preparing photographic pictures upon plates of glass for printing with fatty inks upon a press', and sold the US rights to New York photographer Edward Bierstadt (Figure 6).[22] The collotype stimulated much interest in Europe and America. Others developed variations on Albert's process, including Max Gmoser, a Munich lithographer; Emil Rye, a Danish photographer; and Jacob Husnik, a Czech researcher who made improvements that Albert considered important enough to purchase.[23] Ernest Edwards, a British portrait photographer, developed a collotype method he patented in England in 1869 and brought to the United States in 1872. Edwards called his process 'heliotype', and it was described in the periodical press in glowing terms:

> Everything within the sphere of photography is within its sphere, adding thereto the special excellence of lithography. In fact, the heliotype is the application of photography to the printing press, supplementing all previously known processes. The pictures are in effect photographs printed in printer's ink, on an ordinary printing press, requiring no mounting, produced at small cost, with great rapidity, independent of weather, and possessing all the permanency of a fine engraving.[24]

Ernest Edwards produced both collotypes and, later, photogravures. His experience was typical in that photographers, lithographers and printers alike adopted the new processes and recombined methods to develop new ones. Photomechanical breakthroughs were announced in photographic journals; formulas and trade secrets were published there as well, and the images were exhibited at photographic trade fairs and the international exhibitions.

Collotype printing for science, commerce and art

In the 1870s and 1880s, before the development of a successful halftone screen, collotype provided the fastest, cheapest and most faithful tonal reproductions. Despite press runs limited to about 2000 copies per plate and some technical difficulties with the gelatin printing surface, duplicate plates could be prepared for larger editions. Collotype was used for a variety of publishing efforts in many fields.

Scientists were quick to grasp the significance of the new process for publishing their results. Charles Boyle's lunar globe won first prize at the American Institute fair in 1869, the same year that Edward Bierstadt presented examples of the Albertype. Bierstadt previously

had issued photographs of other lunar scientists' work, so it made sense for him to work with Boyle to communicate his findings on lunar surface features in the form of collotype prints.[25] In 1876, two important palaeontological works were issued, in hot competition: one with Albertype plates by Bierstadt (James Hall's *Illustrations of Devonian Fossils*) and another published by lithographer Julius Bien (C Rominger's *Geological Survey of Michigan*, Volume III, *Paleontology*), with unsigned collotype plates. A colleague wrote to Hall soon after publication of his work:

> As to the technical execution of the plate, I confess that I am only able to admire it without understanding it. Is the printing made on stone or on copper or on steel? The fact is that it is wonderful and that it would admirably apply to Echinoderma and Bryozoarians, and likewise to fossil plants. [It had been used for fossil corals.] Your plates are unquestionalby [sic] superior to the heliotypes in Al. Agassiz's work.[26]

The attributes of collotype were enthusiastically received by the palaeontological fraternity and, in fact, the *Journal of Paleontology* was issued with collotype plates until 1967.

Medicine was another field that adopted the new process. The US Surgeon General's *Medical and Surgical History of the War of the Rebellion* (Washington DC: 1875–88) contained throughout its five oversized volumes illustrations executed in every available graphic process: engravings, lithographs, collotypes and Woodburytypes. Among the most successful were the collotype plates of amputees, as compellingly realistic as the photographs they were based on. Wood-burytypes also were used, but mounting them presented problems – the prints parted from their supports – and they had to be replaced by collotypes and lithographs in later volumes.[27] This publication was a compendium of the pictorial technology available at the time when photomechanics was changing the reproductive field forever. The variety of processes it included suggests something of the difficulties of achieving enough consistent results using any one method to be sufficient for publishers' needs. Another medical treatise, George Fox's *Photographic Illustrations of Skin Diseases* (New York: 1886), used Bierstadt's collotype plates to supply diagnostic details with graphic realism.

