LOOKING AT

PAPER

evidence & interpretation

Symposium Proceedings
Toronto, 1999

1. Michelangelo Buonarroti (1475–1564), *Study of a Mourning Woman*, pen and brown ink on paper with white heightening, 260 mm x 164 mm, Castle Howard, Yorkshire. See page 205.

Looking at Paper: Evidence & Interpretation

SYMPOSIUM PROCEEDINGS, TORONTO 1999

Held at the Royal Ontario Museum
and Art Gallery of Ontario

May 13–16, 1999

Edited by John Slavin, Linda Sutherland,
John O'Neill, Margaret Haupt and Janet Cowan

Canadian Conservation Institute
Institut canadien de conservation

Acknowledgements

The symposium was organized by Margaret Haupt, John O'Neill, Linda Sutherland, Janet Cowan and John Slavin. Generous support and assistance were provided by John Krill, Nancy Bell, Nancy Jacobi and many paper conservators in Toronto.

The symposium was made possible by the financial assistance of the Canadian Conservation Institute, the Canadian Association for Conservation of Cultural Property, the American Institute for Conservation of Historic and Artistic Works – Book and Paper Group, the Japanese Paper Place, the Japan Foundation Toronto, the National Library of Canada, and the Institute for Paper Conservation.

The editors would like to thank the authors for their manuscripts, and Peter Bower and Akinori Ōkawa for allowing their workshops to be recorded and transcribed for inclusion in this book.

Technical review and editing by John Slavin, Linda Sutherland, John O'Neill, Margaret Haupt and Janet Cowan.
Recording transcription by Linda Sutherland.

Production co-ordination by Sophie Georgiev, Mark Smith and John Slavin.
Design and layout by Mark Smith.
Copy editing and proofreading by Gillian Watts.

PRINTED IN CANADA

Available from:

Canadian Conservation Institute
1030 Innes Road
Ottawa ON K1A 0M5
Canada

www.cci-icc.gc.ca

National Library of Canada cataloguing in publication data

Main entry under title :

Looking at paper : evidence & interpretation : symposium proceedings, Toronto 1999

"Held at the Royal Ontario Museum and Art Gallery of Ontario, May 13-16, 1999"
Includes bibliographical references.
ISBN 0-660-18571-7

1. Paper – Congresses.
2. Paper – History – Congresses.
3. Papermaking – Congresses.
4. Papermaking – History – Congresses.
I. Slavin, John.
II. Canadian Conservation Institute.

TS1080.L66 2001 676 C2001-980207-2

The cover stock is EuroArt Silk 8 pt. The text stock is Rolland Opaque Recycled Natural 70 lb. Smooth – acid-free paper (pH 8 to 10 cold extract). Meets ANSI Permanency Standards.

Typeset in Sabon and Myriad.

Contents

Preface

The old book collector's pulse was almost visible, throbbing in his wrist and temples. His voice became deeper as he held the book up to his eyes so he could read more clearly. His expression was radiant.

'A magnificent book,' confirmed Corso, dragging on his cigarette.

'It's more than that. Feel the paper.'

The Club Dumas *by Arturo Perez-Reverte*

Given the commonplace usage and proliferation of paper today, we could easily conclude that its presence is necessary but innocuous. Indeed, it is often of little consequence and easily disposable. However, history informs us that paper production and usage have had, and continue to have, a significant impact on our world.

Close examination of books, documents and works of art on paper reveals that there is much to appreciate in the material itself.

Those attending the *Looking at Paper* symposium — historians, archivists and conservators — delight in its beauty and variety. We often examine papers looking for clues, traces, small imperfections and distinctive characteristics of its making and usage. This evidence can lead to a wealth of information on the origin, user intent, date and authenticity of an obscure letter, a suspicious banknote or a recently discovered old master drawing.

While many experience the excitement of solving little mysteries using fibre identification techniques and microscopic surface analysis, we all enjoy the look and feel of a sheet of paper. Though our interest and curiosity may in large part be professional, we have, at heart, a deep-felt appreciation for paper in its myriad forms and for the unsung contribution of the humble papermaker to the recording of the art and history of civilization.

This appreciation was tacitly acknowledged in a symposium devoted to the many diverse areas of research pursued in the presentations and workshops published here.

John Slavin

Looking at Paper: Evidence & Interpretation

PART 1 : PRESENTATIONS

The White Art: The Importance of Interpretation in the Analysis of Paper

PETER BOWER

Abstract

This is a survey of some of the various methods used to investigate papers and record the results of those investigations. It covers some of the similarities and differences in investigating works of art on paper, documents and printed material through fibre analysis and watermarks and their recording. The accuracy of historical reference material, the importance of mill records and other archival material, and the need for comparative material are discussed. Keeping an open mind in both the analysis and interpretation of the evidence is stressed, along with the importance of collaboration with investigators in other fields. Some aspects of papermaking and watermarking practice that seem rarely to be considered, but which can often have an important part to play in interpreting one's findings, will be highlighted. This paper, along with 'Beating the Forger: Case studies in forensic paper investigation' and my workshop 'Examination of Western Papers,' are designed as three parts of one discourse.

Every sheet of paper tells a story; it contains the marks of its making and, as such, is worthy of close examination. Although the methodology employed in the investigation of any paper artefact, of whatever type — drawn, printed, single sheet, book — often uses the same basic techniques and equipment, it cannot be emphasized enough that there is no formulaic approach to the investigation of individual papers. The techniques and equipment remain the same whether one is engaged in the forensic examination of the object or conducting an investigation to aid art historians or paper conservators. However, the burden of proof required by these various disciplines is very different.

No investigation takes place in isolation since each object has its own complex history having been produced in a particular way at a specific time by a particular individual or individuals. Much of that evidence is either directly visible or can be identified through vigorous analysis. It is crucial to retain an open mind, be surprised by what you may find, and enjoy your work. I find if I am having fun I do much better work.

The papers presented in this symposium show the depth and range of current research into paper (its making and use) being conducted around the world. This publication and others[1] emphasize the increasing importance of the study of paper and its history to people working in a wide variety of disciplines. We all bring different perspectives to our study and all benefit from the findings of those working in other fields.

I came to the analysis of paper from papermaking, and the practical experience of making sheets by hand for a very wide range of uses served me well as my work evolved away from production into analysis. In the late 1970s, I began to collect paper and to analyse the particular properties of individual papers in order to make better paper myself. Over the years the collection has grown and now threatens to overrun all my available space. Examining the ways individual makers at different periods in history had approached similar problems — of continuity of raw material supply, of preparation, of surface treatments and finishing techniques — in order to achieve very particular results in the paper when it was in use, has become an absorbing study and has proved to be an essential background to the forensic study of paper.

However, not all my work is forensic; for many years I had wanted to examine the work of a single artist throughout his or her working life, to be able to understand how the changing nature of materials allowed or assisted very specific changes in working habits on the part of the artist concerned. I have been fortunate enough to be awarded both a Volkswagen Turner Scholarship and a Leverhulme Research Fellowship at the Tate Gallery for a study of J.M.W. Turner's use of paper. This work resulted in two exhibitions and two books.[2] There are some 20,000 drawings and watercolours by Turner at the Tate, and several thousand other works in public and private collections throughout the world. This sheet-by-sheet analysis has been an absorbing and fascinating, not to say time-consuming, occupation.

My other work involves individual and specific analysis for museums, galleries, auction houses, dealers, lawyers, papermakers and private individuals. Much of this work concerns works of art on paper, but also involves work on letters, documents, books, banknotes and other paper artefacts. Another aspect of my work is advice on the design of new papers, which has recently included work on the production of a handmade, linen-rag-based, gelatin-sized watercolour paper for Handgeschoptfe Papiere, Germany, and on the design of various handmade papers for Bingham & Company, now based at Margaux in Burgundy.

The range of papers I have been asked to examine is enormous, extending from a fifteenth-century crucifixion drawing to photocopies made as recently as two years ago. It has included some fascinating cases, three of which form the basis of my second paper on forgery. As my work varies so much from very old to very recent papers, reference material is essential. Mine consists of a library of fibres and raw materials, a collection of paper samples and a library of books and journals.[3] In trawling for information relevant to any particular piece of paper, one has to cast one's net very wide. For example, with respect to banknote information, it was essential to use the Czechoslovak Ministry of the Interior's report on German forgeries of British currency for one piece of my research.[4]

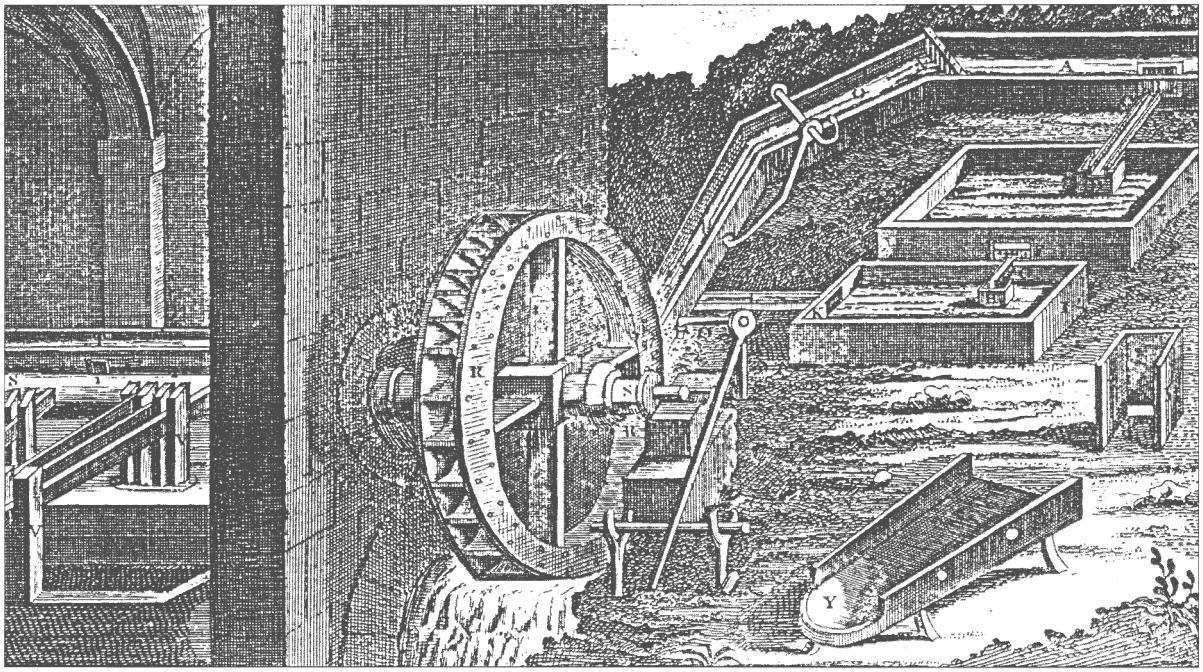


Fig. 1 Water-wheel and water filtration beds, a reprint in John Hinton's 'The Method of Making Paper,' published in the *Universal Magazine*, London, 1751.

The growth of fraud and counterfeiting in so many fields, from banknotes, drawings, books and water-colours to official forms, documentation and packaging used for pirated goods, is demanding much more of the forensic paper analyst than in the past. Fortunately there are many analytical instruments being developed, some originally for use in other fields, such as particle-induced x-ray emission (PIXE), which can aid us if the nature of the work demands that kind of expenditure.[5]

The literature of the papermaking industry, whether it be recent publications or material published years ago, is also essential. For example, when determining the probable age of a toned business paper, the identification of the colouring agent used can tell you much about the source of the sheet, which in turn can help in dating it.[6] Paper mills regularly send me samples of their latest products together with relevant technical data. Any information on current or recent practice is of course highly sensitive, but I have found most mills to be extremely helpful where suspected forgery or fraud are concerned. However, it should be remembered that the literature is often not going to answer whatever your specific problem is, but will be useful in pointing the way. Every case is unique, and what is described as best practice in much of the technical literature is actually more theoretical than most authors would care to admit. Many mills have developed very specific variations of basic techniques, some of which are recognizable under the most careful examination.

One area of research that sometimes needs to be treated with caution is publications on paper and its making from earlier centuries, particularly encyclopedia entries or learned society treatises. One classic instance of this is an engraving of a water-wheel and water filtration beds found in Lalande's *L'art de faire le papier*.[7] Although the settling ponds (filtration beds) illustrated in figure 1 are an excellent idea and were used by many mills at a later date, there is no archaeological evidence that any mill in western Europe was actually using such a technique for insuring the cleanliness of its water for nearly a century after the original date of 1698 for this engraving. The plates found in Lalande were originally engraved by L. Simonneau for a text by Gilles Fileau de Bilettes. On a lighter level, the autobiographies of counterfeiters have occasionally proved useful but they should be treated with great caution. Eric Hebborn's recent autobiography documenting his production of 'Old Master' drawings is perhaps as truthful as the works he produced, adding yet another strand of deception to an already complex web.[8]

Sometimes no special techniques or research are needed. In a recent case I was asked to examine the paper ground of an oil sketch by Raphael over which there was some confusion. The art historians were arguing about the handling of the paint and whether this was by the hand of the master or one of his contemporaries. A brief examination of the paper, simply by holding it up to the light, revealed that the paper was a wove sheet (only invented in the 1750s[9]) and, judging by the details of both the relatively coarse profile of the forming wire and the configuration of the support wires underneath, was likely to be English, dating from *c.* 1800.[10] It was obviously not a Raphael, but an interesting copy by a much later hand.

Over the past century and a half an accelerating technological progression in the manufacturing side of the industry has been coupled with an increasing specialization in the products. There is a vast range of difference between a basic wrapping paper and a quality book paper despite the fact that they will probably both be printed on. In the eighteenth century the main difference between these two types of papers was simply the quality of the raw materials and their preparation; lower grades of the same rags were used for coarse wrappings,

but strong wrappings might well be made from rag grades equal to those used for the finest writings and printings, although less care would have been taken in the quality control of the finished sheets.

In the past, similarities in raw material and production methods made most papers of a particular type suitable for other uses. It is common to find various wrapping papers being used by artists for drawing and painting simply because they liked the colours, tones and surface characteristics. The increasing specialization of most paper mills has led to much less versatility in terms of what any one paper is suitable for. Nevertheless, it is still very common to find artists in particular using papers for purposes quite other than what they were originally designed for. Fax papers have been used for ink drawing, business stationery for drawing, woodcuts and even engraving, and legal and security papers for calligraphy with a quill or a steel nib. A wonderful example of this is the work of David Cox (1783–1859). None of his three favourite papers (a true cartridge paper, a ream wrapping paper and a map paper) had actually been designed for watercolour. He did a drawing, *The Royal Hospital, Greenwich*, on the back of a part sheet of uncut cheque blanks (fig. 2) issued by the Marylebone branch of the London and Westminster Bank.[11] At first the work appears to have been executed on a hot-pressed watercolour paper, but, when seen on the gallery wall, something about the texture of the surface suggested that it could be something quite different. Cox was given a lot of different papers by his brother-in-law, who dealt in various papers, including the map papers supplied to the Ordnance Survey.

There is such a richness of possibility for artists in the choice of paper available. There are presently some 14,000 designed end uses for paper now, compared with half a dozen distinct and designed uses 200 years ago. This diversity can actually help rather than hinder the search for origins or dates for a particular paper. Basic types can be recognized and a search initiated into specific categories. However, the difficulty of such searches is compounded by the level of import and export sales of both raw materials and finished paper across the world today.[12]

Scientific analysis of a paper complements research into the history of the sheet and the results may suggest further avenues for investigating its origins. Over the years different analytical techniques, better equipment and deeper experience have led to the re-evaluation of some earlier scientific findings. Analysis of some of the earliest surviving Chinese papers, deposited at the British Museum in 1909 by Sir Aurel Stein, shows that hemp, derived from waste cloth and rope, was one of the most important fibres used in early Chinese papermaking. Clapperton extensively discussed the use of hemp in early Chinese papermaking, but his fibre analysis, done in the 1930s on 15 different papers from the Stein collections, indicated no hemp was present. Clapperton's interpretation was ramie and paper mulberry.[13] However, later analysis has provided different results. In 1970 Collings and Milner were given permission to remove small samples of paper from points adjacent to those from which

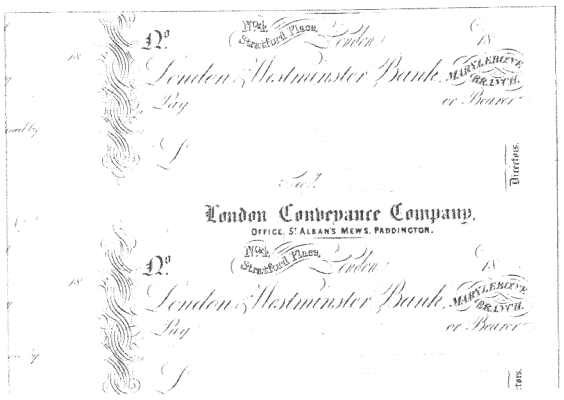


Fig. 2 Verso of a drawing, *The Royal Hospital, Greenwich,* by David Cox (1783–1859), showing that it is executed on the back of a part sheet of uncut cheque blanks. Courtesy of Spink Leger Pictures, London.

Clapperton had removed his samples. Their studies re-evaluating the evidence, using different techniques and more modern optical systems, were based on comparisons with the fundamental identification characteristics of individual fibres derived from botanical specimens, and the conclusions were startlingly different.[14] While blends of ramie and paper mulberry were present in 14 of the samples, 10 of them also contained often large amounts of hemp, including 5 samples which Collings and Milner estimated had more than 90% hemp.[15]

Microscopes and testing can tell one much about specifics, but unless the particular details are placed in their correct context in terms of actual historical papermaking practice — whether that be from 1500, 1700 or yesterday — and are clearly understood, all one has is raw information rather than knowledge. Combining scientific data with the historical and contextual interpretation of that data is crucial. Too many reports are written in such vague terms that they are practically useless. All too often the analysis of paper appears to come down to very general interpretations of somewhat erroneous facts. In the case of an old master drawing or an early-nineteenth-century manuscript, it is infuriating to read that such a sheet is made of linen rag and therefore nothing about it contradicts the purported date. Linen rags were in use all over western Europe and beyond; they were processed in different ways at different times and places and, particularly from the nineteenth century on, were found in combination with a wide range of other fibres.

Much can be deduced or interpreted from a proper examination of the components present in the paper. One should ask whether the fibres are clean. If not, what else is present? Tar, for example, is often found where hemp from old rope has been used together with linen. The nature of the 'whiteness' of a paper can reveal a lot. White papers, for most of papermaking history, were rarely as white as we see today, particularly since the advent of optical brightening agents in the 1950s. Tones of white are, in conjunction with other evidence, very useful in showing one where to begin to look for the origin of a particular sheet. Greyness or yellowness are definite indications of different regions where papers

might have been made. The soaps used to wash the raw materials before they were rags varied from country to country, and these soap residues had distinct effects on the processes of fermentation used to begin the breakdown of rags until the latter part of the eighteenth century.

Other questions to pose are whether there is one type of linen or more present in the furnish. Has the colour of the paper been 'corrected' by the use of any blueing agents such as blue linen fibre, smalts, or dyes such as indigo, ultramarine and (more rarely) Prussian blue? Were the fibres stamper- or hollander-beaten? Stamper-beaten rag is often recognizable. Is there any trace of bleaching of the fibres, for instance, the presence of shives and specks not so amenable to the chlorine bleaching powders that came to be so prevalent in the nineteenth century? Are there other 'rag' fibres such as cotton or hemp present? What, if any, sizing agent has been used? Are any loadings such as china clay or pigments present? Has the surface finish been achieved, for instance, by plate glazing or calendering?

With respect to the examination and recording of watermarks, few researchers seem aware that there is a whole series of factors, determined by the actual making of the sheet, that produce subtle and sometimes not so subtle changes in a watermark image and in what can be seen of the wire profile of the sheet. Sheets made on the same mould with the same watermark can exhibit enormous differences. Drying times, whether or not the sheets are dried in spurs, how many sheets to the spur, the thickness and density of the sheet, couch faults, fibre choice and beating details all contribute to the finished size, proportion and clarity of the mark. Differences in the shrinkage of the sheet during drying can vary the resulting dry sheet size by as much as three-quarters of an inch in any direction, with a resulting difference in the watermark. If the sheet shrinks proportionally more in one direction than the other, then the watermark's actual proportions will change as well as its size.

Phillip Pulsiano's bibliography of published books and articles on watermarks records well over 100,000 watermarks illustrated in the publications he lists. Although incomplete, his listing is the single most useful bibliography of watermarking so far.[16] It was published in 1987 and, given the dramatic increase in watermark research in recent years both in North America and Europe, someone could do us all an inestimable service by producing a supplement bringing it more up to date.[17]

Early mentions of paper and its making are rare in English, aside from the brief reference in Wynken de Worde's printing of *Bartholomeus: De proprietatibus rerum* of 1496,

> And John Tate the younger Ioye mote he broke
> Whiche late hath in Englonde doo make this paper thynne
> That now in our englysh this boke is prynted Inne[18]

There is little before the seventeenth century except Thomas Churchyard's poem of 1588, the first description at any length of papermaking in England or in English:

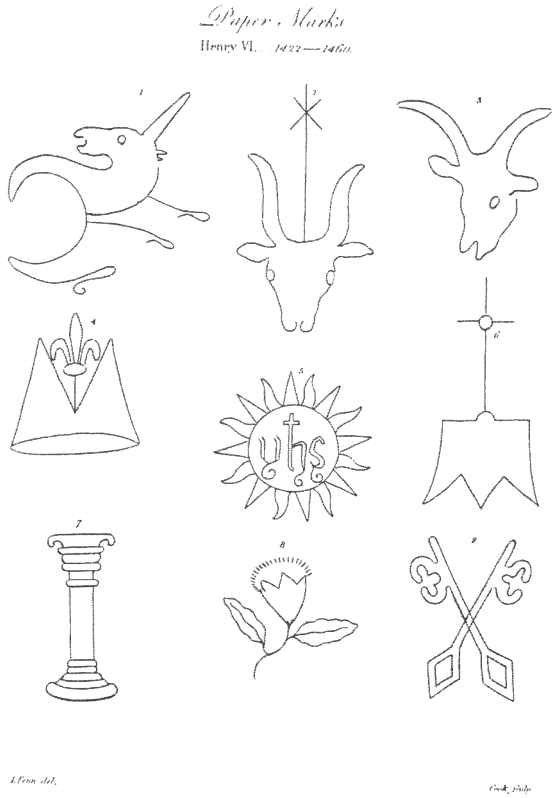


Fig. 3 Plate 8 of John Fenn's *A Catalogue of the Original Letters* . . . (known as the Paston Letters), published between 1787 and 1823.

> I prayse the man that first did paper make,
> the onely thing that sets all vertues forth:
> It shoes newe bookes, and keepes old workes awake . . .[19]

The next most significant publication on paper, if one discounts the 92 times that Shakespeare uses the word *paper*[20], is John Taylor's epic poem *The Praise of Hempseed*. It is worth reading, not for the poetry, which is often dreadful, but for the attitudes to paper and its making expressed in it.[21] One of the earliest texts relating to the investigation of paper is a rare treatise on the introduction of rag paper published by the Dutch scholar Gerard Meerman (1722–71). In 1762 he offered a prize of 25 ducats for the person who could establish the date of the first rag-based paper. Research on the subject and specimens of paper arrived from scholars all over Europe. In 1767 Meerman published the results of his research and illustrated his text with two full-page woodcuts (white on black) of watermarks. These are possibly the earliest illustrations of watermarks published.[22]

More appears to have been published on watermarks than on papermaking. Joseph Hunter records perhaps the earliest mention of watermarks when he refers to Bartholus writing of the paper mills at Fabriano in the marshes of Ancona, 'who wrote in the middle of the 14th century . . . that the manufacturers were accustomed to use certain marks, to which a value was attached.'[23] Besides Hunter, John Fenn,[24] the Reverend Samuel Denne[25] and Samuel Sotheby[26] all published selections of

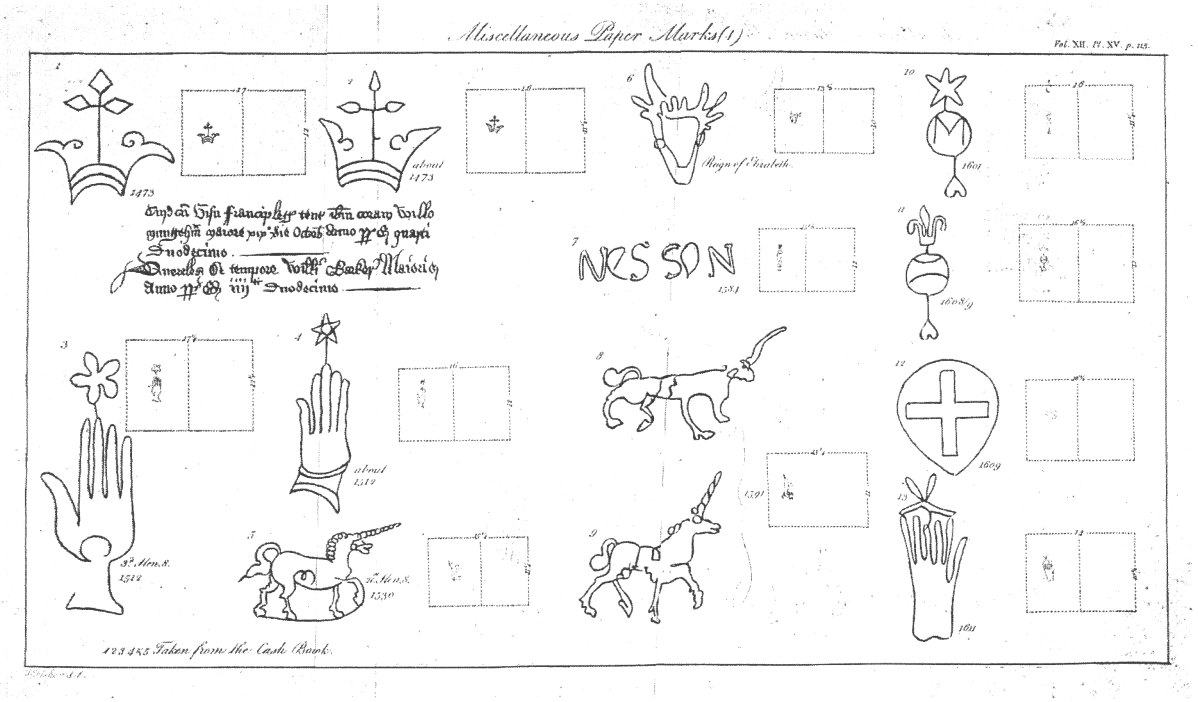


Fig. 4 Plate 15, engraved by Thomas Fisher, of Reverend Samuel Denne's 'Observations on papermarks in a letter to Mr Gough,' in *Archaeologia* 12, 1795. A very useful addition to the marks are the small-scale drawings of each sheet indicating the position of marks and countermarks.

watermark reproductions together with varying amounts of authoritative information (figs. 3, 4 and 5).

Comparisons between two earlier filigranologists with very different working methods may prove instructive. For instance, A. Bates and R. Lemon were amateur filigranologists of very different degrees of skill. The Bates Collection of watermarks[27] was put together for intended publication in the 1920s by Lt.-Col. A.S. Bates, D.S.O., T.D., but sadly no publication materialized.[28] The whole collection consists of several hundred British and European watermarked papers dating from *c.* 1400 to *c.* 1850, as well as Bates' transmitted light photographs (sadly somewhat deteriorated), brief manuscript notes on many of the marks, tracings of approximately half the marks, and tracings made from papers found in books and in other collections — notably James McBey's collection. The collection also has some 70 plates prepared for his intended book and some draft text (figs. 6 and 7). The collection is especially interesting for the insight it gives into the working methods of a serious filigranologist in the earlier twentieth century. Although Bates continued to use tracing as a major part of his recording of watermarks, he is almost unique at this date in realizing the potential of transmitted-light photography in this field, working with both positive and negative images as well as early diazo techniques.

Very little is known about Robert Lemon, who produced a collection of watermark tracings in the 1860s.[29] His watermark plates were first published over 30 years after his death in Scott and Davey's *A Guide to the Collector of Historical Documents* of 1891.[30] Lemon worked at the Public Record Office and was not the first person there to have made a study of watermarks in English documents. Joseph Hunter (1783–1861),

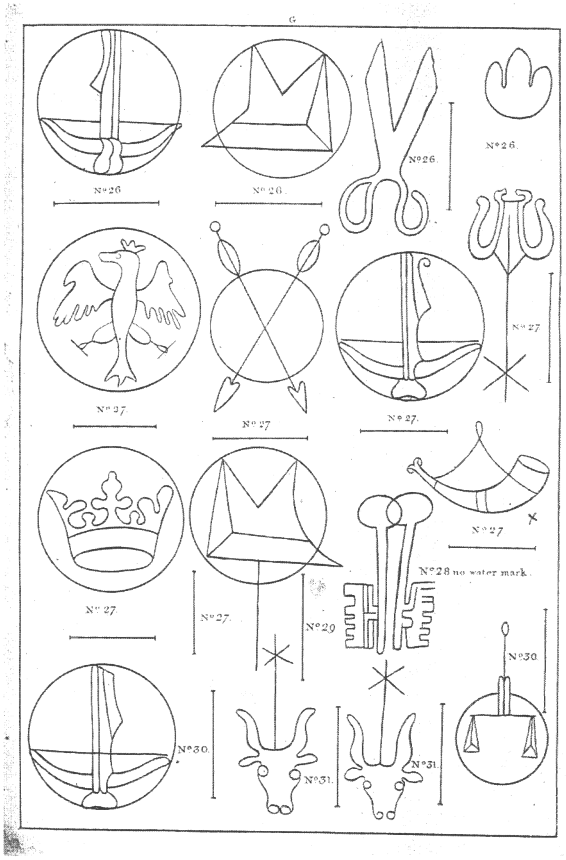


Fig. 5 Plate G from Samuel Sotheby's *Typography of the 15th Century*, Volume 3, London, 1845.

assistant keeper at the P.R.O. and a vice-president of the Society of Antiquaries, presented a paper to the Society in 1857 in which he described some 30 marks.[31] J.G. Brodie, who entered the Record Office in 1879 and retired in 1924 as assistant keeper, made a large set of

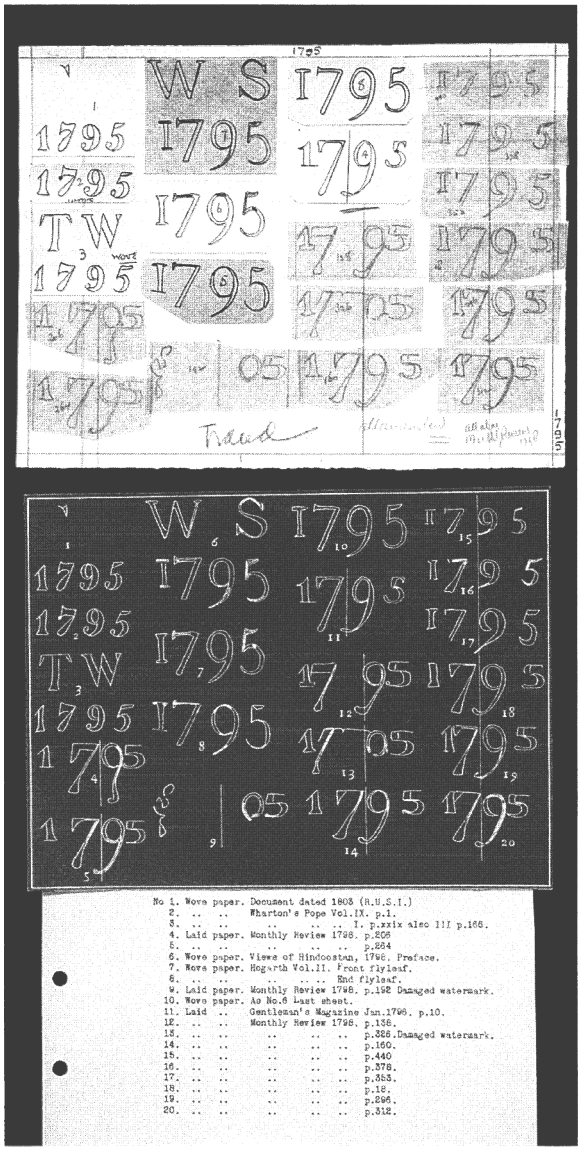


Fig. 6 Bates' working tracings and the finished plate for his dated 1795 watermarks, together with his listing of the sources of the marks.

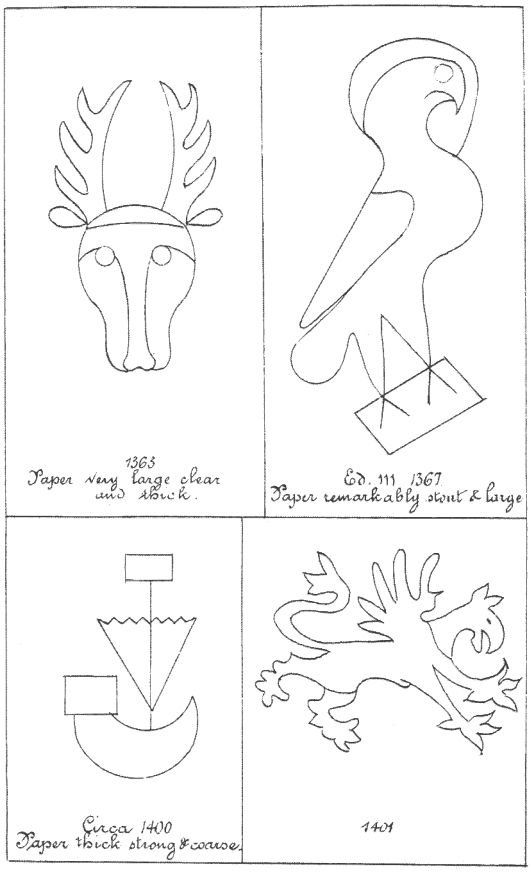


Fig. 7 A plate from Robert Lemon's watermark collection, including his comments on the papers.

tracings of watermarks but would apparently look at nothing after the time of Henry VIII.[32] He does not appear to have published anything on this particular side of his research, and enquiries at the Public Record Office have not unearthed any of his drawings. Judging by the occasional comments made by Heawood in his *Sources of Early English Paper Supply*,[33] Brodie seems to have been in contact with Heawood in the 1920s. One wonders if his tracing collection passed to Heawood, since he talks of a 'rapid examination . . . made at the Record Office of volumes of State papers chosen at random from the long series covering the reign of Henry VIII.'[34] Both Labarre and Heawood were somewhat dismissive of Brodie's collection. With respect to the Lemon collection, Heawood felt that the value was 'reduced by the failure to state explicitly where the documents drawn upon were written.'[35] Labarre also dismissed this collection of watermark drawings with the words 'a somewhat inadequate attempt to collect a series of watermarks . . . under each design — drawn not traced, the straight lines and circles being produced with the help of rule and compasses — is given the date but not the description or place of origin of the document.'[36]

Although I would agree with Labarre about the way the drawings were made, I do not dismiss this collection so lightly. Using it in conjunction with a range of watermark research by others over the past 150 years or so, one can begin to trace the spread of usage across Europe, which brings up some interesting problems. The real value of this collection lies in its place within the evolution of the subject of filigranology as a specific discipline. In this context, it is a perfect example of what not to do. When one looks at all the published eighteenth- and nineteenth-century texts on watermarks, one finds that they separately contain, albeit in embryonic form, most if not all of the elements one might require from the comprehensive recording of a collection of papers.

Lemon's plates were published without any accompanying text, aside from the brief annotations made under each mark on the plates. They are organized chronologically and all carry dates, but sadly without any identification of the actual documents from which they have come. In some instances Lemon has included two or more marks within the same border and with the same date and paper description. I can only presume, given the nature of the marks illustrated, that they occur in the same source document rather than within the same sheet. Some of the annotations refer to specific kings and to the years of their reigns, but the majority of these notes

are very simple descriptions of the paper, for example, 'Paper remarkably stout and large' (no. 2) and 'Paper smaller than foolscap and rather fine for the age' (no. 139).

One problem with Lemon's descriptions lies in the definitions of his recurrent terms: *coarse* presumably means rough, *stout* might be heavy or thick, and *clear* suggests very translucent. Occasionally he describes a paper as 'common'; does this mean that the weight, texture and colour of the paper in question were something that he came across regularly in his work at the Record Office or, more specifically, that this mark was common among the documents that he came across? It is also possible that he is expressing a qualitative judgement, simply using *common* in a pejorative sense — the paper wasn't really very good. Many nineteenth-century descriptive terms have such a distinctly moral connotation.

In this next section I will concentrate on one particular and very common watermark, *1794/J WHATMAN*, in order to discuss various aspects of watermarks to which little consideration is given (fig. 8). It is important to realize that artists often use sheets from a particular batch of paper for many years. Like all artists, J.M.W. Turner kept stocks of paper for use; remnants of different batches bought years before must have been stored in his studio. There are several examples in the bequest of Turner working on relatively old papers.[37] One particular batch of Super Royal drawing paper watermarked *1794/J WHATMAN*, made by William Balston and the Hollingsworth Brothers at Turkey Mill, Maidstone, Kent, was first used by him in that year.[38] He returned to using sheets from this batch in the watercolour *Sketch for Cockermouth Castle, Cumberland* of *c.* 1825[39] and for *Colour Study of Heidelberg,* executed in *c.* 1841,[40] nearly 50 years after the paper was made. What made him return to a particular paper years after he first used it can only be guessed at, but the rich, glowing light is reminiscent of some of his experiments in the 1790s, when he was using large sheets of 1794 Whatman paper to explore the effect of glowing light possible in back-painting, as seen in some of his views of Norham Castle and other works.[41] There are other examples of Turner returning to a paper many years later; the recent Turner exhibition at the British Museum showed the luminous *Lucerne by Midnight* of 1843, in which Turner returned to the same batch of thin writing paper watermarked *J WHATMAN/1816* which he had used (prepared with a grey wash) for many of the series of 51 *Views of the Rhine* of 1817. Many of these views were in the exhibition as well, including some on the same paper.[42]

One must be wary of assuming that all the different examples of the papers watermarked *1794/J WHATMAN* are the same. Papers were being made for many purposes and each different use had its own sheet size and weights, even if the papers were given the same name. As the list in table 1 shows, a Demy Printing is a different-sized sheet from a Demy Drawing. In Turner's case, 23 different *1794/JWHATMAN* papers have been identified in the bequest, some of which are found in three different finishes and all in different weights. It should be noted that in many instances only parts of these sheets can be found in the bequest.

Fig. 8 Two examples of a *1794 / J WHATMAN* watermark from the same batch of paper but used by J.M.W. Turner 20 and 47 years respectively after he purchased the batch of paper.

The sizes in the table are the nominal sizes — there was often considerable variation in size between different batches made on the same moulds. Changes in the furnish used, degree of beating, weight of sheet and seasonal differences in relative humidity and temperature could all affect drying times and the shrinkage in the sheet as it dried, leading to variations in the size of the finished paper.

The basic *1794 / J WHATMAN* watermark followed standard positions in the sheet for laid and wove, but the scale of the lettering varied depending on the size of the sheet; bigger sheets generally had bigger watermarks. The marks were handmade and thus vary slightly from one to another. Turkey Mill used double moulds for the smaller sizes of sheets, giving two subtly different marks on each mould in the pair. Some of the Post, Large Post and Foolscap sheets were watermarked twice in each sheet, giving four marks on each mould and eight to the pair.

It should also be remembered that the *1794/J WHATMAN* watermark, like many other British watermarks during this period, was actually in use for many years. After the introduction in April 1794 of a statutory requirement to include the year date in the watermark of papers to be used for particular purposes, most English paper was dated in the watermark.[43] However, most papermakers, at least at first, changed the dates on their moulds only irregularly, when a particular mould needed replacing. The reason for this requirement was that papermakers could claim a drawback on the excise duties payable for certain printed books, notably

- paper used for certain scholarly books printed by the universities of Oxford, Cambridge and Edinburgh;
- paper used for bibles, prayer books and works of devotion printed by the universities and the King's printers;
- paper used for certain government publications printed by the King's printers;

- paper used for any printed books that were exported (bound ruled account books were included under this heading).

Although the act's provisions relate specifically to printed paper, some of the moulds used, for instance, in Printing Demy could also be used for Drawing Demy. These sheets are often described as having different sizes; some of that difference in size comes from differences in weight and beating, which led to different amounts of shrinkage in the drying sheets even when made on the same mould. Each pair of moulds of a particular size had different amounts of use depending upon the amount of paper of that particular size that needed to be made. Consequently, those moulds which saw much less use did not need replacing until much later than did those moulds in more regular use. In the case of the moulds used by Balston and the Hollingsworths at Turkey Mill which carried the J. Whatman name, the next known date is 1795, in some laid writing papers, but 1797 in some wove papers. Other Whatman wove papers, however, do not appear with a new date until 1801 or, in the case of Double Elephant, 1804. The next date usually found in Whatman wove papers is 1808.[44] The act was repealed in 1811, but by that date most English makers were in the habit of changing the dates on their moulds quite regularly.[45] Stevenson and others have suggested very short lives for individual watermarks on particular moulds, but most of this research has concentrated on much earlier papers. By the end of the eighteenth century, mould construction, particularly in England, had become a very sophisticated craft, and better construction (in particular the corner joints and the strengthening of some areas of the mould frame and deckle) led to much longer periods of usage.[46] I know from my own experience as a papermaker that moulds can last for years, even under fairly constant use.

Western European papermakers have always used and appropriated each other's marks. This sometimes occurred through the subcontracting of particular orders, where the moulds themselves would be lent to another mill, for example, in the late nineteenth century when J. Green & Son made some 'Whatman' papers for the Balstons.[47] But on other occasions makers stole another maker's mark because that mark had come to signify quality.[48] A very complex area of investigation, and one that is particularly relevant in the work of several nineteenth-century artists, is the plethora of marks in forged Whatman paper made on the continent in the first half of the nineteenth century. During his travels searching for watermarks, the late E.G. Loeber realized from the different shapes in the letters and other details that some of the papers with Whatman watermarks were not made by W.R. Balston at Springfield Mill, Maidstone, but were manufactured on the continent with forged marks.[49] All the forgeries found so far are in wove rather than laid papers. Loeber's collection of forged Whatman marks all appear to be from documents found on the continent, but other examples of these continental 'Whatman' papers have been found in England.