Collotypes also were widely used for commercial applications, such as reproducing photographs of machinery and other products for trade catalogues and advertising, offering a more truthful rendering of goods for sale than a more interpretive drawing or wood engraving would provide. Souvenir books of views and travel literature represented a large market for collotype reproductions based on photographs of buildings and landscapes, and the production of postcards kept the process in use well into the twentieth century. One of the most interesting concepts issued in collotype was an album of portraits compiled by New York police inspector Thomas Byrnes, *Professional*

Criminals of America (1886), with 204 mug shots reproduced on 36 plates by Edwards' heliotype process.

It was in the field of art reproduction, however, that the collotype reached its apogee. Works from numerous art collections were reproduced in collotype, providing scholars with access to collections from around the world. Especially in the case of rare early prints, and for unique objects like drawings, it offered ready visual resources for comparison of images. 'The extant works of the recognizable workshops are very widely dispersed, and can be reconstructed and surveyed only by the aid of reproductions.'[28] The public, too, was served, by both a generous approach to producing reproductions for sale and improved access to collections through series publications and illustrated catalogues. Collotype reproductions provided high-quality surrogates at several levels, because the process met, better than any other, 'these rather exacting and conflicting terms: high fidelity to the original within the price range of the average [person].'[29]

Boston publisher J R Osgood used Edwards' heliotype process to reproduce old master engravings from Harvard University's Gray Collection and other sources. Single images after Dürer, Rembrandt and Raphael could be brought into any home for $1, enhancing the educational value of bound editions. The publisher's promotional literature proclaimed their aesthetic value:

> The last decade [the 1870s] has developed with amazing rapidity in our country an interest in and intelligent appreciation of art; and it is in extending that interest and quickening that appreciation that the Heliotype Process, rightly directed, may play an important part.... It comes to the aid of art, multiplies costly and beautiful works, and brings them within easy reach of the whole public.[30]

One benefit of collotype in particular – and indeed photomechanical reproduction in general – was, in the words of the Heliotype Company's advertising, 'to cheapen art without degrading it'. The collotype was successful across a range of edition size and subject matter, producing tonal images of exceptional quality, but as a planographic process it was not compatible with the production of text, and its use for bound publications required separate pages of plates.

The development of the screened halftone

Early on, Talbot recognised the need to provide a grain or screen to hold the ink in the darker areas of the plate. He applied a traditional aquatint ground, and he also used gauze as a screen. His 1852 patent suggests the application of delicate fabrics or a sheet of glass covered with fine opaque lines to provide photographic veils or screens, and many experimenters tried variations of the screen concept in the following decades. Baron F W von Egloffstein, a Prussian working in the US, patented his heliographic screen in 1865. He exposed an

image onto a plate sensitised with a coating of asphaltum through a finely ruled glass screen to produce an intaglio halftone. His process was used for cartography and illustration, and produced very good results for separately printed plates for about five years.[31] Photomechanical relief methods had achieved great success with line work at this time, and photo-engraving blocks made from pen drawings had begun to replace the more labour-intensive wood engraving. But the desire for type-high blocks carrying tonal images spurred continuing experiments with halftones. In the 1870s, New York's Moss Engraving Company introduced the Mosstype, combining line drawing and photography to make a swelled-gelatin relief that could be moulded and produced as a stereotype for letterpress printing.[32] Stephen Horgan's single-line halftone image, 'Shantytown', appeared in the *New York Daily Graphic* in 1880, the first newspaper halftone printed in relief (Figure 7).[33] George Meisenbach of Germany patented his process in Britain in 1882. Building on the work of others, particularly the American Frederic Ives, Meisenbach is credited with the first commercially successful relief halftones to be produced by turning single-line screens during exposure to achieve a cross-line effect. The work of Ives and the Levy brothers in the United States improved on the manufacture and use of cross-line screens interposed between the camera and the subject. The gradations of these screens, expressed in lines or dots per inch, successfully divided photography's tonal values into minute dots of black or white that created the illusion of tone, depending on their size and spacing. The resulting negatives, with the screened images, were used to expose a sensitised plate to be etched in relief. Relief halftone printing blocks for type-compatible imaging finally appeared by the 1880s.[34] First used in newspapers and periodicals, halftone relief prints rapidly spread into book illustration and commercial and scientific work. Coarse and grainy at first, these primitive experiments could not compare with the tonal superiority of collotype, Woodburytype and photogravure, but their speed and cheapness of execution, together with their letterpress compatibility, drove continuing improvements that made them acceptable, and finally dominant, before the turn of the twentieth century.