Size	Designed Use	Type	Dimensions (in.)
Antiquarian	drawing	wove	31 × 53
Atlas	drawing	wove	26 × 34
Colombier	drawing	wove	23.5 × 34.5
Demy	drawing	wove	15.5 × 21
Demy	printing	wove	17.5 × 22.5
Double Elephant	printing	wove	27 × 40
Double Elephant	drawing	wove	26.75 × 40.25
Double Medium	writing	wove	23 × 36
Foolscap	writing	laid and wove	13.5 × 17
Foolscap	drawing	wove	13.25 × 16.5
Imperial	writing	wove	22 × 30
Imperial	drawing	laid and wove	22 × 30.5
Imperial	printing	laid and wove	22 × 30
Large Post	writing	laid and wove	16.5 × 21
Medium	writing	wove	18 × 23
Medium	drawing	wove	17.5 × 22
Royal	writing	laid and wove	20 × 25
Royal	drawing	wove	19 × 24
Royal	printing	wove	19.5 × 24 25
Small Imperial	drawing	wove	21.5 × 28.5
Super Royal	drawing	wove	19.5 × 27.25
Thin Post	writing	laid and wove	15.25 × 19.5
Thick Post	writing	laid and wove	15.25 × 19.5

Table 1 Papers watermarked *1794 / J WHATMAN* found in the Turner Bequest.

Three sketchbooks used by J.M.W. Turner, all bought in Austria on his way to Venice in August 1840, contain a J Whatman mark but are not genuine Whatman paper.[50]

These fake Whatman papers were produced in France, Germany and Austria during the early part of the nineteenth century. The reasons for its production varied in different countries. In France, for example, it was essentially a question of cashing in on the name and reputation of Whatman,[51] whereas in Austria such 'foreign' papers were deliberately manufactured 'in order to render the Country independent of the seemingly indispensable foreign types and qualities.'[52]

Eineder describes the beginnings of this tradition in the Italian possessions of the Austro-Hungarian Empire, with the forgery of the watermarks of the celebrated Dutch papermakers Dirk and Cornelis Blauw by Valentine Galvani of Pordenone in the 1760s.[53] Quite large amounts of Dutch paper, from the Blauws, Cornelis and Jan Honig, Jacob Honig and Zoon, Pieter de Vries, Piet van der Ley, and Jan Kool were available in Italy throughout much of the eighteenth century, and examples of these papers have been found not only in the work of many British artists who travelled and worked in Italy, including Joseph Wright of Derby (1734–97), John Downman (1750–1824), William Pars (1742–82), and Francis Towne (1739–1816), but also in the working drawings of architects and goldsmiths such as the Valadier family, who worked in Rome from 1695 to 1839.[54] Subtle differences within many of the supposed Dutch marks suggest that several of them were probably

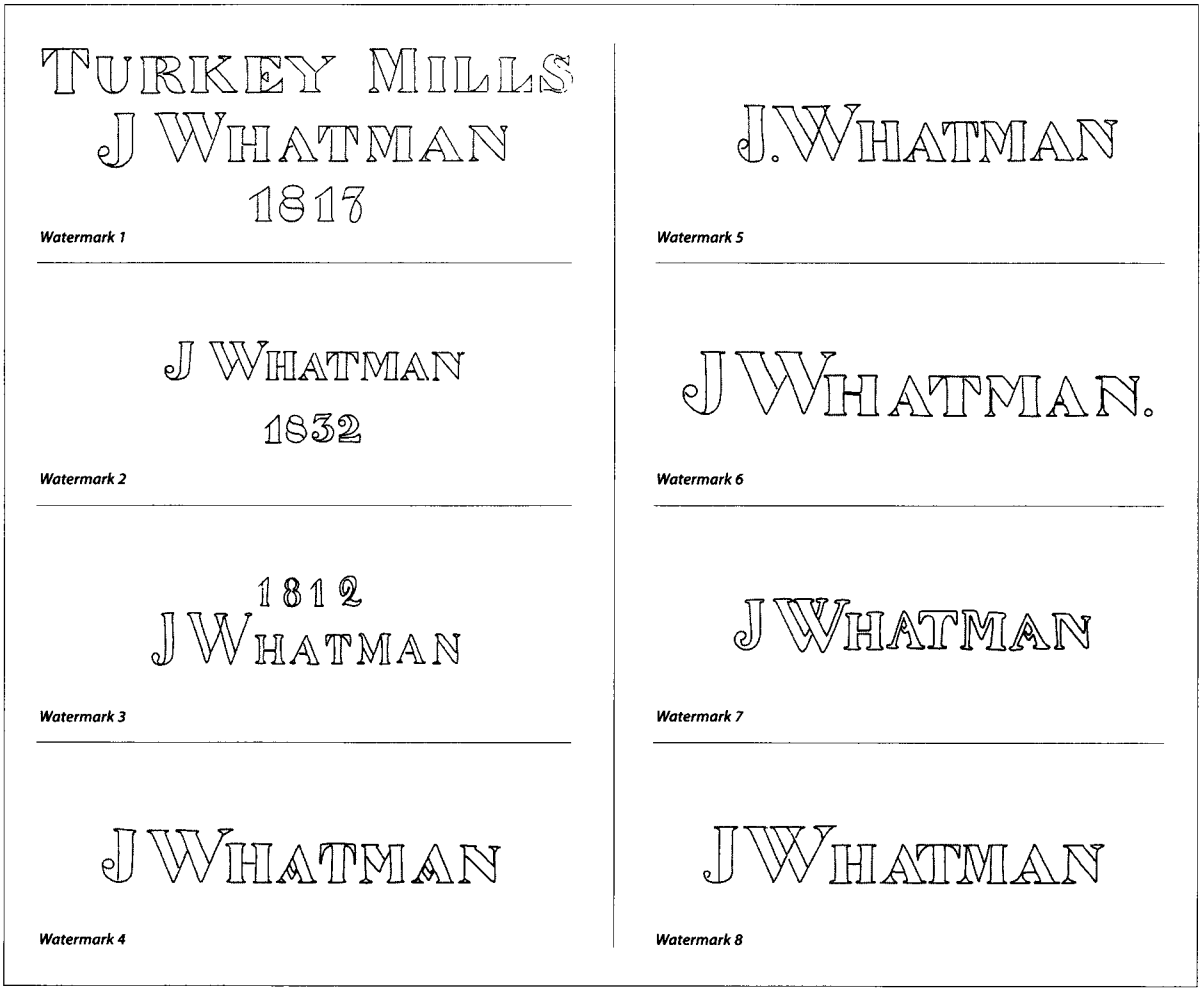


Fig. 9 Examples of genuine and forged Whatman watermarks.

Watermark 1: *TURKEY MILLS / J WHATMAN/ 1817*
Genuine mark from the Hollingworth Brothers at Turkey Mill, Maidstone, Kent. After 1807 both Balston and the Hollingworths had the right to the Whatman name. The Hollingworths distinguished their product by the addition of *TURKEY MILLS* or, usually, *TURKEY MILL*, to the watermark. The *J WHATMAN* is more often found above *TURKEY MILL* than in the form seen here. There is some doubt as to whether this form was ever forged. Source: Loeber KLH 5A/FI 6595, document dated 1818.

Watermark 2: *J WHATMAN / 1832*
Genuine mark from William Balston at Springfield Mill, Maidstone, Kent. This letterform style is typical of Balston's production from about 1810 and throughout the rest of the century. The same basic form is found in many different sizes depending on the actual sheet size of the paper. Source: Loeber DLA 132/FO 2339/FI 7849, document dated 1837, Paris.

Watermark 3: *1812 / J WHATMAN*
The position of the date above the name and the thinner style of lettering seen here suggest that the layout and style were copied from genuine Whatman marks dating from the 1790s. By 1812 the lettering and date layout would have been similar to Watermark 2. Source: Loeber 23 KBH 342/FI 10057, undated document, Göttingen.

Watermark 4: *J WHATMAN*
Most of the letters in this mark are wrong. The dropped crossbars in the As are similar to those seen in other forged Whatman marks (see Balston, plates 16.2 and 16.5). This style of dropped crossbar is more commonly found in German watermarks than in English. Source: Loeber 23 KBH 305/FI 10035, document dated 1829, Hannover.

Watermark 5: *J. WHATMAN*
The full stop between the J and the W never appears in genuine Whatman marks. The wires crossing in the centre of the W are also something that was not being done in genuine Whatman marks after the 1790s. Source: Loeber 23 KBH 2926/FI 10038, document dated 1832–36, Göttingen.

Watermark 6: *J WHATMAN.*
The full stop after *WHATMAN* is also something that was not done at Maidstone. Another feature not seen in genuine marks is the doubling of the wires in parts of the letters. Source: Loeber DLA 210/FO 2397/FI 7873, document dated 1838, Amsterdam.

Watermark 7: *J WHATMAN*
The crude letterforms, particularly the W, are very similar in style to marks from Roedter and Gossler, who each operated a small mill at Neustadt and Frankeneck in the Rhineland. Source: Loeber DLA 158/FO 2421/FI 7853, document dated 1839, Naples.

Watermark 8: *J WHATMAN*
This would normally pass as a Whatman mark except for the crossed wires in the center of the *W*. It is similar to, but not the same as, the Austrian fakes used by Turner, which have a full stop after the J. Source: Loeber DLA 171/FO 2453/FI 7861, document dated 1840, Dresden.

produced by Galvani rather than the Dutch maker whose name is in the watermark.

Austrian manufacture of such papers was based at three mills. Gabriel Ettel ran the Pelsdorf Mill on the Elbe, Bohemia, which in 1817 was producing the finest 'foreign' papers and 'Whatman' wove.[55] The Ettel family also operated the Hohenelbe Mill on the same river. Gabriel Ettel ran the mills from 1786 until 1830, when he was succeeded by Johann Gabriel Ettel. At this date the mills employed 80 people producing 1,150 bales (11,500 reams) annually. Peter Weiss produced fake Whatman at the Scurelle Mill, Val Sugana in the Torrente Maso, Southern Tyrol, from 1826 onwards. The business transferred from father to son (the same name) in the 1830s and continued to be operated by the Weiss family until 1917.[56] The third mill was the Klein Neusiedl mill on the river Fischa in lower Austria.

In 1793, I. Th. von Pachner had founded the largest handmade paper factory in Austria that was devoted to making 'foreign' papers.[57] From 1815 onwards von Pachner was producing banknote, security and other papers which his contemporaries thought were in no way inferior to the famous English Whatman papers. This may well have been the case then, but time has not dealt kindly with some of the Austrian Whatman forgeries, many of which are now somewhat yellowed and brittle. Pachner died in 1814, to be succeeded by his son Anton, who worked the mill until 1837, when it was bought up by Georg Borkenstein. By 1840 the mill operated four vats and three machines and employed about 380 people, including rag pickers.

The detection of these forgeries is not just a question of the watermarks (fig. 9), it also involves examination of the fibres, sizing and finishing techniques used, as well as the actual paper sizes found. Some of the continental forgeries are continental sizes rather than English ones. It must be said that none of the Austrian 'Whatman' papers that I have seen could, in their present state, be mistaken for the genuine article. The weave textures of the felts are generally more regularly marked than in Whatman paper and, where the sheets have been hot-pressed, the felt weave is still very visible despite the glazing. In transmitted light a curious, regular criss-cross pattern of different densities of pulp is very apparent. Also, they are usually a deep cream to light buff colour, quite unlike any of the white or toned papers from Balston or the Hollingsworths, although, judging by the comments above, they may well have looked better when they were first made.[58]

Acknowledgements

I would very much like to acknowledge the advice, assistance and practical help of Susan Bennett, Sally Bower, Ursula Bull, Melvyn Card, Ian Dye, Helen Forde, Mike Grey, Richard Hills, Katherine Meyer Hornton, Robin Kahan, Marcus Leith, Michael Prater, Rod Tidnam and Dominic Winter.

Notes

1. For example, the forthcoming *Puzzles in Paper: Proceedings of the 1996 International Conference on Watermarks in Roanoke, Virginia*, ed. D.W. Mosser, M. Saffle and E.W. Sullivan II. To be published by Oak Knoll Press.
2. Bower, P. 1990. *Turner's Papers — A Study of the manufacture, selection and use of his drawing papers 1787–1820*. London: Tate Gallery.
   Bower, P. 1999. *Turner's Later Papers — A Study of the manufacture, selection and use of his drawing papers 1820–1851*. London: Tate Gallery.
3. Currently my collection consists of about 1,000 microscope slides of fibres, 90 different papermaking plant samples, some 200,000 paper samples and several hundred publications.
4. Sem, J., and J. Mayer. 1945. Report on forgery in Sachsenhausen concentration camp. Central Criminal Office Report No. 395/45, December 15.
5. For a discussion of the literature and possibilities of this technique see Cahill, T.A. 1980. Proton microprobes and particle-induced x-ray analytical systems. *American Review of Nuclear Particle Science* 30: 211–52, and more specifically, Cahill, T.A., B. Kusko and R.N. Schwab. 1981. Analysis of inks and papers in historical documents through external beam PIXE techniques. *Nuclear Instruments and Records* 181: 205–8.
6. In dealing with coloured paper stock, publications such as Sandoz Chemicals' *Acid and Basic Dyestuffs on Paper* (Basle, 1951), which contains 233 tipped-in examples of various dyes applied to three different fibre furnishes, have proved indispensable.
7. Lalande, J.J.F. 1761. *L'art de faire le papier*. Paris: Desaint et Saillant. Plate 2, figure 1.
8. Hebborn, E. 1991. *Drawn to Trouble: The Forging of an artist*. Edinburgh: Mainstream.
   Black, C., and M. Horsnell. 1989. *Counterfeiter: The Story of a British master forger*. London: New English Library, is another highly selective tale; an amusing but rather shallow 'autobiography' of Black, who specialized in English currency.
9. The actual date of the invention of wove paper is placed *circa* 1754–56. James Whatman the elder made the first wove paper for John Baskerville, who wanted a printing surface that would not distort the serifs of the smaller point sizes of his new typefaces. See Balston, J. 1998. *The Whatmans and Wove Paper*. West Farleigh: Balston, for more detail on the dating of early wove papers.
10. Occasionally one is very lucky in one's research; in this instance the vatman who had been forming the paper had not kept his mould clean and pulp became stuck between the wires of the forming surface and the grid of support wires underneath. This distorted the proper drainage of the mould during use, leaving thinner areas in the sheet that are visible in the pattern of support wires. This can be 'read' as easily as a watermark, leading to a reasonably precise date for the paper.
11. Cox, D. *The Royal Hospital, Greenwich*, pencil on paper, 180 × 256 mm. At Spink Leger Pictures, London.
12. The best international directory of the world's paper trade, and one way into this maze, is the annual edition of *Birkner*. It covers every aspect of papermaking and the paper trade. Available in book form or on CD-ROM from Birkner & Co., Postfach 54 07 50, D-22507, Hamburg, Germany.
13. Clapperton, R.H. 1934. *Paper, An Historical account of its*

making by hand from the earliest times down to the present day. Oxford: Shakespeare Head Press. 1–26.

14. Collings, T.J., and W.D. Milner. 1979. An Examination of early Chinese paper. *Restaurator* 4: 129–151.
15. Collings and Milner. 1979. 130–31, tables 1 and 2. The five 90% plus hemp samples were
    S 116, early 5th century: 90% hemp, 10% ramie
    S 88, early 5th century: 100% hemp
    S 312, AD 637: 95% hemp, 5% ramie
    S 912, AD 803: 95% hemp, 5% ramie
    S 86, AD 991: 90% hemp, 10% ramie
    My own examination of these microscope slides suggests the same fibres in the same proportions.
16. Pulsiano, P. 1987. A Checklist of books and articles containing reproductions of watermarks. In *Essays in Paper Analysis*, ed. S. Spector. Washington: Folger. 115–53.
17. For example, just one publication, the British Association of Paper Historian's journal, *The Quarterly*, has illustrated and documented nearly 200 watermarks in their series 'British Watermarks' and other articles.
18. Bartholomeus. 1496. *De proprietatibus rerum*. London: Wynken de Worde.
19. Churchyard, T. 1588. *A Sparke of Frendship and Warme Goodwill* . . . London. This was reprinted in 1978 with an introduction by Colin Cohen.
20. Thomas, P. 1988. *Shakespeare on Paper Mills*. Santa Cruz: Good Book Press. This miniature book (only 60 × 48 mm) is a real curiosity.
21. For more information on this important publication see Bower, P. 1998. The Man in the brown paper boat. *The Quarterly*. 27 (July): 1–14. Two versions of Taylor's epic were published in his lifetime: Taylor, J. 1620. *The Praise of Hemp-Seed with the Voyage of Mr. Roger Bird and the Writer hereof, in a Boat of Browne Paper from London to Quinborough in Kent*. London, and Taylor, J. 1630. The Praise of hemp-seed with the voyage of Mr. Roger Bird and the writer hereof, in a boat of browne paper from London to Quinborough in Kent. In *All The Works of John Taylor, The Water Poet, Being 63 in Number* . . . London.
22. Meerman, G. 1767. *De Observationes Chartae vulgaris seu linea origine*. Hagae Comitum: Nicholaum van Daalen.
23. Hunter, J. 1857. Specimens of marks used by the early manufacturers of paper, as exhibited in the public archives of England. *Archaeologia 37*.
    Bartholus' writings were first published by Bisshe in his supplementary material to the 1654 edition of Upton's *Tractus de Insignis et Armis*.
24. Fenn, J. 1787–1823. A Catalogue of the original letters, etc and a list of the plates and numbers thereon. In *Original Letters Written During the Reigns of Henry VI, Edward IV and Richard III*. Vol. 2. London: G.G.J. and J. Robinson etc. [known as the Paston Letters].
25. Denne, S. 1795. Observations on papermarks by the Rev. Samuel Denne, F.A.S. in a letter to Mr. Gough. *Archaeologia* 12.
26. Sotheby, S.L. 1845. *The Typography of the 15th Century*. Vol. 3. London: T. Rodd.
27. Bought at auction. Dominic Winter, Swindon, June 14–15, 1994. Lot 1254.
28. Very little is known about Bates other than that he served in the army. Army records give his service as 1902 and 1908: Lieutenant, 1st City of London Rifle Volunteer Brigade; 1913: Captain, 5th City of London Battalion, London Regt. (Territorial); no army lists published from 1914 to 1918; 1919: Lieutenant Colonel, 4th Battalion (Territorial) Loyal North Lancashire Regt.; and 1923: Lieutenant Colonel, 5th City of London Regt., London Rifle Brigade.
29. I am indebted to Mrs Ursula Bull for the following information from her research into the Lemon family. Her published sources are *The Dictionary of National Biography* and *Collecteanea Cornubiensis*.
30. Scott, H.T., and S.J. Davey. 1891. *A Guide to the Collector of Historical Documents, Literary Manuscripts and Autograph Letters*. London: S.J. Davey.
31. Hunter, J. 1858. Specimens of marks used by the early manufacturers of paper as exhibited in the public archives of England. *Archaeologia* 37:8.
32. Helen Forde, head of the Public Records Office Conservation Department, tells me that Brodie was the editor of *The Letters and Papers of Henry VIII*.
33. Heawood, E. 1929–30. Sources of early English paper supply. *Transactions of the Bibliographical Society*. Series 2, vol 10. *The Library*. December 1929 and May 1930.
34. Heawood, E. 1930. 428.
35. Heawood, E. 1929. 284–85.
36. Labarre, E.J. 1952. The Study of watermarks in Great Britain. In *The Briquet Album*. Hilversum, Holland: Paper Publications Society. MCPHI 2: 99.
37. Bower, P. 1990. 62–64 has a discussion of Turner's use of a nearly 40-year-old paper for one of his *Views over the Lake at Stourhead* of 1798.
38. Other early Super Royal *1794 / J WHATMAN* sheets include TB XXXI J (although this is a two-ply laminated card) and the papers used in some sketchbooks: TB XXXVIII, TB XLV, TB LIII and TB LIV. Turner also used this batch of paper for three watercolours connected to his 1801 tour of Scotland (TB LX, B, E and G), as well as the large batch of paper he had prepared with a wash of tobacco and Indian ink for the *Scottish Pencils* (TB LVIII). [TB=Tate Gallery, Turner Bequest]
39. Turner, J.M.W. *c.* 1825. *Sketch for Cockermouth Castle, Cumberland*. Tate Gallery, TB CCLXIII 92, D25214.
40. Turner, J.M.W. *c.* 1841. *Large Colour Study of Heidelberg*. Tate Gallery, TB CCCLXV 34, D36325.
41. For example, TB L, B and C, and the watercolour W 225, Cecil Higgins Art Gallery, Bedford, and W 226, now in a private collection.
42. Sloan, K. 1998. *J.M.W. Turner: Watercolours from the R.W. Lloyd Bequest*. London: British Museum. The Lloyd Bequest Views of the Rhine from 1817 on the *J WHATMAN / 1816* writing paper are *Abbey near Coblentz, Lurleiberg and St. Goarhausen*, and *Bingen from the Nahe*. Two others in the Lloyd Bequest, *Hirzenach below St. Goar* and *The Johannisberg*, are on a very similar lightweight writing paper watermarked *J WHATMAN / 1814*.
43. The statute being 34 Geo.III c.20.
44. The author would very much appreciate it if anyone who comes across any other dates in Whatman papers from the period 1794–1811, particularly in wove papers, could let him know of them.

45. 51 Geo.III c.95.
46. Bower, P. 1990. 32–34 has illustrations and descriptions of two early nineteenth-century moulds.
47. On a recent exploration of part of the paper collection at Hayle Mill, Kent, one of 11 large cardboard boxes, each labelled 'Old Paper mostly working samples,' was sampled. One such box contained 22 packages tied up with string, which, judging by the ties and the dust, had not been opened since they were put aside in the 1880s. Two of the packages were opened and examined and one, labelled 'Sundry Sheets 1887,' which contained 17 different sheets of paper each folded into eight and annotated, included an example of a Corrected White (blue) laid Demy sheet watermarked with a fleur-de-lys and the Whatman cypher, and countermarked *J WHATMAN / 1887*. It was annotated 'J. Barcham Green & Son.'
48. Bower, P. 1995. Challenge and responsibility: caring for random collections of paper. *The Paper Conservator* 19: 66–67, illust. 75. The origins of two separate sets of continental makers' initials found in an *IV* + Fleur-de-Lys / *4WR* mark are discussed.
49. Balston, J.N. 1992. *The Elder James Whatman*. West Farleigh: Balston. 2, vi and vii. Plate 16 illustrates seven further marks from Loeber's collection, including (mark 7) a dark mark from a Hague document of 1835.
    Gravell, T.L., and G.E. Miller. 1983. *A Catalogue of Foreign Watermarks Found on Paper Used in America 1700–1835*. New York: Garland Press. No. 769/dod1828 illustrates a Whatman mark with subscript L that is also very suspect.
50. Tate Gallery, Turner Bequest. TB CCXCIX, *Trieste, Graz & Danube* (renamed) sketchbook; TB CCCX, *Passau to Wurzburg* (renamed) sketchbook; TB CCCXIII, *Venice & Botsen* sketchbook.
51. Visiting the Canson Montgolfier mill at Annonay in the Ardeche, I was surprised to see hanging in a corridor outside one of the offices a mould of very obvious French construction, watermarked *J WHATMAN / 1814*. They also had another French-made mould, dating from the same period, with a J Green watermark. The mill was quite open about having made 'Whatman' paper in the early nineteenth century.
52. Eineder, G. 1960. *The Paper Mills of the Austro-Hungarian Empire*. Hilversum, Holland: Paper Publications Society. MCPHI 8: 45.
53. Eineder. 1960. 169. Dirk and Cornelis Blauw operated several mills, including De Herder (The Shepherd) and De Ijver (The Diligence) at Zaandijk, and De Oude Blauw (The Old Blue) at Wormeveer. See H. Voorn's *De Geschiedenis der Nederlande Papierindustrie*. Vols 1 and 2.
54. Bower, P. *The Valadier papers: The Papers used by three generations of Roman goldsmiths 1895–1839*. An investigation of the papers used for some 1,000 drawings. Bower Report No. 43 92 7.
55. Eineder. 1960. 126.
56. Eineder. 1960. 100.
57. Eineder. 1960. 45–46.
58. The tones of the Austrian 'Whatman' papers used by Turner do, however, approximate some of the fine artists' papers produced by Thomas Creswick, used by De Wint among others, which may well be what attracted Turner to them. Some years after Creswick's retirement, on the urging of various artists' colourmen, the Balstons at Springfield began to produce a Whatman Imitation Creswick. By the 1860s they had dropped the word 'Imitation' and the paper was just known as Creswick.

Invoking the Past: John Taylor Arms' Use of Antique Papers

DEBORAH CARTON AND M. BRIGITTE YEH

Abstract

John Taylor Arms (1887–1953), foremost among American etchers of the early twentieth century, was a consummate craftsman known for his meticulous rendering of architectural subjects. Functioning within a traditional set of standards that stressed the importance of materials and technical accomplishment, Arms favoured printing on antique as well as handmade papers.

The artistic environment that fostered this use of antique papers is explored. Among his influences, that of the American expatriate James McNeill Whistler (1834–1903) was paramount — evidenced not only by his choice of subject matter and medium, but also by his partiality for papers of antique origin. In this manner Arms hoped to perpetuate the Whistlerian tradition as it was transmitted to him through the other pre-eminent architectural etcher, Joseph Pennell (1859–1926), his colleagues and followers.

During his lifetime, John Taylor Arms produced approximately 440 prints, most of which were etchings and aquatints. The two most complete collections of his work reside in the New York Public Library and the Library of Congress. These collections are surveyed in order to determine the extent to which he used antique papers as well as to identify their select types. Complemented by the study of his publications, correspondence, and personal library, the survey reveals the artist's motivations and working methods.

Introduction

John Taylor Arms (1887–1953), foremost among architectural etchers in America during the first half of this century, lived and worked in a time that witnessed the genesis of Fauvism, Expressionism and Cubism in the art world. Despite these modernist trends, Arms managed to maintain an artistic vision that was distinctive in looking to the past for inspiration. For this reason, he has been referred to as a 'modern mediaevalist.'[1] As evidence of this designation, one may observe how his application of the 'antique' idiom may be found in his choice of antique subjects, his fidelity to traditional techniques and his use of old papers. For subject matter, he favoured images of old European street scenes, architectural details of old buildings and Gothic cathedrals in particular. Regarding technique, he was a consummate craftsman who adhered strictly to traditional printmaking methods and materials. In accordance with his sense of craftsmanship, Arms assigned great importance to the quality of the materials he used. Lastly, Arms relied heavily on the legacy of artists who shared his antiquarian view, most notable among them James McNeill Whistler (1834–1903) and Charles Meryon (1821–68). Through the inspiration of Whistler and Meryon and the generation of American printmakers after them, Arms developed his love for antique papers.

The investigation into Arms' use of antique papers was occasioned when several of his etchings from the Sylvan Cole Gallery came to New York University's Conservation Center for treatment. Through observations of the watermarks and laid/chain line characteristics, it became obvious that the papers selected by Arms were not contemporary to his time. In light of the recent studies on Whistler's use of antique papers, it was hypothesized that Arms represents the continuation of the Whistlerian tradition in America. In an effort to avoid repeating the scholarship already published on Whistler's antique papers,[2] this paper will focus on the manner through which the antique vision was transmitted to and adopted by later graphic artists, including Arms, in America. Through the study of the extensive holdings of Arms' prints in the New York Public Library and the Library of Congress, light may be shed on the rationale, extent and systematic pattern in Arms' use of the 'antique' as paradigm. At the same time, by identifying artistic trends of early twentieth-century America that led to such use, this paper alerts the art historian and conservator to the circle of American artists who may have used antique papers in their work.

Artist's biography

John Taylor Arms' emphasis on architectural subjects derived from his studies at Princeton University and the Massachusetts Institute of Technology, where he majored in architecture. After graduating in 1912, he practised as an architect for several years at the firm of Carrère and Hastings and later as a partner in the firm of Clark and Arms. In 1913, Dorothy, his wife and collaborator, introduced him to etching as a hobby with a Christmas gift of a small etching kit. This modest gift eventually led to a 38-year career as an etcher, during which time Arms produced in excess of 440 images at his principal studio in Fairfield, Connecticut, garnering numerous awards, including gold medals from the American Art Dealers Association (1934), the Paris International Exposition (1937) and the American Institute of Architects (1945). Among his many honours, Arms was inducted into the French Legion of Honour as Chevalier in 1933 and as Officer in 1951, and was elected to the American Academy of Arts and Letters in 1947.[3]

Aside from his artistic accomplishments, Arms received much recognition during his lifetime as a spokesperson, activist, educator and leader in the field of graphic arts. He served as president of the Society of American Etchers for more than 30 years, and was both the founder and president of the American National Committee on Engraving. Arms also juried innumerable exhibitions both domestically and abroad. From 1937 to 1953 he served on the first Pennell Fund Committee,

named in memory of the etcher Joseph Pennell, that was responsible for purchasing prints for the permanent collection of the Library of Congress. In addition to these activities, he also found time to conduct more than 150 public demonstrations on etching throughout the country. To a large extent, Arms may be credited with revitalizing the art of etching in America.

Of the approximately 440 images he produced, over 420 were etchings. Only eight lithographs were made during time spent working with Bolton Brown (1865–1936) early in Arms' career, around 1921. In his initial endeavours, Arms also experimented with aquatinting in order to produce fields of tonality, but abandoned the medium in favour of pure etching, since aquatinting did not prove to be fine enough for the artist. This quest for detail leads to a discussion of one of John Taylor Arms' most outstanding traits: his absolute meticulousness. He was exceedingly detailed in nearly every aspect of his work, from the selection of his materials to the execution of his designs. As an example, his preliminary drawings on tracing paper, which were used to transfer the outline of an image onto a grounded plate, are exceptionally specific. His etched lines even record the grain of wooden doors and the surface texture of cut stone, as may easily be seen in close-ups of his print *Study in Stone* (1933) (fig.1). Emphasizing his virtuoso skill, his work on miniature etchings is consistent with his penchant for the minute, as shown by *Notre Dame the Tiny* (1935), which is barely larger than a postage stamp. Not infrequently he resorted to using the finest sewing needles to achieve the delicately etched lines he desired. His ability to see in such detail was considered so unusual that his vision was studied by scientists at Johns Hopkins University.[4] Another illustration of Arms' meticulous nature is his day-to-day discipline. On average, he spent 18 hours a day working on printmaking. He also kept careful records of the hours that he spent working on a particular plate. In one extreme case, he logged 2,172 hours to produce *Spanish Profile, Palencia* (1950).[5]

Art historical context

It is important to realize that John Taylor Arms was not unique in some of the above-mentioned traits. Rather, Arms was operating within the context of what has been called the Realist movement. Proponents of this American movement advocated a type of 'naked eye realism' characterized as exhibiting carefully controlled compositions, a pristine technical mastery and the influence of James McNeill Whistler.[6]

All of these traits more than readily apply to John Taylor Arms. Through his use of architecture as subject matter, Arms maintained carefully controlled compositions. Perhaps not by coincidence, many of the Realist artists had previously been trained as architects, applying their skill as draughtsmen and knowledge of European architecture to their graphic art.

It has been well established that Arms took Whistler to be one of his principal influences. Arms admired Whistler's work for its 'loving attention to detail and textural quality, beautiful drawing and remarkable blending of strength and delicacy.'[7] Arms' early works

Fig. 1 Detail of *Study in Stone, Cathedral of Orense* (1933). No. 8 of the Spanish Churches series.

assumed the characteristic vignetted presentation and technical fluency of his predecessor. A comparison of one of Arms' early prints, *Ancient Gables, The Twins* (1922), with Whistler's *Wych Street* sufficiently proves this point (figs. 2,3). As further evidence of his admiration, Arms' personal art collection, which was donated to Wooster College in Ohio, contains eight prints by Whistler that he purchased. Arms therefore did not work in isolation, but rather was part of a movement — a movement shadowed by the legacy of Whistler.

The Antiquarian movement in America

Artists who belonged to the Realist movement also conveniently overlapped with the Antiquarian movement, which was already part of the art scene in America. The Antiquarianists frequently borrowed their subjects from 'old European heritage.' Through his many trips abroad, Arms and others like him made the Grand Tour of Europe a pilgrimage, seeking to capture what he called the 'Gothic spirit' in architecture. Carl Zigrosser of the Philadelphia Museum of Art once observed that Arms approached his subject 'with a sense of worship, with medieval nostalgia.'[8] In his quest for this spirit, Arms consistently returned to certain architectural themes, which he organized into designated series, including French Churches, Spanish Churches, English Themes, Gables, Gargoyles, Italian Scenes and Princeton University.

Naturally, Antiquarianists also professed to borrow from past styles. In a letter to his mentor, the printer Eugene Higgins, Arms affirmed his dependence upon antique antecedents: 'The work of Rembrandt, of course, and of Dürer and Meryon, some of Whistler's, Millet, and among the lesser Masters Jacque, Lalanne, Appian, Bracquemond, Samuel Palmer, Legros, Lepere — these are my gods of etching ...'[9] The manner in which Arms appropriated his predecessors' artistic notions becomes apparent when directly comparing his works. For example, his *Le Penseur de Notre Dame* (1923) is the identical subject etched by both Charles Meryon and Joseph Pennell, and may be considered as homage to them.

The obsessive craftsmanship that characterized the Realist movement was shared by the Antiquarianists as well. Looking back to mediaeval times, they reacted

against products of the Industrial Revolution by taking immense pride in creating artworks with quality handmade materials. For instance, dissatisfied with products in the marketplace, artists returned to grinding their own inks. Of commercial inks, Arms states, 'I have never found really fine etching ink already prepared and put up in cans or tubes.'[10] Arms also recognized the importance of paper in printmaking and was selective in his use of modern papers, working exclusively with the finest-quality handmade papers. 'The English Whatman and Head papers are among the best of those made today. About 50% linen and 50% cotton rag make an excellent printing paper. The linen gives durability, the cotton receptiveness.'[11] Among the modern papers gleaned by Arms in England, France, Italy and the U.S., as listed by Fletcher in his catalogue raisonné, were **Maidstone, Whatman, Head, Charles I, David Strang, Dard Hunter,** Yeddokami, Praga, **Arnold, Van Gelder, Rives, Arches, Japan, Barcelona,** OWP & ACL, **England,** Bond No. 2, 1919, B.S., **Michalett, Ingres,** Shogun and **Chine.**[12] Those in boldfaced type were identified by their watermarks in the collections of the New York Public Library and the Library of Congress.

As another indication of his insistence on quality, Arms learned to make his own paper with Dard Hunter at Lyme Rock, Connecticut, between 1928 and 1931.[13] He produced a greenish-blue ARMS handmade paper, on which he printed his impression *Palazzo dell'Angelo* (1931).

As a member of the Antiquarian movement, Arms had a devotion to paper that went beyond a search for quality among contemporary paper mills, even beyond his attempts to make paper himself. Arms joined many of his colleagues in a hunt for old papers. Of paper Arms said, 'old paper is very beautiful to print on ... because the "size" has worn off and the paper has assumed, in time, a tone which cannot be obtained by staining modern paper.'[14]

Arms was far from unique in his attitude towards old paper. Particularly informative with regard to the Antiquarianists' interest in old paper are etchers' manuals published in Britain and the U.S. in the late nineteenth and early twentieth centuries. A review of 10 manuals[15] found each author referring to common use of antique papers. The young Arms was undoubtedly familiar with these turn-of-the-century treatises, since nearly all were found among the books in his personal library, which was given upon his death to Bryn Mawr College. In his 1925 guide *The Art of Etching*, E.S. Lumsden describes contemporary sentiments:

> Till the nineteenth century — about 1820 — when the adulteration which ended in making cheap paper by machinery began, a good quality article could be had for the ordering. Now it is a very different matter, as very few firms make really reliable paper at all, and still fewer make one which combines those qualities necessary for the printing from an intaglio plate. This regrettable state of affairs — simply a matter of supply and demand — has caused artists to fall back upon the use of old paper.[16]

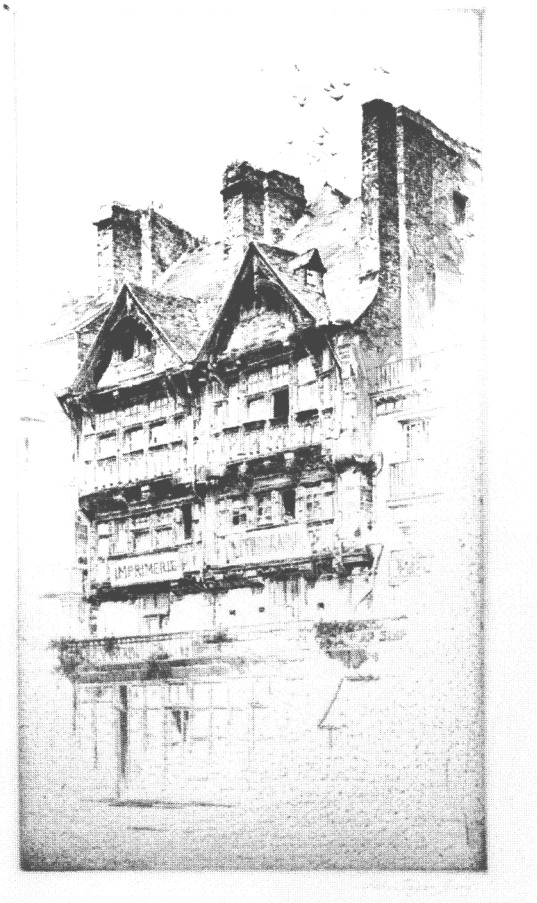


Fig. 2 *Ancient Gables, The Twins* (1922).

Fig. 3 *Wych Street* (undated) by James McNeill Whistler.

In the early years of scavenging old paper, an emphasis was placed on the quality and warm tone of aged papers, along with the breakdown of the sizing agent, which made the paper more receptive to the ink during printing. Eventually, however, the authors of these etching manuals came to the realization, as did Arms, that quality, modern, handmade paper could indeed be found. Arms admitted that 'Paper of equal or even better quality was being made.'[17] Thus, artists continued to seek out old papers for primarily aesthetic reasons.

Joseph Pennell, well-known as Whistler's most ardent admirer and follower, pronounced in his 1919 book *Etchers and Etching*:

> Paper is as important as any other factor in the making of an etching. The only good paper on which etching can be really properly printed must be one hundred years old. Doubtless a little of the paper being made today is good — or will be good for printing in a hundred years. But the paper which has lasted for a hundred years is good, though not all of it. The tone of time, if the paper itself is good, is everything.[18]

Through John Taylor Arms' writings and correspondence, one learns that Arms closely associated himself with Pennell and the cult of using antique papers. Thus one can easily trace the lineage of using old papers from Whistler, to Pennell and his contemporaries, and then to Arms.

The Collections

Arms' use of antique papers began with his earliest etchings, *A Gable in the Grande Rue, Lisieux* (1916) and *Out of My Window* (1916), and continued throughout his career, ending with *Abbaye de Saint-Paul-au-Bois* (1952). In order to determine the extent to which Arms used antique paper, as well as to identify their types, two of the most complete collections of his work were surveyed, those in the New York Public Library (NYPL) and the Library of Congress (LC).

Arms had established as many as 30 private collections of prints for his family and friends. Table 1 lists those of primary importance. Collections A through D as designated by Arms were to include one proof of the published state of each plate. Collection E, the 'artist's own proof,' now in the NYPL, was established by the artist as a 'total collection containing at least one example of every print in every stage,' regardless of whether it was published. The artist pulled each of these prints himself, generally making notes in the margins on the success of each impression.[19]

Collection	Designated Recipient	Present Location
A	Dorothy Noyes Arms	Library of Congress
B	Margery Arms Roberts	private collection of Lewis and John Roberts
C	John Taylor Arms III	private collection of Penelope Arms
D	Henry Noyes Arms	private collection
E	John Taylor Arms	New York Public Library

Table 1 Major Collections of Arms Prints

Fig. 4 Detail showing pronounced texture from drying felts in antique papers.

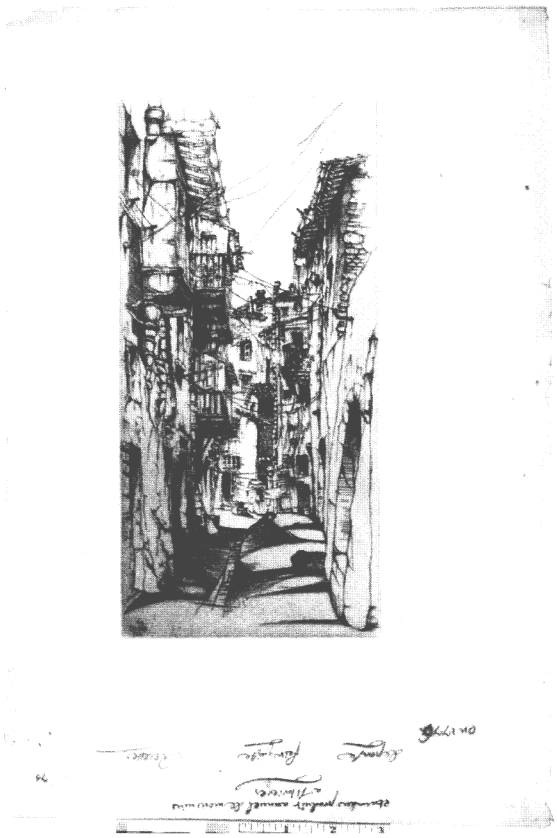


Fig. 5 *Via Facchini, Pisa* (1927). No. 11 of the Italian series.

Although the artist's intention with regard to these collections was to create complete sets of his prints, upon his death the terms of his will were not carried out, and as a result all of the collections were partially dismantled or intermingled. For example, several 'artist's proof' prints intended for the NYPL's collection are instead found in the LC. To date no complete collection exists. The one in the LC is the most complete, lacking only 12 impressions, whereas the NYPL collection contains 191 images. As two of the most complete collections of John Taylor Arms prints in public institutions, these were selected as the focus of this survey.