The Osborne Collection in the National Museum of American History

The range of experimentation and development described above represents only a cursory introduction to a very complex field. Citations to publications employing some early trials are provided to suggest examples for study and comparison that may be available to readers. The most complete source of specimens from a number of these pioneers, however, is the Osborne Collection in the National Museum of American History. Donated to the Smithsonian in 1888, the collection represents three decades of early international developments in photomechanical work. Among its 1300 specimens

Figure 7 Stephen Horgan, shanty town screened news cut.

are examples of photo-engraving, photogravure, collotype, halftone, and – Osborne's particular speciality – photolithography, acquired from nearly 100 practitioners in Australia, Britain, France, Belgium, Germany, Canada and the United States. This early work may be studied together with the Smithsonian's collection of traditional graphic art and photography, the oldest and most complete of such collections in the Institution.[35]

Born in Ireland in 1828, Osborne moved to Australia as a young man.[36] In 1859, while employed by the Surveyor General of Victoria in Melbourne, he developed and patented a photolithographic transfer method suitable for copying maps, then much in demand for land surveys and property development. A slender manuscript album in the collection records Osborne's early progress with nearly 100 examples produced between August and October 1859. Most are land maps drawn in line and printed both directly and as transfers, some reduced in size from the original drawings. One tonal image of the Flagstaff Observatory represents a successful photolithographic transfer to a grained stone. Osborne assembled the examples into the album in August 1860, 'as soon as it became evident that they marked the early stages of an invention certain to hold its ground'.[37] For some time he had been following contemporary discoveries in applying photographic science to the graphic arts, and in 1862 he took a leave of absence, travelling to Britain, where he visited the Crystal Palace Exhibition. He contacted W H F Talbot and acquired several examples of Talbot's photogravures, including images of Notre Dame and the Louvre, as

well as works by Pretsch, Pouncy and James.[38] In 1863 Osborne went to Berlin to study lithography and to work with photographer Wilhelm Korn, from whom he received a number of early photolithographs. Among these were a tonal image Korn made in Paris in 1861 or 1862 by Poitevin's process under Lemercier's instruction, and several examples of line work Korn had made using Poitevin's process before Osborne arrived in Berlin.

In 1864 Osborne emigrated to the United States. He set up the American Photo-Lithographic Company in Brooklyn, New York, and was contracted to print the official US patent drawings between 1871 and 1874. His work appeared in trade journals and advertising. *Anthony's Photographic Bulletin* regularly featured line drawings of suggestions for posing portrait subjects printed by Osborne's photolithographic process. Later he lived in Washington DC, where he served as a printing consultant.

Osborne arrived in the United States at the very beginning of American photomechanical printing, and he received specimens from those of his new compatriots who were making their own contributions – such as Cutting, Turner and Bradford in photolithography, Bierstadt and Edwards in collotype, and some of Ives's photorelief work for Crosscup & West. With remarkable prescience, Osborne acquired examples of early experimental work from nearly everyone of any importance in the field, but he did acknowledge that not all who did 'important and progressive work' had been included.[39] His collection is richly documented with marginal notes by Osborne, Koehler and the donors. On many prints and pamphlets these notations identify makers, dates and production details, offering a rare contemporaneous assessment of a technology in the making. Its research value was recognised by Koehler, who noted that 'already myths and false statements' clouded the beginnings of photomechanical work. 'The difficulty of clearing it up and of illustrating [it] with authentic specimens grows from year to year.'[40] Koehler used examples from Osborne's gift in presenting the history of photomechanics in his exhibitions at the US National Museum in Washington and for special exhibitions at Cincinnati in 1888 and at the Boston Museum of Fine Arts in 1892.[41] Visitors to his exhibitions must have absorbed a great deal of information about the rapidly changing images in their visual world. Collectively, these pictures resulted in the explosive growth of printed pictures that created modern media. Individually, their achievements rank with some of the most beautiful aesthetic productions of the time.