Identifying antique papers

For the purposes of this survey, the authors have chosen

to define *antique* simply as papers manufactured before the time of the artist. The term *old papers* is defined in the same way and is used interchangeably with *antique papers*. Several distinctive characteristics have made the identification of antique papers quite reliable, as has been brought to light by the recent writings on Whistler by Martha Smith and Harriet Stratis.[20] In transmitted light, pre-industrial handmade paper has an accumulation of pulp beside the chain lines where the wooden ribs attach the chain lines to the mould, producing a pattern called *antique laid*. Uneven chain-line intervals, idiosyncratic to handmade moulds, as well as fibrous inclusions, fibre bundles and uneven pulp dispersion resulting from incomplete separation and beating of rags, customarily distinguish handmade papers. Moreover, characteristics visible under low magnification include colour imperfections which also result from incomplete separation of rags prior to beating. A final feature is the distinctive surface texture of fibre impressions retained from the drying felts used in pressing and drying the sheets (fig. 4).

In addition to the characteristics produced during the original formation of the paper sheets, antique papers may often be identified by evidence of ageing and usage. For example, a patina of a warm tone may develop over a period of ageing. Staining, mildew, foxing, creases, discolouration, insect holes, dirt and wear may also provide a sense of the age of a sheet of paper. Finally, evidence of earlier usage may aid in the identification of antique papers. Most often, old papers collected by Arms and others may be identified as flyleaves or blank book pages removed from account books, scrapbooks or ledgers. Frequently ink stamps or pen-and-ink inscriptions of page numbers and ledger headings appear in the margins of a print, as in figure 5. Often three sides of the sheet are trimmed and bear traces of edge colouring or gilding from the original text-block decoration. Discolouration characteristic of atmospheric acid migration into the text block may be evident on these same three edges but absent on the fourth, indicating that a particular sheet was formerly bound in a book. Similarly, sewing holes are often found along the fourth, uneven and untrimmed edge, attesting to the sheet's earlier function as part of a book (fig. 6).

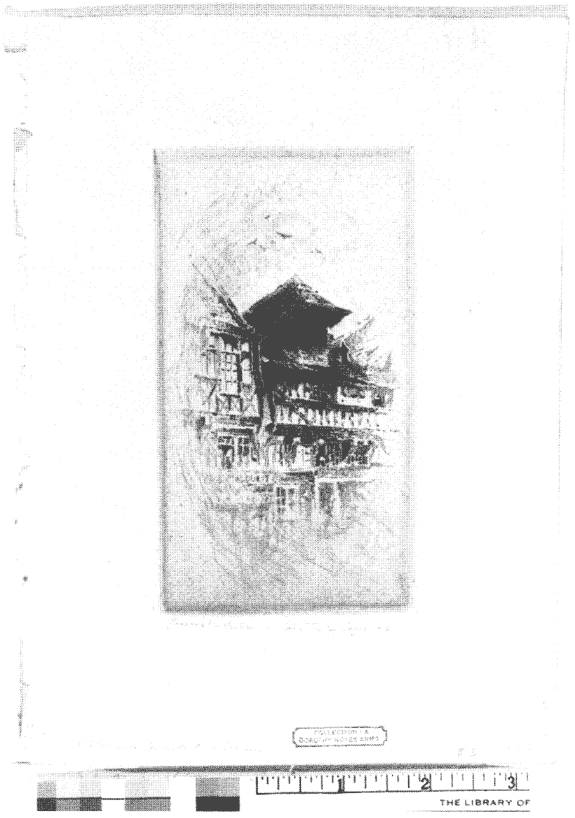


Fig. 6 Sewing holes visible on torn edge of *A Gable in the Grande Rue, Lisieux* (1916).

Survey of the collections

Using these characteristics as a basis, a survey of the collections in the LC and the NYPL showed that Arms employed antique paper in 107 of a total of 656 prints (see Table 2).

These statistics, together with an entry from the John Taylor Arms manuscript materials in Bryn Mawr College Library, indicate that Arms reserved the use of antique papers for only a relatively small percentage of impressions within larger editions. The entry refers to an edition of 100 proofs that were consigned to Kennedy and Company by the artist:

> December 19 1935
> Venetian Mirror 59 [proofs]
> of which 45 are on modern Whatman paper
> 8 are on modern Head paper
> 6 are on old paper
> This completes the edition of 100 proofs consigned to Kennedy & Co. [21]

It is also interesting to note that each proof was priced at $24, regardless of whether it was printed on old or modern paper.

Thus Arms seems to have limited the number of impressions per edition that he pulled on antique paper. Most notably, this survey showed that the printmaker

Collection	Impressions in the Collection	Antique Paper		
		Total Impressions on Antique Paper	Impressions on Blue Antique Paper	Impressions with Watermarks
New York Public Library	209	45	19	21
Library of Congress	447	62	19	27
Total	656	107	38	48

Table 2 Survey Data

Series	Impressions in the Series	Impressions on Antique Paper	
		NYPL	LC
Christmas Card	31	1	5
English Themes	15	1	4
French Churches	55	21	16
Gables	8	1	3
Gargoyles	14	2	2
Italian Scenes	27	8	12
Mexican	2	—	1
Princeton University	6	—	7
Spanish Churches	15	2	2
Not in a series	78	9	10
Total	251	45	62

Table 3 Antique Paper Use According to Series

was also discriminating in the subject matter that he chose to depict on his antique stock (Table 3). Arms generally matched old paper with historic European architectural images. In other words, he deemed the 'antique aesthetic' to be well suited to the subject. Conversely, his modern subjects, such as the images of New York City and those from the U.S. Navy Ship series appear almost exclusively on modern papers.

Arms' selection of antique papers

Scattered references from Arms' diaries serve as an indication of how particular he was in choosing his paper:

> May 24, 1934
> Up early and inspected and signed trial proofs of [Valley of the] Savery and [Principal Portal of the Church of San Pablo] Valladolid from Strang. Then spent the day picking out old paper for these two plates.[22]

His mention of Strang above refers to another printer, David Strang, whom Arms employed from 1936 to 1950. The diary entries show that, although Arms most often did not print his own plates, he nevertheless was scrupulous in designating on which papers they were to be printed. Once Arms was content with a trial impression, he selected papers and prepared them for shipment to the printers.

Arms was also interested in exploring the aesthetic potential of paper in printmaking. Subtle variations were achieved by printing different impressions from a single plate on a variety of paper colours, such as blue, cream and ivory — all examples purposefully included in his collection. In one instance, Arms seemed to have had a particular appearance in mind when he made the artist's proof for *West 42nd Street* (1920) in the LC collection. In this unique case, the paper has been toned with an even tan wash, recto only, to produce the desired aesthetic.

Arms' experimentation with the effects of paper tone and colour may have been inspired by Whistler's use of subtle variations in his printing papers.[23] Arms' use of coloured papers for more dramatic effects may be attributed to the influence of Meryon, who 'was one of the first — if not the first — to make use of variously tinted papers to aid the impression he wished to convey in any particular plate; and his practice has been followed by most of the moderns.'[24]

In selecting papers on which to pull a particular impression, Arms seems to have relied mainly on trial proofs to establish his preference:

> May 10, 1952
> ... Jobs until noon — finished second (final?) state black and white, Tréb [the print entitled *Black and White, Trébrivan*], this afternoon. I will send to CSW [Charles S. White, employed as printer by Arms, 1931–53] monday for few proofs on white paper to see if need aqua[-coloured paper].[25]

His mention of aqua-coloured paper refers to Arms' general predilection for blue papers, which ranged from a subtle, blued white to a vibrant blue-green that he labelled aqua. The NYPL and LC collections each contain 19 prints on antique blue papers, comprising 40% and 31% respectively of the antique papers that he employed. Again, one might look to Meryon as the stimulus for this interest in blue-green papers, as he was known to have exploited blue papers for his sombre architectural images, printed in strongly bitten lines.[26]

Acquisition of antique papers

Entries from Arms' diaries indicate that he had established a cache of papers from which he could draw when desired. As described in the manuals of the period, artists ransacked old rag shops and second-hand book shops looking for blank pages during their periodic excursions to Europe. However, as early as 1895 there were signs that the supply of old papers, particularly old Dutch handmade papers, was disappearing.[27] By 1923, Hubbard writes that 'the stores of old paper have been rifled long ago, and it is rarely that one can obtain even a few fly-leaves in good condition. These precious sheets are kept for a few special prints; but for ordinary purposes it is necessary to use new paper.'[28] It was not only hoarding by artists that contributed to the depletion of the antique paper supply. The First World War, as Pennell mournfully notes, depleted many of these resources by necessitating both the shutdown of paper mills and the repulping of old paper:

> Gone forever are the mills along the little streams of north Italy, and the little streams of Philadelphia. gone is the old paper of France and Germany and Belgium, gone for war work — gone to end a war that need never have cursed the world (Jan. 1, 1919).[29]

Lumsden supports this when he writes that 'the stock of good, old paper — especially since the re-pulping of much during the war — is fast disappearing.'[30]

Despite its increasing scarcity, Arms continued to acquire antique paper. Among the materials from the Arms library, now in the Bryn Mawr College Library, is

an old address book, dating from around 1928 to 1936. Under the heading *O/P* there is an entry entitled 'Old paper,' listing the names and addresses of three Parisian dealers:

Old paper
F. Marhias jeune
8 Rue Blanche, 8
Paris

Victor Riverre
55 Rue Bonapartie
Paris 6eme

Orvis, L.W.
30 Rue Jacob, Paris
Old Paper
30 Rue Jacob[31]

The etcher also collected old papers in America. The oldest that Arms purchased was a 'Baptismal Register Kirchen Ordnung,' from the Reformed Church, Middletown, Dauphin County, PA, 1708, from a book shop in Philadelphia.[32] Arms may even have acquired some of his papers from other artists. In his diaries he mentions his desire to purchase a stock of old papers left by Pennell upon his death.[33]

Regardless of the means through which Arms was able to procure antique paper, he appears to have amassed a sizeable collection. A portion of his stock of unprinted old papers may have been distributed by his wife to his fellow artists upon his death. The extent to which this stock of papers, both contemporary and antique, was distributed is uncertain. However, the John Taylor Arms Collection of unprinted paper, numbering in the thousands, made its way into the collections of the Manuscripts Department of the Houghton Library, Harvard University, shortly after his death.

Watermark data

The diversity of the watermarks and countermarks in Arms' prints suggests that Arms collected western antique paper widely, without preference for a particular date or manufacturer. No correlation was found between the date and place of manufacture of the paper and the subject or origin of the print. The majority of the watermarks on antique papers were documented both by tracings and by beta radiography. Of the 45 antique papers in the NYPL collection, roughly half, or 21, exhibit watermarks. This frequency is consistent with the 27 watermarks that appear on the 62 antique papers in the LC collection. The watermarks include well-known motifs such as the Fleur-de-Lys, Pro Patria (Maid of Holland), Strasbourg Bend and Lily, Posthorn, Grapes and the Crown with *GR* below (fig. 7). The countermarks of J. Baffet Acariol, Ivermot, D'Angoumois, Ardon and Lubertus van Gerrevink were also found.

The Arms Collection of antique laid papers in Harvard's Houghton Library was the subject of a 1976 study[34] in which 519 tracings of watermarks and countermarks were recorded. Identification of the paper-

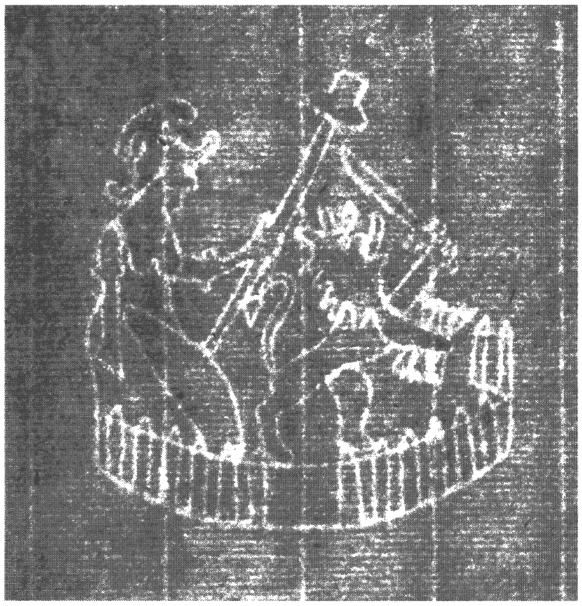


Fig. 7 Beta radiograph of Pro Patria watermark from *Old Rouen* (1927).

maker, date and geographic location was made wherever possible with the greatest possible accuracy. The results of the survey demonstrate that Arms was eclectic in his taste for papers, collecting western European and U.S. papers from the fifteenth to the twentieth centuries, including Italian (16th–17th), German (16th), French (17th–19th), Spanish (18th), Dutch (17th–19th), English (18th–20th) and American (18th–20th). Among the watermarks on old papers in the NYPL and LC collections, two could be matched with those in the Houghton Library collection.

Conclusion

John Taylor Arms invoked the past in many ways: through his preoccupation with old European architectural monuments, his mediaeval manner of preparing his own materials and, of course, his use of antique papers. Arms was not alone in his veneration for things old, nor in his appreciation of antique papers. Among the generations of etchers succeeding Whistler, the Antiquarian movement thrived through the existence of a well established circle of artist-printmakers who shared a common vision. The late-nineteenth- and early-twentieth-century etchers listed in the Appendix were all proponents of this movement and were known to have been in communication with one another. Those names appearing in boldface are known to have used antique papers during their careers, while the others are likely to have used antique papers because of their close association. Prior knowledge of the possible use of old paper is relevant to the conservator and art historian alike, as it introduces complex implications with regard to conservation treatment and aesthetic interpretation. When encountering artworks such as those by John Taylor Arms, the conservator must be aware that imperfections in the paper may be inherent to their creation. Therefore, stains, discolouration, foxing, sewing holes and so on are sometimes best left untreated. Thus the conservator must carefully consider the origins of the paper and analyse

evidence of its prior use before devising a conservation treatment plan.

Acknowledgements

The illustrations are reproduced courtesy of the Prints and Photographs Division, Library of Congress, with permission from the estate of John Taylor Arms. The authors wish to acknowledge the following institutions and persons for their assistance in this research: Margaret Holben Ellis (Conservation Center, Institute of Fine Arts, New York University); Kathryn Blood, Marita Clance, Conservation staff, Tom and Sylvia Albro, Jesse Munn, Mary Wooton, Terry Boone (Library of Congress); Department of Prints and Photographs (New York Public Library); Harriet Stratis, David Chandler, Margo McFarland, Marc Pascale (Art Institute of Chicago); Carol Campbell, Kathy Whalen, Kim Pelkey (Bryn Mawr College Library); Sylvan Cole (Sylvan Cole Gallery); Liz Lunning (Menil Collection); Reba Fishman Snyder (Pierpont Morgan Library); and the Andrew W. Mellon Foundation.

Appendix

Please see Table 4, Etchers Associated with the Use of Antique Papers.

Notes

1. Arms, D.N. 1934. John Taylor Arms, modern medievalist. *Print Collector's Quarterly* 21(2): 126–41.
2. Smith, M. 1997. Hunting for old paper with James McNeill Whistler. *Book and Paper Group Annual* 19: 90–91.
   Stratis, H.K. 1998. Whistler's papers: Their appearance, selection, and use. In *The Lithographs of James McNeill Whistler*. Volume 2, *Correspondence and Technical Studies*, ed. M. Tedeschi. Chicago: Art Institute of Chicago. 298–304.
3. Pelletier, S.W. 1976. John Taylor Arms: an American mediaevalist. *The Georgia Review* 30(4): 908–87.
4. Johnson, U.E. 1980. *American Prints and Printmakers: A Chronicle of over 400 artists and their prints from 1900 to the present*. Garden City, NY: Doubleday and Company. 36.
5. Bassham, B.L. 1975. *John Taylor Arms, American Etcher*. Madison, Wisconsin: Elvehjem Art Center, University of Wisconsin – Madison. 29.
6. Johnson. 1980. 35–36.
7. Arms, J.T. 1934. *Handbook of Print Makers and Print Making*. New York: Macmillan. 28.
8. Zigrosser, C. 1978. John Taylor Arms. In *The Artist in America: Contemporary printmakers*, ed. C. Zigrosser. New York: Hacker Art Books. 28.

AMERICAN	BRITISH
James McNeill Whistler (1834–1903)	**Francis Seymour Haden** (1818–1910)
↓	Philip Gilbert Hamerton (1834–94)
Charles F. M. Mielatz (1860–1919)	**Samuel Palmer** (1805–81)
Joseph Pennell (1857–1926)	↓
James D. Smillie (1833–1909)	**Frederick Wedmore** (1844–1921)
↓	**Frank Short** (1857–1945)
John Taylor Arms (1887–1953)	**Hugh Paton** (1853–1927)
Frank Benson (1862–1951)	↓
Samuel Chamberlain (1895–1975)	Muirhead Bone (1876–1953)
Kerr Eby (1890–1946)	David Young Cameron (1865–1945)
Gerald Kenneth Geerlings (1897–1935)	**Frederick L. Griggs** (1876–1938)
Ernest Haskell (1876–1925)	**James McBey** (1883–1959)
Frederick Childe Hassam (1859–1935)	
Arthur William Heintzelman (1891–1965)	
Eugene Higgins (1874–1958)	
Lester George Hornby (1882–1952)	
Armin Landeck (1905–84, early work until 1934)	
Martin Lewis (1881–1962)	
Ernest Lumsden (1883–1948)	
Donald Shaw MacLaughlin (Canadian-born, 1876–1933)	
John Marin (1870–1953, working dates to consider 1905–11)	
Louis Conrad Rosenberg (1890–1975)	
Ernest David Roth (1879–1964)	
Charles Sheeler (1883–1965)	
Jules Andre Smith (1880–1959)	
Cadwallader Washburn (1866–1965)	
Herman Armour Webster (1878–1970)	
Horace Wallace Welsh (1888–1959)	
Levon West (1900–68)	
John Winkler (1890–1979)	

Artists included in this list are late-nineteenth- and early-twentieth-century etchers associated with John Taylor Arms through his writings and art historical scholarship. Names appearing in boldface are those artists known to have used antique papers; the others are likely to have used antique papers because of their close association with one another

Table 4 Etchers Associated with the Use of Antique Papers

9. Fletcher, W.D. 1982. *John Taylor Arms, A Man for All Time: The Artist and his work*. New Haven: Eastern Press. 18.
10. Arms, J.T. 1941. John Taylor Arms tells how he makes an etching: Part 3 – Printing. *American Artist* 5(2): 13.
11. Arms. 1941. 13.
12. Fletcher. 1982. 15.
13. The Arms diaries predating 1930 have been missing since the time of his death. Therefore the precise dates and extent of time that the printmaker spent with Hunter are uncertain.
14. Arms. 1941. 13.
15. Paton, H. 1895. *Etching, Drypoint, Mezzotint: The Whole art of the painter-etcher*. London: Raithby, Lawrence, and Company, Ltd.;
    Short, F. 1912. *Etching and Engravings: What they are, and are not with some notes on the care of prints*. London: Royal Society of Painter-Etchers and Engravers;
    Jaques, B.E. 1913. *Concerning Etchings*. Chicago: Chicago Society of Etchers;
    Plowman, G.T. 1914. *Etching and Other Graphic Arts: An Illustrated treatise*. New York: John Lane Company;
    Reed, E.H. 1914. *Etching: A Practical Treatise*. New York: G.P. Putnam's Sons;
    Pennell, J. 1919. *Etchers and Etching*. New York: Macmillan;
    Pennell, J. 1921. *The Graphic Arts: Modern men and modern methods*. Chicago: University of Chicago Press;
    Hubbard, E.H. 1923. *On Making and Collecting Etchings*. Hampshire, England: Prints Society Publications;
    Lumsden, E.S. 1925. *The Art of Etching*. London: Seeley, Service and Company, Ltd.;
    West, L. 1932. *Making An Etching*. New York: The Studio Publications, Inc.
16. Lumsden. 1925. 137.
17. Arms. 1941. 13.
18. Pennell. 1919. 233.
19. Fletcher. 1982. 12.
20. Smith. 1997. 90–91.
    Stratis. 1998. 298–304.
21. Arms, J.T. October 30, 1930 – June 14, 1938. Unpublished records of consignment of prints to Kennedy and Co. John Taylor Arms Papers 1910–1952. Bryn Mawr College Library, Bryn Mawr, Pennsylvania.
22. Arms, J.T. 1934. Unpublished diary entry. John Taylor Arms Papers 1923–1953. Archives of American Art, Smithsonian Institution, Washington, D.C. Microfilm reel 65, frame 304.
23. Lochnan, K.J. 1988. *Whistler's Etchings and the Sources of His Etching Style 1855–1880*. New York: Garland Publishing, Inc. 273–74.
24. Lumsden. 1925. 278.
25. Arms, J.T. 1952. Unpublished diary entry. John Taylor Arms Papers 1923–1953. Archives of American Art. Microfilm reel 69, frame 434.
26. Lumsden. 1925. 140.
27. Paton. 1895. 111.
28. Hubbard. 1923. 108.
29. Pennell. 1919. 234.
30. Lumsden. 1925. 39.
31. Arms, J.T. 1928–36. Unpublished address book. John Taylor Arms Papers 1910–1952. Bryn Mawr College Library, Bryn Mawr, Pennsylvania.
32. Fletcher. 1982. 12.
33. Arms, J.T. 1947. Unpublished diary entry. John Taylor Arms Papers 1923–1953. Archives of American Art. Microfilm reel 67, frame 414.
34. Lunning, L. 1976. The Antique laid papers in the collection of John Taylor Arms. Unpublished typescript. Houghton Library, Cambridge, Massachusetts.

Additional references

Arms, J.T. 1923–53. John Taylor Arms Papers. Unpublished diaries. Archives of American Art, Smithsonian Institution, Washington, D.C. (On microfilm.)

Arms, J.T. 1910–1952. John Taylor Arms Papers. Unpublished papers. Bryn Mawr College Library, Bryn Mawr, Pennsylvania.

Arms, J.T. 1940. John Taylor Arms tells how he makes an etching: Part 1 – Preparation of plate. *American Artist* 4(10): 14–16, 36.

Arms, J.T. 1941. John Taylor Arms tells how he makes an etching: Part 2 – Drawing-on and etching the plate. *American Artist* 5(1): 10–12.

Arms, J.T. 1941. John Taylor Arms tells how he makes an etching: Part 3 – Printing. *American Artist* 5(2): 13–15.

Chamberlain, S. John Taylor Arms . . . phenomenon. *Prints* 1(4): 43–44.

Eaton, C. 1923. *John Taylor Arms, Aquatinter: An Appreciation of the man and his works with an authoritative list of his aquatints*. Boston: C.E. Goodspeed and Company.

Grand Central Art Galleries. 1937. *Twenty-one Years of Drawing: A Retrospective exhibition of the works of John Taylor Arms, January 5–30th, 1937*. New York: Grand Central Art Galleries.

Kraeft, J., and N. Kraeft. 1982. *American Architectural Etchers: The Traditionalists (1900–1940)*. Bethlehem, Connecticut: Kraeft.

Kraeft, J., and N. Kraeft. 1984. *Great American Prints 1900–1950: 138 Lithographs, etchings and woodcuts*. New York: Dover Publications.

Morgan, C.L. 1925. The Pencil and John Taylor Arms. *Print Connoisseur* 5: 93–125.

Pelletier, S.W. 1981. John Taylor Arms: An Evaluation. *Print Review* 14: 11–25.

Saville, J. 1995. *John Taylor Arms: Plates of perfect beauty*. Honolulu: Honolulu Academy of Arts.

Watrous, J. 1984. *American Printmaking: A Century of American printmaking, 1880–1980*. Madison, Wisconsin: University of Wisconsin Press.

Wheelock, W. 1939. John Taylor Arms, modern medievalist. *Art Instruction (American Artist)* 3(2): 17–21.

Whitmore, E.M. 1925. *John Taylor Arms: Notes on the development of an American etcher*. New York: Kennedy and Company.

History Revealed: Looking at Ferdinand Bauer's *Flora Graeca*

NANCY BELL

Abstract

When botanical artist Ferdinand Bauer (1760–1826) left Oxford in 1786 with Professor of Botany John Sibthorp for a botanical tour of the Levant, it is unlikely that he had any indication that the approximately 500 sketches from his travels would produce the *Flora Graeca*, one of the greatest botanical books of the eighteenth century. His tour with Sibthorp lasted one year, and upon his return he finished artworks from the sketches prepared in the field. The *Flora Graeca* was eventually published in parts between 1806 and 1840.

The Plant Sciences Department, University of Oxford, holds within its collection the preparatory sketches and finished art works for the *Flora Graeca* and archival materials relating to Bauer and Sibthorp. During examination and subsequent conservation treatment of the guardbook of sketches, it became apparent that Bauer used five distinct types of paper for his sketching project, and that the geographical origin of these papers coincided with known stops on his tour. In looking at the sketches represented in each paper type, correct geographical locations could be assigned to the sketches, which helped to confirm the chronology of the tour. Most of the paper was Dutch and was produced by the Honig firm, although Bauer also used a British paper watermarked *I. Taylor*.

The story of Ferdinand Bauer's most accomplished work, the *Flora Graeca*, begins in the eighteenth century, a period described by historians of ideas as an age of curiosity. It was a century that witnessed a complete reordering of social, economic, political and scientific institutions. The field of natural history, and in particular observational science, the discipline in which this story is set, was no exception. Advances in design and the availability of both the telescope and the microscope provided, particularly to the botanist, a means to measure, observe, and quantify the natural world in a way that was not possible a century before. Technological innovation allowed assumptions about the world to be challenged; the natural world was rediscovered by direct observation through a lens. These developments enabled what Foucault terms the 'description of the visible,' and the seeing of the 'hitherto unsuspected.'[1] For the study of botany there was one other landmark event of the mid-eighteenth century that needs mention. The development of plant taxonomy, first by Tournefort and later by Linnaeus, who used visual images to promote his ideas, provided a language to the student of natural history on which to hang the visible. The botanist could now order and classify the influx of newly discovered plants from around the world, and therefore make comparisons to a degree that was not possible a century earlier.

The legacy of the eighteenth-century science of curiosity is a material culture rich in specimens brought back from expeditions: shells, flowers, bones and geological specimens were assembled and grouped for comparison. Equally interesting, but sadly now often dispersed into larger library collections, are outstanding natural history books produced in the eighteenth century to illustrate all aspects of the natural world, particularly plants and animals. This is not to suggest that the tradition of picturing plants in printed books and manuscripts was not well established in the period before the mid-eighteenth century. Plants had for centuries been illustrated in medical manuals and, of course, for general plant identification, as well as for symbolic representation and pure aesthetic delight in all forms of artistic expression. Beginning in the seventeenth century and certainly by the eighteenth century, however, there was a shift in emphasis in the purpose of botanical illustration. Many books produced during this period were not just beautiful; the principal aim was to transmit ideas and to communicate the results of enquiry and analysis through visual images. The text was integral to the work, but it was the image that had to explain what was seen, with great precision and accuracy. Generally speaking, these books were executed by botanical illustrators, in contrast to those produced by artists who were supplying a market hungry for beautiful pictures of flowers, but which were not always scientifically accurate. It is within this context that our story is set, in 1784 — an age of curiosity and exploration.

The Department of Plant Sciences, University of Oxford, holds a large body of material relating to one of the greatest botanical works ever produced, the *Flora Graeca*, said even today to remain unrivalled for its thoroughness and botanical accuracy. The collection includes folded sheets of preparatory sketches, 966 finished gouache drawings of images of the flora and fauna of the Levant, 141 wash-and-ink drawings of visited sites, the herbarium specimens collected during the journey, extensive archival material, including the diaries of John Sibthorp, and the final hand-coloured printed edition of the *Flora Graeca*.

This paper, however, will focus on only one small part of the collection: first, the papers Bauer used for the preparatory sketches as illustrator for Professor John Sibthorp during his expedition to Italy, modern Turkey and Greece, and second, Bauer's selection of paper for his full-scale watercolours of the flora and fauna of Greece. The aim is to demonstrate how physical analysis of the paper has informed our understanding of Bauer's artistic technique and his method of working.

The Preparatory sketches

The collection of preparatory sketches, some 150 sheets, had been randomly assembled and bound in a guardbook earlier this century. Over time the unevenness of

the format had caused physical damage to the sheets, particularly along the foredge. Consequently, a decision was made to disbind the volume, which also provided an opportunity to reassemble the drawings in a more logical order. Once the sheets were separated, it became clear that the sketches had been executed on seven distinct types of paper, mostly folded sheets, although there were a number of half-sheets without cognate leaves, thus proving that many more sketches once existed but are now lost. Closer examination suggested that the seven papers seemed to have a distinct order (fig.1). Ultimately the close study of these papers helped to establish more confidently the chronology of Sibthorp's journey and to confirm some hitherto uncertain information about the plants.[2] It was also a rare chance to study thoroughly a fine collection of eighteenth-century papers.

Before continuing with the story of the *Flora Graeca*, the two principal characters should be formally introduced. The first is John Sibthorp, born in 1758. His family was a prominent landed family of Lincolnshire. His father was an eminent professor of botany, a path his son followed after first taking up medical studies at Edinburgh University. Sibthorp later returned to Oxford to pursue his preferred interest, botany. There are several significant events in Sibthorp's life that are related to the story and that indeed made the *Flora Graeca* possible. His mother died when he was 22 and left him an estate that provided a comfortable income for a young man. As the recipient of a Radcliffe Travelling Fellowship, he received the sum of £300 per annum for ten years, on the condition that he travel abroad for at least five of those years.[3] After John completed his degree in Oxford, his father retired from his position as Sherardian Professor of Botany in 1784. Only a matter of months after his father left his post, John Sibthorp became the third Sherardian Professor of Botany.

In contrast to the wealthy, well-educated Sibthorp, the second key character in the story is Ferdinand Bauer. He and his brother Franz had already established themselves as accomplished botanical illustrators, having had drawings published by the time they reached early adolescence. Bauer was born in the small village of Feldsburg, north of Vienna, since renamed Valtice and now part of the Czech Republic. According to several published biographical sources, his father was a court painter to the reigning prince of Liechtenstein, although he died when the children were very young. Ferdinand's education was guided by his mother, who arranged for the children to be tutored in drawing. It is said that they spent their youth copying their father's work on canvas and, in particular, copying birds and animals. Ferdinand was also taught to paint in miniature by Father Norbert Baccius.[4] In 1780 the Bauer brothers moved to Vienna, where they were employed by Father Niclaus von Jacquin, professor of botany and chemistry at Vienna University, where they contributed to many publications. It was this early training which came to formulate and guide Bauer's work by drawing directly from nature and collecting specimens rather than by copying. This early apprenticeship consolidated his distinctive artistic technique and helped to develop his incredible facility for capturing an image with speed and precision.

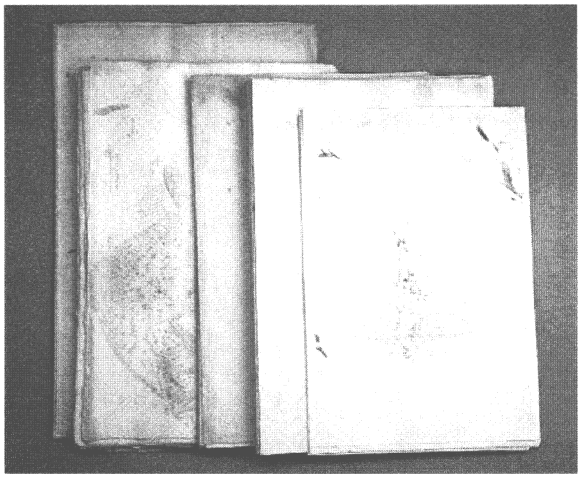


Fig. 1 Different types of paper used for the sketches.

Having taken up his post as professor of botany, Dr Sibthorp left Oxford in 1784 to study the famous botanical codices of Dioscorides in the Imperial Library, Vienna, in preparation for his planned expedition to the Levant to rediscover the work of Dioscorides and to collect specimens of the flora and fauna of the area. Having arrived in Vienna, Sibthorp obviously met Jacquin, Bauer's employer, and through him contracted Bauer to accompany him as painter on his journey to Greece, Turkey and many of the surrounding islands.

The expedition took several months to prepare, with the party leaving Vienna on 6 March 1786. Sibthorp's diary records 'the day cold — wind and snow.'[5] More importantly, we know that Bauer left with at least two kinds of writing paper, being of a size and watermark consistent with writing papers of the period. Watermarked *Crowned Posthorn* and countermarked *I Heller*, and marked *Crowned Posthorn* and countermarked *I A Heller*, these papers were identified as being made on a single-face mould at a mill on the Bohemian-Moravian border, at Iglau, close to Bauer's home (fig. 2). A mill had been producing paper on the site for some time and was working until 1793, so it is likely that this paper was contemporary with their departure in 1786.[6]

From Vienna the group travelled to Trieste; the journey was mountainous and hard going. From there they departed to Venice, where Sibthorp was 'more impressed with the city than the botanical offerings.' Bologna was the next stop, where Sibthorp found the botanic garden equally unsatisfactory — a city 'better known for its sausages than learning.' Continuing south to Florence they arrived in early spring and found the environs 'highly beautiful.'[7] Bauer sketched several species of plants, including a species of tulip later named *Tulip florentinas*, which Bauer recorded on a white laid writing paper, watermarked with an ornamented hammer and countermarked with grapes. It dates from 1753–84 and is likely to be Italian, possibly purchased in Florence (fig. 3).

The journey continued south to Pisa and Siena, then on to Rome, where Sibthorp visited many sites, including the Villa Borghese. There was some recording of the plants

there, but Bauer was actively involved in doing sketches of the archaeological sites, which he later completed as finished wash drawings upon his return to England.[8]

From Rome they travelled to Naples, where they spent three weeks before setting sail for Capri on 21 April, stopping first at Sicily, and recording the plants on Heller papers that Bauer had brought with him. It was from Capri that they started the main part of the journey, crossing the Aegean in pursuit of the lands of the Levant. Bauer took with him at least four kinds of writing paper purchased in Italy — enough paper to last the entire journey. Was this decision to take the papers with him by choice or was it by chance?

The slight tooth of the fine-quality Italian writing papers provided a good surface for drawing on with a fairly hard pencil, since it would inhibit the chances of smudging. Carrying ample supplies of paper for the expedition across the Aegean to the islands of the Levant meant that Bauer did not have to rely on local, unpredictable sources, possibly of inferior-quality papers, or resort to using heavily glazed sheets made in the Arabic tradition, with a smooth surface that would have made it more difficult to render a sharp pencilled image.

Bauer carefully used the folded sheets in portrait format, filling the recto of each leaf with detailed pencilled images of birds, fishes and, of course, plants, then continued working on the verso of the sheet as one might use a sketch-book. For the most part he used one kind of paper for each geographical area, although there are some anomalies. The sheets completed at the end of the journey were turned upside down and over so that he could draw on the unused portion of the back, thus separating one group of plants from another by judicious use of his supplies.

The journey continued for five days across the sea before they sighted the coast of the Peloponnese, and then anchored at the port of Milo. They found the island decimated by the plague. Nevertheless, they continued undaunted and soon set about recording a large number of plants and animals, while at the same time searching for a boat to return them to their awaiting anchored vessel.[9] Eventually they found their way back to their boat, pleased to sail on to Crete, where Bauer completed a large number of pencilled drawings using the second group of paper marked *Heller*.

The journey across the Aegean was exhaustive, making stops at the port of Kusidasi, the island of Samos, Mount Olympus and Smyrna. Their findings were all illustrated by Bauer on a lightweight Italian writing paper watermarked with a circled fleur-de-lys and countermarked with grapes (fig. 4). This fine writing paper was probably made at a mill near Naples, the most likely site being Amalfi. It dates from about the mid-1780s.[10]

They entered the Levant at the end of the summer, when plants had finished flowering. The diary entries for this period are extensive and fully describe life in Istanbul. Time was spent collecting seeds. They stayed for Christmas. Sibthorp wrote in a letter to Joseph Banks, 'my painter has taken the outline of 500 plants and shall have at least 300 new species to add to the Linnaean

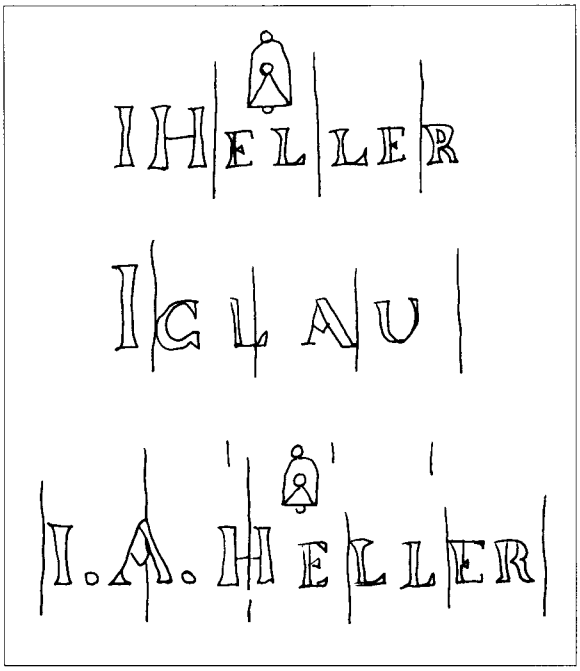


Fig. 2 ***I Heller*** **and** ***I A Heller*** **countermarks.**

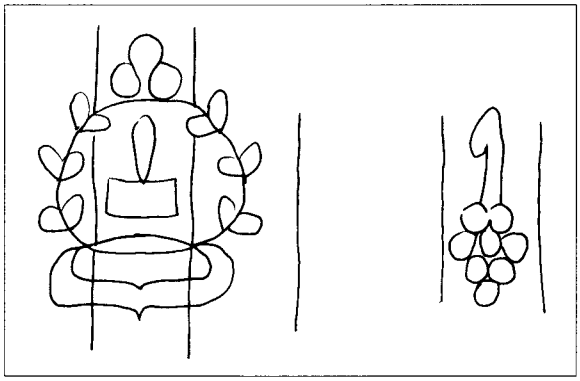


Fig. 3 Ornamented hammer countermarked with grapes.

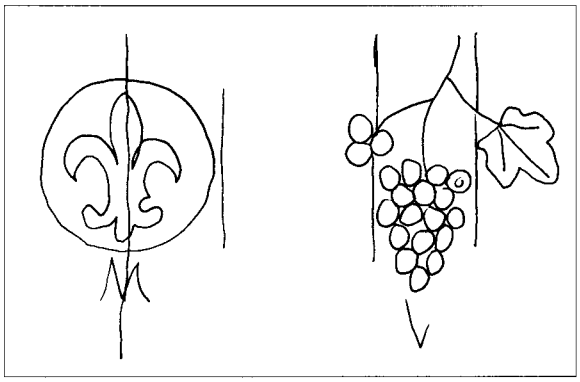


Fig. 4 Fleur-de-lys countermarked with grapes.

nomenclature, also completed about 100 fish.'[11]

From Istanbul they travelled to Cyprus, then on to Athens, Thessaloniki, Corinth and Mount Parnassus. All of their work was recorded on the Heller papers that Bauer first used in Florence. At the end of summer and the end of the journey the time for collecting plants was drawing to a close. The first autumn-flowering bulbous plants were recorded on another writing paper, watermarked with three hats and countermarked *CS* (fig. 5). The Three

Hats watermark, often found on papers in the north-eastern part of Italy, was possibly from Venice and was used for ledger papers and documents. This was a corrected white paper, containing some very fine red and blue fibres added to counteract its yellowness. The drawing, on the reverse side of the sheet, is annotated 'Morea,' the last collection site in the Ottoman Empire. The team returned to Oxford 15 months after leaving Vienna, with approximately 1,500 sketches, having endured treacherous sea journeys, a host of illnesses, and a tense relationship between Bauer and Sibthorp. The sketches of the area included depictions of geological and archaeological sites. They had scaled rocky coasts, carrying their own food and water, in their search for herbarium specimens, which they had pressed between paper.

The Finished watercolours

When the journey ended in 1787 Bauer returned to England with his companions and the booty of their trip: stuffed birds, preserved fishes, shells, plants, seeds and so on. Bauer immediately set about producing the finished botanical works. He worked from the small pencil sketches to make full-size images, beginning with a full outline pencil drawing, using the collected herbarium specimens, before starting to colour in gouache using a colour code. He completed 966 drawings between the years 1787 and 1794 — the equivalent of 18 works per month. The sophistication of these drawings and the phenomenal speed with which they were completed is a testament to the artist's considerable skill and profound visual memory.

All 966 finished works are executed on two types of hard-sized laid writing papers. The sheets are untrimmed at the head and tail. The *back* of the handmade sheet — the distortion made across half the sheet when the paper was hung to dry — is still visible along the foredge of most sheets, suggesting that Bauer probably did not expect the sheets to be bound. This provides clear evidence that a half-sheet, roughly imperial or imperial super royal (British sizes measuring approximately 48 × 30 cm or, doubled, 48 × 60 cm), was used. All the drawings are executed on writing papers as opposed to drawing papers, and were produced by the Dutch maker C.I. Honig and by the British mill that marked its papers *I. Taylor*. What is particularly interesting, after examining the completed works of both flora and fauna, is that it is clear that Bauer consistently chose to use the felt side of each sheet rather than the slightly rougher wire side. By consciously selecting the smoother surface, he could render sharper images, since the smoother surface prevented the heavy pigment layer from being visually flattened. This offers further evidence that Bauer was consistently attentive to the fine subtleties of drawing and painting and to the overall effect of the finished work (fig. 6).

Bauer selected two types of paper for his finished works, one of which was the same as the paper used for his Liechtenstein drawings.[12] Was his selection of paper by choice or was it by chance? It is unlikely that we will ever know the answer to this question with any certainty.