Comparisons between photography and the other graphic arts, or between original and reproductive artwork, were not as sharply drawn in the 1880s as they are today. Distinctions between fine art, commercial art and popular imagery were considerably more fluid before 1900. Reproductive prints and original prints in every medium were regularly considered together, in the press as in the

Smithsonian's exhibitions. This inclusion indicates the numerous graphic intersections in nineteenth-century culture, before stricter demarcations began to emerge. The modern preoccupation with 'original' prints, and photography's recurrent tendency to cloak itself exclusively in the mantle of fine art, has unjustly neglected these reproductive genres so important in the development of our visual culture. Fortunately, Osborne's collection documents its critical early years and its incremental developments.

As evident in the works Osborne gathered, photographers and printmakers on three continents tried in numerous ways to create quality images for a wide audience. Multiple forms of image production persisted for decades, as experiments and improvements led photographers, printers and publishers to work with whatever was available and most suited their needs. Among the earlier processes, collotype and photogravure remained in use through the twentieth century, and today artists are using these beautiful processes for creative original prints. Their superb reproductive qualities inspired the refinement and ultimate success of the cross-line screen for three- and four-colour halftone relief (sometimes called 'process' printing), for rotary photogravure (called rotogravure) and for offset lithography, now the dominant process. All these efforts, in their varying nuances of 'success', changed the dominant visual syntax from line to tone and made possible the extraordinary range of today's visual culture.

Visual culture and communication

What is the role of the available technology in the formation and acceptance of cultural communications? The camera seems at first to have been an individual tool, the outgrowth of artistic or scientific experiment, and in that sense, perhaps more accidental than deliberate. It suggests a very specific and personal, if not elitist, form of communication. But getting the camera's images out into the world required more deliberate action. Printing multiple copies, whether from negatives or on a press, became an effort at once more populist and more generalised, as well as intentional. Photomechanical printing brought about a rapid transformation of the cultural idiom of pictures.

Previously, traditional methods of graphic reproduction had each carried their own syntax. The unique, rarefied canvas, direct from the hand of the artist, once was sensitively interpreted through lengthy handwork by the engraver. Nineteenth-century rhetoric privileged the reproductive engraving as a beneficent medium supplying the skill of the engraver as value added to a painting, in its printed form. Engravings were regarded not as copies or imitations of paintings, but as translations, in black and white. The engraver used line and tone representing light and shade to translate the colours of the original, and the sensitivities and styles of different engravers were considered integral to the viewing experience.[42] French critic Henri Delaborde

advocated prints over photographs for the reproduction of artwork, recognising the interpretative contribution of the printmaker.[43] The same arguments had influenced aesthetic directions in earlier photographic developments, as the daguerreotype and carbon print (and ultimately the screened halftone) delivered objective information with precise definition, while the softer and more diffused Talbotypes, platinotypes and photogravures offered a more subjective oeuvre, stimulating the viewer's imagination in a manner akin to the interpretive function of the engraver.[44]

The etching revival of the 1880s, with its new appreciation of original prints ranging from Rembrandt to Whistler, appeared just at the time that photogravure and collotype succeeded in producing exquisitely perfected reproductions of art. Together they spelled the end for the highly finished engraving. Once so esteemed by high Victorian culture, it was diminished and replaced by a somewhat polarised interest in originality on the one hand, and reality on the other.

The halftone's realistic appearance, following in the path established by the 'hard' objectivity provided by the polished metal daguerreotype, took over mass media, while the 'soft' effect of the Talbotype upheld the traditional, more subjective aesthetic reflected in pictorialism and soft-focus photogravure.[45] Neil Harris, in discussing Estelle Jussim's work, considers that photomechanics 'defeated the artist-mediated form of reproduction'. Readers had been aware of the 'subjective, contrived character of pictures'. The photographic halftone, on the other hand, offered verisimilitude: 'The illusion of seeing an actual scene, or receiving an objective record of such a scene, was immeasurably enhanced.'[46]

This analysis raises questions about the cultural value of reproductions and popular attitudes of their acceptance over time. The personal agency of the engraver was transmuted in a flash to a photographic or photomechanical facsimile, a seemingly perfect representation of 'the original'. That reproduction then became something anyone could see, own and ultimately replace – with another just like it, or just like something else. What had been so eagerly sought and acclaimed as democratising and uplifting very soon became the victim of its own success. The technology that made it possible to reach a wide audience, so long a goal of artists and publishers alike, in the end undercut the higher principles of its proponents. Values and expectations changed along with the formats available. Art, indeed any pictorial representation, had been both cheapened and degraded by mass production. Achieving truth and beauty seemed to have left something missing. Critics have debated whether the widespread availability of photomechanical exactitude enfranchised all in a new visual culture, thereby increasing social value, or whether its success somehow diminished the precious aura of the original and the personal understanding of art. The final victory of the

screened halftone over more accomplished processes like collotype and photogravure somehow seems hollow indeed.

Visual culture studies today address the role that images play in communication, often perceived and interpreted in the absence of text. Film, television and the Internet reach millions with messages based on pictures rather than words. Some would credit only the camera with this visual revolution, forgetting the necessary intervening role played by printed pictures and their influence in mass media. The history of photomechanics is a neglected but integral part of the study of visual culture.

Miles Orvell addresses the role of the camera in bringing about the world of virtual reality, 'in which distinction between what is real and what isn't becomes (literally) immaterial'.[47] I would argue that the camera alone has not accomplished this feat, but rather it was the extraordinary international effort joining photography with the printing press that is the basis of it all, for better or worse.

Notes and references

1 Jussim, E, *Visual Communication and the Graphic Arts* (New York: R R Bowker, 1974), p8

2 Despite the influence of graphic media on mass culture, historians have long favoured text-based resources, according to Harris, N, 'Iconography and intellectual history: the halftone effect', in *Cultural Excursions: Marketing Appetites and Cultural Tastes in Modern America* (Chicago: University of Chicago Press, 1990), pp304–17. This essay first appeared in Higham and Conkin (eds), *New Directions in American Intellectual History* (Baltimore, MD: Johns Hopkins University Press, 1979), pp196–211.

3 Wright, H E, 'The Osborne Collection: photomechanical incunabula', *History of Photography*, 24/1 (Spring 2000), pp42–6

4 Lady Eastlake, 'On photography', *Quarterly Review*, 101 (April 1857). Mary Warner Marien discusses Eastlake and other contemporary commentators in *Photography and Its Critics: A Cultural History* (Cambridge: Cambridge University Press, 1997).

5 Hammond, A K, 'Aesthetic aspects of the photomechanical print', in Weaver, M (ed.), *British Photography in the Nineteenth Century: The Fine Art Tradition* (Cambridge: Cambridge University Press, 1989), pp163–79. Here, Hammond considers the carbon print and the platinotype as 'photo manual' processes in her discussion of the genre.

6 For an introduction to printmaking and photomechanical processes, with numerous bibliographic references, see Bridson, G and Wakeman, G, *Printmaking and Picture Printing: A Bibliographic Guide to Artistic and Industrial Techniques in Britain 1750–1900* (Oxford: Plough Press, 1984) and Crawford, W, *The Keepers of Light: A History & Working Guide to Early Photographic Processes* (Dobbs Ferry, NY: Morgan & Morgan, 1979).

7 Crawford, W, note 6, p240

8 Crawford, W, note 6, pp70, 283

9 The early carbon processes are outlined in Crawford, W, note 6, pp71–4. For their aesthetic impact, see Hammond, A K, note 5, pp172–3 and Hamber, A, 'A higher branch of the art', in *Photographing the Fine Arts in England, 1839–1889* (Amsterdam: Gordon & Breach, 1997), p165.