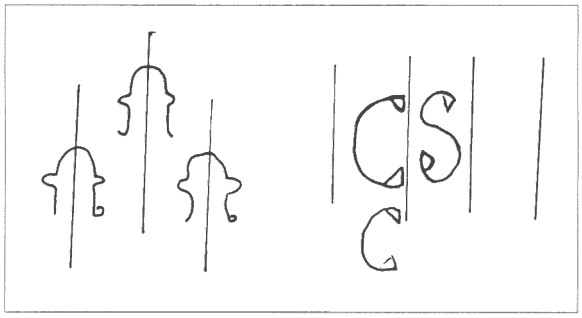


Fig. 5 Three Hats countermarked *CS*.

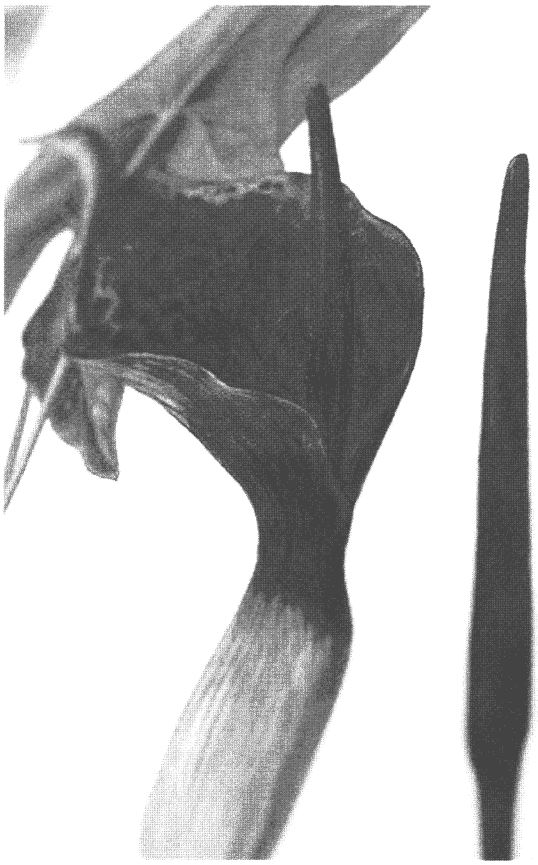


Fig. 6 Detail of one of the finished watercolours.

Nevertheless we can get closer to discovering the answer by looking at what he required and what might have been locally on offer. Because he selected writing paper, mostly Italian, to render the preparatory sketches, one can conclude that Bauer preferred a harder-surfaced paper, probably to prevent the pencilled outline drawings from smudging. For his completed watercolours he repeated his style of rendering a fine outline drawing first and then adding many more details. He needed a large quantity of large-format sheets with a warm, rich tone for good contrast and to enhance the careful choice of colour. The papers also needed to be heavy enough to accept thinly applied layers of paint and, in places, the extensive use of gum, without becoming distorted.

We know that when Bauer arrived in Oxford it was his first visit to England. As a newcomer, it is unlikely that he would have known what paper was available. He could have either selected his sheets from local sources or perhaps had them sent by his brother Franz,

who was employed as botanic illustrator at Kew Gardens when he returned to England.

By the end of the eighteenth century favourable economic conditions coupled with a growing market for better papers gave rise to an increase in the number of mills in England producing white papers. As Coleman states, 'the imposition of duties on imported paper heavier that those on paper of British make gave the British manufacturers a decided advantage in competing in the home market with French, Italian, Dutch and German makers.'[13] The shift in economic advantage and the growing demand for paper was a national pattern repeated in the Oxford area, where there were at least seven mills, including the largest, Wolvercote Mill, just north of the city. Of these, most were engaged in making writing and printing papers to service the university and the large printing works of Oxford University Press, as well as a thriving bookbinding trade which provided a market for good-quality papers for ledgers and account books. A review of Jackson's *Oxford Directory* for the years before Bauer's arrival, and when he was completing his final version of the flora and fauna of the Levant, offers few clues. There are many listings for stationers, almost always cited with booksellers, but the emphasis on bookselling in all the advertisements can only suggest that bookselling was the principal activity. The one exception was Samuel Milburn, who was 'glad to serve all tradesman shopkeepers and others with several sorts of paper.'[14] The dearth of advertisements promoting new paper products could simply reflect the ubiquitous nature of the product and the higher profit margins to be gained from books, but this does not necessarily imply that a wide selection of papers was not on offer. It is unlikely that local mills could have provided a paper to suit Bauer's needs, and he seems to have rejected wove papers, which were certainly available but perhaps unknown to him at this time, although he did elect to use wove papers for the finished, coloured works of his later Australian journey.

A few words about the papers themselves. Unravelling the complex history of Honig papers — his main choice — with their distinct beehive watermark, is complicated, and little primary source material still exists for the eighteenth century. We know that Dutch writing papers were the envy of papermakers throughout the rest of Europe, but the same standard of excellence was never reached in their printing papers. Large quantities of paper were exported to England. In fact, the British government contracted the Honig firm to produce writing papers watermarked with the royal arms, to be sent to England for use for official documents. The other paper Bauer used was watermarked *I. Taylor* and was made by I. Taylor at the Basted Mill, Wrotham, Kent, from 1776 to 1802. The Taylor family had a reputation for good-quality papers and made some of the first wove papers.[15] We know that Bauer completed his work along the Linnaean system, starting with the first orders and moving along, beginning with the flora and then the fauna. At the end of the work he prepared seven frontispieces on Whatman's wove paper.

Bauer's selection of these papers may have been by chance. However, his choice of writing papers selected for the journey and his careful and systematic use of paper and colour for the finished works is indicative of an artist consistently attentive to every detail and to all aspects of the final presentation. It is almost certain that he would not have selected papers that would compromise his drawings in any way, despite the cost, which for this quality and quantity would not have been insignificant.

With the completion of the coloured drawings behind him, Bauer left Oxford and the employ of John Sibthorp. In 1801 he left England to travel with Matthew Flinders' expedition to Australia to record the flora and fauna. Eventually the *Flora Graeca* was published — the first seven volumes between 1806 and 1831 and the remaining three volumes from 1832 to 1840. Only 25 copies of the first edition were issued, at a cost of £254 per set, the cost being met by Sibthorp's estate.[16]

Professor Lack has said that the letters and diaries of Sibthorp and his travelling aid J. Hawkins allow us to follow the progress of Bauer's work over the years, and, at the same time reflect the quality of his illustrations. If I could suggest one additional resource that should be added to Professor Lack's notes concerning the letters and diaries, it must be the papers. On their own they cannot provide a full account, but analysis of the physical evidence of Bauer's work, including the papers, has made for a much richer story.

Notes

1. Foucault, M. 1970. *The Order of Things*. London: Editions Gallimard. 125.
2. Throughout the process of conserving the preparatory sketches I had many exciting discussions with Herr H.W. Lack, Botanischer Garten und Botanisches Museum, Dahlem-Berlin, who has recently completed the most exhaustive study of Ferdinand Bauer. His incredible knowledge of Bauer's tour and the plants that Sibthorp studied enabled the various pieces of the material evidence to be ordered.
3. Lack, H.W. 1999. *The Flora Graeca Story: Sibthorp, Bauer and Hawkins in the Levant*. Oxford: Oxford University Press. 18.
4. Blunt, W., and W. Stearn. 1995. *The Art of Botanical Illustration*. Reprint. Woodbridge, Suffolk: Antique Collectors' Club. 225.
5. Lack. 1999. 18.
6. Bower, P. 1992. Ferdinand Bauer: Flora and fauna drawings. Unpublished typescript. More work would be needed to determine whether this paper was contemporary with his departure or if it was from his own supplies.
7. Lack. 1999. 34.
8. Lack. 1999. 34.
9. Lack. 1999. 50.
10. Bower. 1992.
11. Lack. 1999. 41.
12. Lack. 1999. Personal communication.
13. Coleman, D.C. 1958. *The British Paper Industry 1495–1860: A Study in industrial growth*. Oxford: Clarendon Press. 52.

14. Davies, E. [n.d.] *Chronological Synopsis and Index to Jackson's Oxford Journal 1753–1780*. Oxford. 6.
15. Balston, J.N. 1998. *The Whatmans and Wove Papers*. West Farleigh, Kent: J.N. Balston. 121.
16. Blunt and Stearn. 1995. 226.

The Role of China Paper in Nineteenth-Century French Printmaking

KIMBERLY SCHENCK

Abstract

The nineteenth century marked a period in the history of French printmaking which combined innovative printing techniques with artistic commitment to the graphic arts. Prints from the century were executed on a variety of supports including an oriental paper frequently called China paper by print scholars. China paper is a soft, thin, absorbent paper, pearl grey to ivory white in colour, with distinct brush marks often found on one side. Nineteenth-century printmaking manuals praised China paper and described its application in printing, often outlining directions for mounting sheets onto stouter plate papers. A broad survey of nineteenth-century prints and a review of contemporaneous print manuals provided the foundation for this study. Suggestions presented in the manuals are compared with actual practices observed in the prints. In addition, this study outlines China paper's manufacture and discernible characteristics.

Introduction

During the nineteenth century, three major factors influenced the proliferation of printed images in France: an expanding market for illustrated print material, technical innovation and a renewed artistic commitment to graphic media. Aloïs Senefelder's 1798 invention of lithography spread rapidly because of its abilities to provide an economical and speedy printing process and to autographically reproduce drawn information. Lithographic stones could withstand numerous printings, according them a great commercial advantage over intaglio copper plates. Artists of the highest calibre, in addition to commercial lithographic draughtsmen and engravers, contributed to the great output of illustrated materials. The century marked the beginning of an ardent collaboration between painters and printers who engaged in creative technical experimentation in pursuit of artistic expression.

When French prints from the nineteenth century are examined, various types of papers are observed, including fine French laid papers, soft white wove papers, specialty or coloured papers and exotic oriental papers. The increased use of lower-quality fibre sources, chlorine bleaches, mechanized papermaking procedures and acidic sizing agents provoked criticism of contemporary European papers. Lithographers from the second quarter of the century complained of acidic papers breaking down the delicate balance of drawn and blank areas of the lithographic stone and suggested testing papers with litmus before printing.[1] The need for responsive printing surfaces and the desire to experiment led artists to seek out novel papers, such as fine old antique laid papers and delicate oriental papers. Increased trade with China, and then with Japan later in the century, initiated the

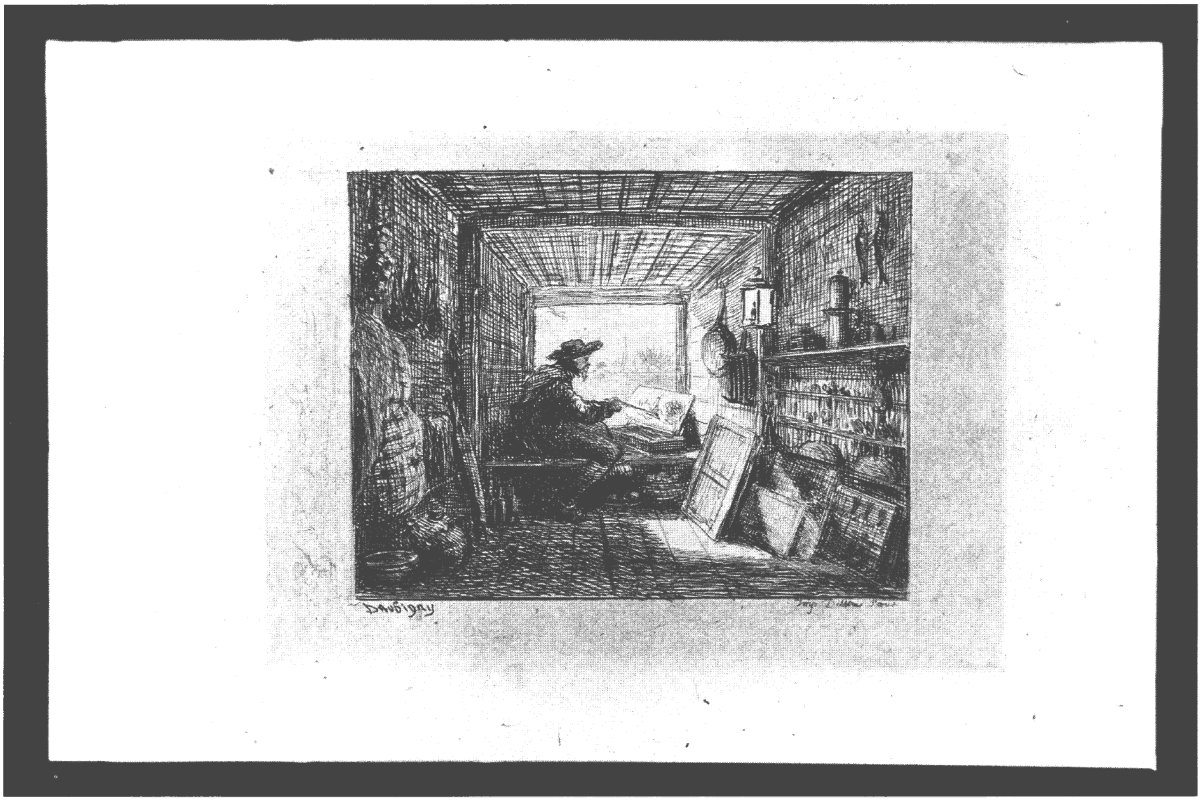


Fig. 1 Charles Daubigny, *The Studio on the Boat*, 1861, etching on unmounted China paper (BMA 1996.48.4258).

rediscovery of oriental papers, which had not been used to any great extent in Europe since Rembrandt used them in the seventeenth century. These thin, supple papers, available in an array of pleasing tones, took impressions beautifully and successfully from lithographic stones, copper plates and wood blocks alike.

One particular oriental paper seen frequently throughout the century in French prints of all media is China paper, or *papier de Chine* (fig. 1). *China paper* is a descriptive term characterizing a soft, thin, absorbent paper, relatively opaque and pearl grey to ivory white in colour. Prints may be found on single sheets, called *chine volant*, or pasted onto heavier Western papers, known as *chine collé* or *chine appliqué*. The British terms for China paper — India or India proof paper — developed from its association with the British East India Company, which began regular trade with Canton, China, in the mid-eighteenth century.[2] William Savage in 1822 suggested that China paper had first arrived in Europe as the linings of tea chests and as wrappers for products such as silk and porcelain.[3] J.B. du Halde, in his book on the Chinese empire published in 1736, remarked on the advantages of Chinese papers, describing them as uniformly white, soft and smooth.[4] It is unclear how China paper began to be used in French printmaking.

China paper and bamboo papermaking

Sheets of China paper range in quality from finely made with limited flaws to coarse with long, dark, undigested fibre strands, shives and clumps of pulp. When viewed in transmitted light, some papers display an even dispersion of pulp and a distinct laid pattern, while other sheets appear cloudy with an obscured screen design (figs. 2, 3). The chain-line interval averages 20 to 23 mm, but narrower widths ranging from 4 to 17 mm are frequently seen in parts of a sheet. In comparison, Japanese papers typically exhibit chain-line intervals of 30 to 40 mm. Sheets of China paper vary in colour from pearl white, with cool grey to warm grey overtones, to an occasional pale yellow. They average in thickness from 3 to 5 mils and are not found more than 7 mils thick. One side features distinct, ridged brush marks while the other side is usually smooth, but not glazed, with little dips or recesses sometimes apparent with low-level magnification (fig. 4). On thicker sheets the brush marks may be seen to a lesser extent on the opposite side. China paper feels similar to a softly textured paper towel with limited internal strength. Indeed, the sheets are unsized and highly absorbent.

The fibre content of several prints on typical China paper was identified as bamboo. Scanning electron microscope (SEM) imaging of a China paper sample from 1833 revealed numerous particles lying between the bamboo fibres (fig. 5).[5] Elemental examination with energy-dispersive spectrum analysis (EDS) indicated a high presence of silicon and some calcium, which are thought to be present naturally in the bamboo plant.[6] In addition, residual calcium may be present from the processing of bamboo fibres with lime (calcium oxide). A China paper sample from 1925 contained silicon, aluminium and potassium, indicating a clay filler was present. (Fibre analysis and SEM/EDS analysis of these papers is discussed more thoroughly in the Appendix to this paper written by Debora Mayer.)

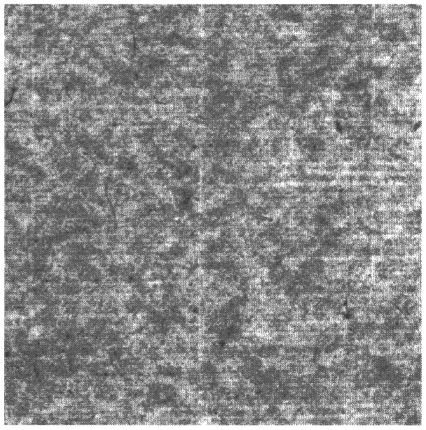


Fig. 2 Beta radiograph of China paper. Eugène Bléry, *View taken at Granges in Cevennes*, 1838, etching on unmounted China paper (BMA 1996.48.221).

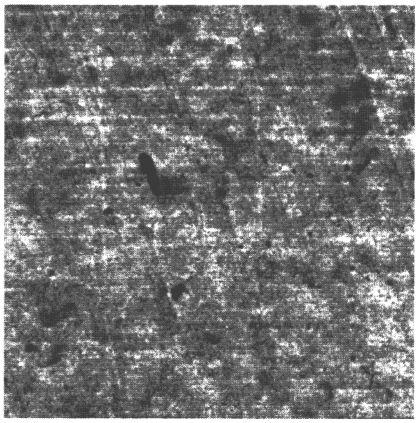


Fig. 3 Beta radiograph of China paper. Eugène Delacroix, *Muleteers of Tetuan*, 1833, pen lithograph on unmounted China paper (BMA 1925.12.1).

China paper, as the name implies, appears to have come from China, where bamboo has been a chief source of papermaking fibre since the middle of the Tang dynasty (618 – 907 AD). In the Yangtze valley and southern provinces, bamboo grows rapidly and abundantly, and costs little to process into paper. Bamboo fibres are frequently used in Chinese papers intended for calligraphy and woodblock printing because they absorb ink nicely, have a pleasant colour and easily conform to the surface of a printing block. Since production costs were low, bamboo papers were used extensively for printing and were widely exported. Sixty species of bamboo (*Gramineae* family) reportedly grow in China. According to Floyd Alonzo McClure in *Chinese Handmade Paper*, *Phyllostachys edulis* (Carr.) de Lehaie is the most widely distributed species and the one from which the best paper is made.[7] Other species for papermaking include *P. heteroclada* Oliv., *P. congenta* Rendle, and *Bambusa arundinacea* Retz. Depending upon the degree

of processing, the colour of bamboo papers ranges from white to yellow and even to medium brown.

Young bamboo stalks, cut into short pieces, are fermented with lime in pits for several months, rinsed in water to remove the lime and cleaned of the tough outer skins.[8] The resulting pulp is steamed in alkaline solutions of lime, wood ash or rice-straw ash and then rinsed. Because bamboo is more difficult to digest than bast or grass fibres, fermentation and cooking times are prolonged and repeated. The elevated amount of alkali required to break down the bamboo stalks and its residuals probably contributes to the apparent lack of acidity in China paper, which often reads above neutral when tested with pH indicator strips. Between cooking steps, the pulp may be spread out on the ground or on racks and sprinkled with water to bleach in the sun. Chemical bleaching, faster but more expensive than sun bleaching, has been used in China since the 1890s and has slowly become the predominant bleaching method over the last century.[9] The pulp is beaten by hand using either a mallet or a large mortar and pestle, or beaten with a foot-powered stamping machine. The pulp is then put into a water-filled vat. Starch pastes and vegetable gums are added to the vat to aid sheet formation, obtain better fibre distribution and act as gentle sizing agents. These substances are made from boiling the leaves, twigs or barks of various plants — *Hibiscus manihot*, *H. syriacus*, *Actinidia chinensis*, *Althaea officinalis* and *Ilex pubescens*. Loading agents such as soy bean (*huang tou* in Chinese and written as *hautong* in some print treatises), clay and powdered limestone are added to some papers to increase opacity and weight.