10 For more on lithography, see Twyman, M, *Lithography 1800–1850* (London: Oxford University Press, 1970), especially Chapter 10 on lithotint and the search for tonal techniques.

11 Koehler, S R, 'Catalogue of the contributions of the Section of Graphic Arts to the Ohio Valley Centennial Exposition, Cincinnati, 1888', *Proceedings of the US National Museum*, 10 (Washington DC: 1888), p724

12 One of the problems in identifying and understanding the plethora of photomechanical processes is the issue of nomenclature. Each inventor devised his own name for his contribution in order to maintain proprietary rights to what might become a lucrative system, once patented. By about 1900, most of the processes were recognised as more or less generic categories and were identified by standardised terms like photogravure and collotype.

13 Koehler, S R, 'Exhibition illustrating the technical methods of the reproductive arts from the XV century to the present time, with special reference to the photo-mechanical processes', catalogue from exhibition, 8 January – 6 March 1892 (Boston, MA: Museum of Fine Arts, 1892), p72. Koehler served in a dual appointment as curator in Boston and Washington, dividing his time between the two museums. He borrowed much of the photomechanical work for the Boston exhibition from the US National Museum, the majority of which came from the Osborne Collection.

14 For details of the working partnership between Daguerre and the Niépces, and specific information about the processes of Donné, Berres, Fizeau and others, see Eder, J, *History of Photography*, trans. Epstean, E (New York: Columbia University Press, 1945), pp215–32, 577–80.

15 Kainen, J, 'The development of the halftone screen', *Annual Report of the Smithsonian Institution for the Year 1951* (Washington DC: 1952), p411

16 Bridson, G and Wakeman, G, note 6, p166

17 Mumford, I, 'Lithography, photography, and photozincography in English map production before 1870', *The Cartographic Journal*, 9/1 (June 1972), pp30–6; Wright, H E, note 3

18 Nadeau, L, 'Photolithography', in *Encyclopedia of Printing, Photographic, and Photomechanical Processes*, Vol. 2 (Fredericton, New Brunswick: Atelier Luis Nadeau, 1990), p375. British and French photolithography are covered in Bridson, G and Wakeman, G, note 6, p177–9 and Kainen, J, note 15, pp413–15. For information on Bradford, see Tatham, D, 'The photolithographs of L. H. Bradford', in O'Gorman, J (ed.), *Aspects of American Printmaking, 1800–1950* (Syracuse: Syracuse University Press, 1988), pp105–40.

19 Nadeau, L, 'Poitevin', note 18, p391; Waterhouse, J, 'Alphonse Louis Poitevin and his work', in *Penrose's Pictorial Annual*, Vol. 17 (London: 1911–12), pp49–53

20 Kainen, J, note 15, p416; Bridson, G and Wakeman, G, note 6, pp170–2

21 Crawford, W, note 6, pp285–6

22 Albert, J, US Patent 97,336, 30 November 1869. The licensing of Albert's patent in the USA is described in Wright, H E, *Imperishable Beauty, Pictures Printed in Collotype* (Washington DC: NMAH, 1988).

23 Eder, J, note 14, pp617–19

24 *Old & New*, 8/3 (September 1873), pp376–8

25 Boyle used photographs by Rutherford, Draper De La Rue and Whipple to construct his model, and Bierstadt published photographs and collotypes of Draper's Moon and solar spectrum. See Warner, D J, 'The American Photographical Society and the early history of astronomical photography in America', *Photographic Science and Engineering*, 11/5 (1967), pp342–7.

26 Clarke, J M, *James Hall of Albany, Geologist and Paleontologist, 1811–1898* (Albany, NY: 1921), p476. I am grateful to William A Oliver, Jr of the US Geological Survey for information concerning early collotype reproductions in the palaeontological literature.

27 John Carbutt of Philadelphia produced the Woodburytypes under licence as the American Photo-Relief Company. His difficulties in providing sufficient prints are detailed in copies of correspondence kindly provided by Michael Rhode, Archivist, National Museum of Health and Medicine, Washington DC.

28 Dodgson, C, Preface, *Woodcuts of the XV Century in ... the British Museum* (London: 1934). Other such series include the publications of the International Chalkographische Gesellschaft (Berlin: 1886–1912) and a series of old-master drawings published by the Vasari Society for the Reproduction of Drawings between 1905 and 1935.

29 Hofer, P, 'Full-tone collotype for scientific reproduction', Reproduction Series of the Harvard University Library, Department of Printing and Graphic Arts, Supplement No. 15 (Meriden, CT: Meriden Gravure Co., 1941)

30 'All about Heliotype', Heliotype Company advertising circular, reprinted from the *New York Tribune*, 1 November 1877

31 Hanson, D A, 'Baron Frederick Wilhelm von Egloffstein: inventor of the first commercial halftone process in America', *Printing History*, 15/1(1993), pp12–24

32 Nadeau, L, 'Mosstype', note 18, p335

33 David Reed considers Horgan's relief version a 'derivative' of Leggo's lithographic halftone, and he 'wonders just how much credit Stephen Horgan should receive for his part in its production'. See Reed, D, *The Popular Magazine in Britain and the United States, 1880–1960* (Toronto: University of Toronto Press, 1997), pp30–1. However, Horgan's own reminiscence discredited the usefulness of Leggo's contribution and touted his own. See Horgan, S H, 'Bringing photography to the printing press', *The Photographic Journal* (August 1929), pp355–61.

34 Kainen, J, note 15, pp417–20

35 The print collection is described in Wright, H E, *Prints at the Smithsonian: The Origins of a National Collection* (Washington DC: NMAH, 1996). *History of Photography*, 24/1 (Spring 2000) is a special issue devoted to the NMAH Photographic History Collection.

36 For details of his early life, see 'Osborne, John Walter', *Australian Dictionary of Biography*, Vol. 5, pp375–6.

37 Osborne, J W, 'Photolithographic specimens showing the gradual development of the process at present employed in the Department of Lands & Survey, Melbourne', 20 August 1860, 1, GA 4257.

38 In fact, in Osborne's earliest experiments he tried to replicate Talbot's photo-intaglio method on steel plates. See J W Osborne to G Brown Goode, 6 June 1888, Smithsonian Accession File 23,155.

39 Osborne provided a chronology of his travels and an assessment of his peers in a letter accompanying his donation. J W Osborne to G Brown Goode, 6 June 1888, Smithsonian Institution Accession File 23,155.

40 S R Koehler to G Brown Goode, 1 October 1891, Smithsonian Institution Archives, Division of Graphic Arts Files, Record Unit 70, Box 39. Koehler urged the publication of a catalogue of photomechanical examples, a goal he realised in 1892. See note 13.

41 Koehler, S R, note 13

42 These ideas were expressed by Italian engraver Giuseppe Longhi in his 1830 treatise *La Calcografia*, a work that included recommendations on the formation of a print collection. His views were in vogue as late as the 1870s, when he was cited by Charles Sumner, 'The best portraits in engraving', *The City: An Illustrated Journal*, 1/1 (January 1872), pp6–17, illustrated with Edward Bierstadt's collotypes after the original prints. A copy of this short-lived publication is in the Osborne Collection, NMAH.

43 Delaborde, H, *Mélange sur l'art contemporain* (Paris: 1866), pp375–55, cited in Marien, note 4, pp74–5.

44 Hammond's essay develops the history of a 'hard' versus 'soft' aesthetic from the mezzotint through photogravure, describing the subtleties of tone as 'a preoccupation of British art for more than 200 years'. See Hammond, A K, note 5, p163.

45 Hammond, A K, note 5, p164

46 Harris, N, note 2, pp306–7, discussing Jussim, E, note 1, p288.

47 Orvell, M, *After the Machine: Visual Arts and the Erasing of Cultural Boundaries* (Jackson, MS: University Press of Mississippi, 1995), p173