Sheets of paper are formed on screens made from thin strips of bamboo sewn together with horsehair, silk, flax or ramie. The screen sits on a ribbed frame, and deckle sticks, held in place by the papermaker, keep the fibres from flowing off the screen. The mould is dipped into the vat at least twice, creating a laminate structure which separates into distinct layers when samples are prepared for fibre analysis. Prints on China paper which have received prolonged immersion in water may show some delamination at the corners. After formation the sheets are couched on top of one another without felts and then pressed between boards. For drying, the sheets are brushed with a coir brush onto a heated double wall constructed of either earthen bricks or bamboo lattice and plaster, producing the distinct ridges found on the sheet's one side. Even though the brush is coarse and prickly to the touch, holes from the brushing are rarely seen in China paper, but an associated pattern may sometimes be detected in transmitted light where the stiff brush has displaced the pulp (fig. 3). Authors of printing manuals speculated that this drying system contributed to how well China paper receives an impression, since the paper is not heavily pressed and so remains resilient, thereby moulding itself more perfectly to the plate.[10]

Several nineteenth-century French lithography manuals identify bamboo as the fibre used to make *papier de chine* and thoroughly discuss the Chinese process for making bamboo papers. The descriptions are fairly accurate and include information on fibre preparation and beating, sheet formation, and drying. Not only was bamboo listed as a papermaking fibre source but so too were hemp, mulberry bark, rice and wheat straw, bark from several kinds of trees and silk. Early sources on Chinese papermaking may have provided the basic information for the printmaking texts, including J.B. du Halde's *Description géographique, historique, chronologique, politique, et physique de l'Empire de la Chine et de la tartarie Chinoise*, from 1736, and Joseph de Lalande's *L'Art de faire le papier*, from 1760.[11]

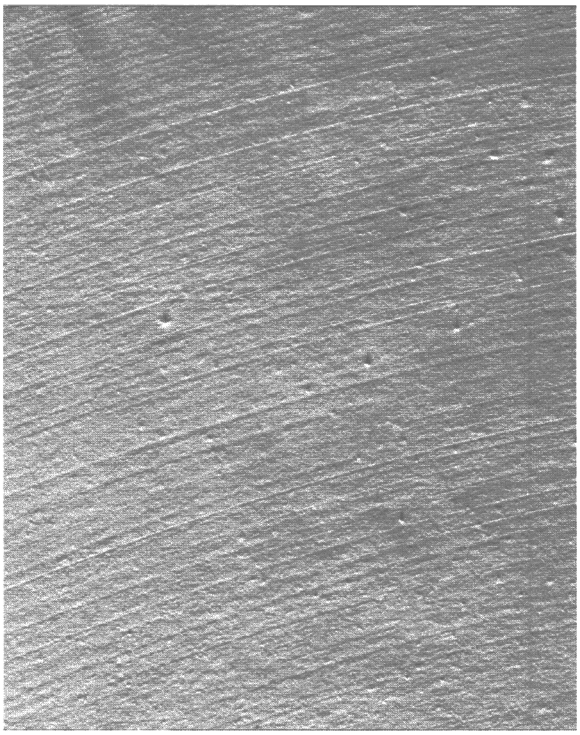


Fig. 4 Brush marks on China paper seen in raking light. Delacroix (BMA 1925.12.1).

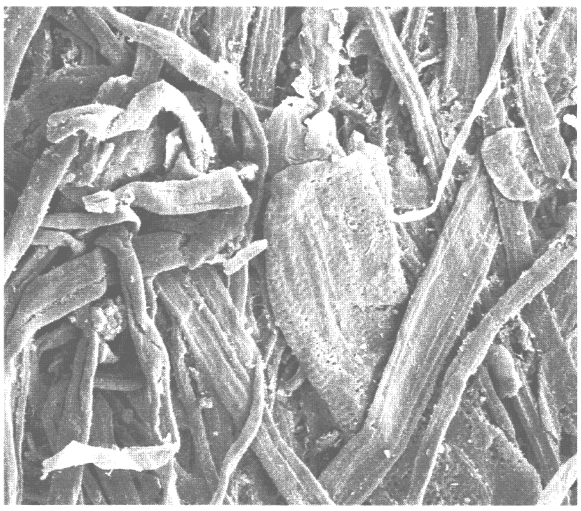


Fig. 5 Scanning electron microscope (SEM) image of China paper, 450X. Delacroix (BMA 1925.12.1).

Oriental papers similar to China paper

In addition to the paper typically described as China paper, other less common oriental papers with similar

characteristics were used by nineteenth-century French printmakers. These papers are Chinese or Japanese in origin and are difficult to identify by appearance. They are thin, approximately 3 mils thick, creamy white to pale yellow and finely made, with random dark bits or fibre strands evident. They exhibit an even distribution of pulp, a distinct narrow chain-line pattern common to Chinese papermaking screens and weak brush marks on one side (fig. 6). These papers feel silky and smooth, less soft and pulpy than bamboo papers, and are more translucent than China paper. Samples taken from these papers reveal the fibre composition to be a mixture of bast and grass fibres, not just bamboo as seen in typical China papers.

Fine Chinese papers used for painting and calligraphy, of a type called *xuan zhi*, are made from bast fibres — paper mulberry (*Broussonetia papyrifera*), *Edgeworthia chrysantha* and blue sandalwood, known as *quin-tan* or *ching-tan* (*Pteroceltis tatarinowii maxim*) — or from grass fibres, such as bamboo and rice straw (*Oryza sativa*), and mixtures of bast and grass fibres. Genuine *xuan* (mainland Chinese spelling) or *hsuan* (Taiwanese spelling) papers of the highest quality are made in Anhui province in central China from rice straw and blue sandalwood in various fibre ratios.[12] Rice-straw fibres are added to papers for calligraphy to increase their absorbency and lustre, but will produce a weak paper if used alone. In areas where blue sandalwood does not grow, papermakers use local fibre sources to make imitation *xuan* papers.

Japanese papermakers produce *gasenshi*, papers imitating Chinese calligraphy paper. Chinese papers were praised by Japanese calligraphers for their soft blurring of the ink and smooth brush touch, and were imported to Japan during the Edo period (1603–1867).[13] By 1873 Japan exported *gasenshi* to China.[14] When making *gasenshi*, Japanese papermakers sometimes employ a mould with narrow chain-line intervals, typical of Chinese screens, to better imitate the Chinese calligraphy papers. To dry *gasenshi*, Japanese papermakers traditionally brushed sheets onto wooden boards instead of the heated wall used by the Chinese. Japanese papermakers have used *kōzo*, *mitsumata*, rice straw, bamboo and wood pulp, and frequently a mixture of fibres to make *gasenshi*. Some Japanese papermakers feel the best *gasenshi* is the kind made from bamboo, Chinese style, so they add imported bamboo to other fibres such as *kōzo* and *mitsumata*.[15] Even though bamboo is a traditional Japanese fibre, its use for papermaking is not as common in Japan as are other fibres. By 1890 *gasenshi* was being made with *kōzo* and chemical wood pulp.[16]

French imitation China papers

Throughout the nineteenth century, French papermakers produced papers imitating the characteristics of China paper and other papers especially for use in *chine collé*. These papers are often referred to as *papier de Chine français*. Even though bamboo was known to be the fibre source for China paper, these imitation papers were made from common Western fibre sources, such as linen, cotton, hemp or grasses, and not from bamboo. In 1820 a prize of 3,000 francs was offered by the Société d'encouragement des arts et métiers, a state-aided society, for a French paper that would successfully compete with *papier de Chine*. M. Delapierre, a papermaker from the Vosges, won the prize in 1831 with a paper composed of marsh grass (*Arundo phragmites*) after his many attempts using a variety of other plant materials, including mulberry bark, had failed.[17] Unfortunately his paper did not satisfy the needs of the printers, and this limited its distribution. At the 1839 exposition, the factory of MM Breton and Company in Grenoble presented their Chinese-type papers measuring 112 by 72 cm, at a price comparable to *papier de Chine*. Reportedly, the printing house of Lemercier, Bénard and Company purchased some of this paper for lithographic prints. Lasteyrie made a fine imitation *papier de Chine* from straw pulp, but the cost of fibre preparation was prohibitive.[18] Alfred Lemercier of the famous lithography family wrote in 1896 that the house of Blanchet Brothers and Kléber and the papermakers of Pont-de-Claix had long made excellent papers imitating *papier de Chine*.[19] These papers were often used for printing portraits and were preferred by Lemercier over China paper because they exhibited fewer defects which needed to be removed or disguised by detailed and richly printed designs. Lemercier suggested pearl-grey French papers for light subjects or portraits and light, warm-toned papers for soft interiors.

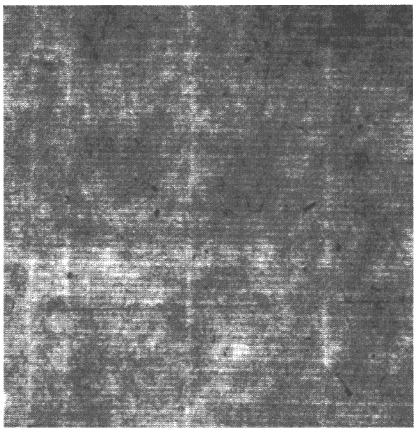


Fig. 6 Beta radiograph of oriental calligraphy paper. Jean-Michel Grobon, *The Forest of Rochecardon*, 1800, etching on oriental paper (BMA 1989.46).

Commerce of China paper

Chinese papers came to France from China directly, from trade with England during peaceful times, and possibly through French interests in south-east Asia. Even though the first French ship arrived in Canton, China, as early as 1698, direct trade between the two countries was only sporadic. One source from 1857 stated that 150,822 kilograms of Chinese paper of all kinds were exported from Canton in the summer of 1845, costing 199,661 francs.[20] In 1838 it was recorded that China paper came to France through trade with England; however, relations between the French and British were strained periodically

throughout the century.[21] England traded more heavily with China than did France from the mid-eighteenth century forward to the nineteenth century.

Artists and printers purchased China paper from businesses specializing in printmaking materials, from paper stores and possibly from shops selling oriental merchandise. On the back page of Chevallier and Langlumé's 1838 treatise on lithography is an advertisement from the shop of M. Mantoux on rue du Paon in Paris which lists *papier de Chine* along with typical lithography supplies such as crayons, acids, sponges, presses and transfer paper. Packages of the finest quality China paper sold for 50 francs while packages of lesser qualities sold for 25 and 30 francs; single sheets cost 70 centimes. For comparison, the price of a sheet of China paper in 1820 was nearly 3 francs.[22] In an 1895 exhibition catalogue celebrating the centennial of lithography, advertisements from Parisian paper stores, such as Maison R. Fritsch & Cie and Darblay Père & Fils, list *papier de Chine* and *papier du Japon* along with various other papers used for writing and printing.[23] The notice of D. Rivage on rue Lauzin mentions packages of *papier de Chine* in four thicknesses, various transfer papers and *papier hydrochine*, a paper of unknown manufacture. Also advertising China paper in this exhibition catalogue were the lithography shops of Ch. Lorilleux & Cie and Lemerier & A. Vanhymbeeck, makers of crayons and inks respectively. Shops specializing in Chinese, Japanese and Indian merchandise may also have sold oriental papers, including La Porte Chinoise, which first opened as Salon des thés in 1826, Mme Desoye's shop, which opened in 1862, and Decelle's À l'Empire Chinois.[24]

According to one source, sheets of China paper were available in a range of colours from yellow to off-white, in various qualities, in ordinary or large sizes and with or without sizing.[25] Sheets of China paper measured 4 feet long and 2 feet wide (130 by 65 cm) and came folded in packets of 96 sheets, with 15 packets in a crate.[26] Chinese characters were printed in ink on the ends of the sheets forming the stack. Indeed, some prints on unmounted China paper, and even occasionally on *chine collé*, display traces of red, blue and green inks along one edge. The printing of characters on the sides of paper stacks appears to be a Chinese custom and not Japanese, and is found on some Chinese papers today.

Prices for prints on China paper, whether *chine volant* or *chine collé*, were higher than for those on European papers. Proofs and special editions were often printed on distinctive papers, such as China paper or Japanese papers, and were sought after by discerning collectors and promoted by printers and publishers. In printer Jules Desportes' estimation in 1838, printing lithographs on China paper cost nearly twice as much as printing on wove paper because of the expense of the paper and the time-consuming work required to prepare *chine collé*.[27] Later in the century, the publisher Alfred Cadart lists the prices of individual impressions from his 1877 album of etchings as 80 francs for a proof on Holland paper, 100 francs on China paper, 150 francs on Japanese paper and 500 francs on parchment.[28]

Printmaking treatises

In the nineteenth century, printmaking manuals and periodicals became available to professional printers, technically-minded artists and inquisitive amateur printmakers. Manuals offered technical advice on the physical preparation of the printing matrix, the drawing of the design and its printing onto paper. In some treatises, authors noted historical information and provided aesthetic guidelines. Early books describing the new, mysterious process of lithography were printed in small editions, while Maxime Lalanne's etching manual, in both French and English editions, sold widely.

After the opening of his commercial lithography shop in 1816, Godefroy Engelmann's technical innovations and insight brought him attention from both printers wanting to learn his secrets and leading painters who embraced the immediacy of the new medium. In 1822 he published *Manuel du dessinateur lithographe*, his first manual describing the materials and techniques of lithography.[29] Despite Engelmann's claim to have developed the use of China paper in lithography in 1820, his early treatise does not mention China paper. However, in the final French edition of *Traité de lithographie* in 1840, Englemann thoroughly describes China paper's use in printing as well as its manufacture.[30] The earliest French treatise referring to *papier de Chine* may be L. Houbloup's 1825 *Théorie lithographique* where he briefly cites but does not describe the paper.[31]

By the 1830s several French lithography treatises provided detailed descriptions of China paper, praising its thin, soft nature and pearl-grey colour, which was considered a complement to the crayon drawing. According to Engelmann, a proof on China paper 'will be more fine, more pure, and more vaporous in its light tints, more transparent, and more brilliant and vigorous in the darkest parts' than the same plate on another paper.[32] He attributes this superiority in impression quality to the delicacy, tenacity and suppleness of the paper's fibres, even though he considered that the paper is not as well made as the best European papers. Not surprisingly, Engelmann frequently employed China paper for the printing of lithographs and promoted its use in *Voyages pittoresques et romantiques dans l'ancienne France* (1820 to 1878), the most ambitious publication enterprise of the century, involving over 150 artists. Most manuals mention that China paper is available in a range of colours and fineness, contains small flaws and bits of shive and has two sides — one smooth, the other slightly ridged with brush marks. Engelmann and Desportes suggest that China paper can be used not only as a printing support, but also as a type of transfer paper and for counter-proofing.[33] The colour of China paper was so desirable for the printing of lithographs that Chevallier and Langlumé in their 1838 treatise discuss its imitation by use of tint stones.[34] Tint or tone stones of a solid secondary colour, often tan or grey, are printed in transparent ink over the black lithographic drawing. Frequently the tint stone was selectively scraped, producing slightly embossed white highlights in the print.

By mid-century French painter-printmakers began to view lithography less as an artistic medium than as a

commercial means of reproducing paintings or didactic materials. Rejecting the crayon and stone, artists again picked up the etching needle. This etching revival created a market for new treatises on intaglio printmaking, some outlining unusual or recently rediscovered techniques. Intaglio manuals list papers suitable for printing, such as common laid paper for general proofs and *papier de Chine*, *papier du Japon*, coloured papers and parchment for special proofs. However, they do not provide the lengthy discussion of papers and papermaking found in the earlier lithography texts.[35] Interestingly, Auguste Delâtre (1822–1907), the most famous etching printer of the century and the one often credited with reintroducing Japanese papers to artists, does not describe printing papers in his book from 1887, *Eau-Forte, pointe sèche et vernis mou*.[36]

The most popular treatise on etching, *Traité de la gravure à l'eau-forte*, written by Maxime Lalanne, was first published in 1866 at the beginning of the etching revival by Alfred Cadart, the influential director of the Société des aquafortistes.[37] Lalanne suggests that laid paper is the most suitable for etching, but that Japanese paper, with its warm yellow tones, is 'excellent, especially for plates which need more of mystery than brilliancy,' and that parchment has no equal in beauty. 'China paper (India paper) promotes purity of line; but, as its surface is dull, it furnishes somewhat dry and dim proofs.' Lalanne does not describe *chine collé*. However, he does refer to unmounted proofs on Chinese and Japanese papers, calling them *épreuves volantes*, as prints that are not pasted down onto secondary papers but instead are attached at the two upper corners to Bristol board. Lalanne appears not to have used China paper often for his etchings, even for *chine collé*. One exception is a proof on a sheet of unmounted China paper inscribed 'A Monsieur Delâtre — Lalanne.'

During the nineteenth century, fewer books describing the techniques of woodcut and wood engraving were published in France than for lithography and etching, although some essays on relief printing are to be found in journals.[38] Papillon's 1766 treatise covering both the history and the technique of the woodcut attempted to revive interest in the medium.[39] He briefly discusses paper and points out the difficulty of printing wood engravings on heavy laid papers, but he does not mention China paper. Other than for commercial purposes, wood engraving and woodcut were not embraced by French artists until later in the nineteenth century. One discussion on paper appears in an 1839 English text by Jackson and Chatto, who warn about the knots found in India paper (China paper) indenting the wood block and causing white spots in subsequent impressions.[40]

New lithography manuals were published towards the end of the century when lithography regained popularity, especially for the printing of posters and other coloured images. Alfred Lemercier's treatise reviewing the history of lithography discusses paper thoroughly, with several paragraphs describing Western, Chinese and Japanese papermaking.[41] As in earlier treatises on lithography, Lemercier admires China paper for its suppleness and agreeable tone.

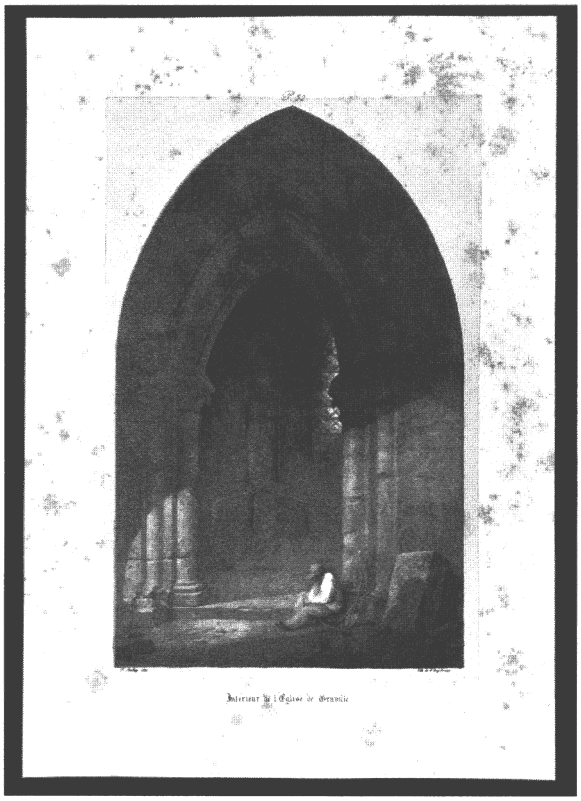


Fig. 7 Jean Baptiste Isabey, *Interior of Graville Church*, 1821, crayon lithograph with tint stone and scraping on *chine collé* of China paper and wove paper (BMA 1996.48.12520).

In another lithography manual from the century's end, Henri Bouchot reflects that prints on paper from the reign of Louis-Philippe (1830–48) appear lifeless and spotted with unpleasant stains and that only the prints on real *papier de Chine* are free from spots.[42] Indeed, many plate papers from the century do appear foxed while the attached China paper is comparatively unstained (fig. 7).

Preparation of *chine collé*

Lithography manuals often advise that China paper does not have enough internal strength to survive the rigours of passing alone through the press, and so should be pasted onto unsized wove paper to support it. Engelmann, as well as other authors, notes how the margins of the white plate paper enhance the pale grey (*nankin-grisâtre-clair*) of the *papier de Chine*.[43] According to Bouchot in 1895, the elevated price of China paper prohibited its use in the margins.[44] The following is a general description of the *chine collé* process for mounting China paper or any thin paper, compiled from several treatises written within a few years of each other.[45] The texts are very similar, but each author contributes his favourite methods and materials.

Sheets of China paper are laid onto a table with the brush-marked side face up. Starch paste, thinned with water and strained through a horsehair sieve or squeezed through cloths to remove the lumps, is applied thinly and evenly to the China paper with the flat side of a sponge or large brush called a *queue-de-morue*. Authors warn against flour paste or gum arabic, which turn yellow and discolour the paper. One should avoid getting paste on

the smooth side of the paper which will receive the ink, as the sheet may stick to the stone during printing. After applying the paste, the papers are hung on cords or rounded dowels to dry and are then stored together flat or rolled.

In preparation for printing, the sheets of China paper are cut into appropriate sizes using an iron rule and sharp knife on a cutting board of soft-grained wood, such as beech or pear, or of cardboard. Also, a large sheet can be folded as many times as needed and then placed under a plank or in a press and trimmed all around so as to obtain sheets of equal and regular size. Impurities, such as fibre clumps, hair, dirt and even paste lumps, are removed with a fine-pointed knife or scraper. To save time, a proof of the print is reviewed and those parts of the China paper which will bear highlights or important visual information are thoroughly cleaned of impurities, while only the most obvious fibre strands or lumps are removed from areas that will be dark. At least a half-hour before printing, the China paper is placed between damp sheets of ordinary paper to make the paper limp and to lightly moisten the glue. The China paper is placed on the inked stone in line with registration marks made with a carmine solution or an etching needle, and is then covered with a dampened plate paper. If a hole is accidentally made in the China paper, a little piece of torn paper can be put over it after placing the sheet on the stone and before the plate paper is set. The pressure of printing adheres the lightly pasted China paper to the plate paper support.

In one lithography manual, Berthiau and Boitard describe attaching China paper to plate paper without the use of paste.[46] The plate paper is brushed vigorously to raise the fibres and create a nap. The dampened plate and China papers are run through the press together, using pressure alone to secure the sheets. However, heavily inked areas may cause the China paper to stick to the ink and pull away from the plate paper when the print is lifted from the stone, causing bubbles between the sheets.

Observations on French prints

French intaglio, lithographic and relief prints from the late eighteenth century and throughout the nineteenth century in the collection of the Baltimore Museum of Art were surveyed to determine the frequency of China paper's use and to study the paper's characteristics and its effects on impression quality and the practices carried out by artists and printers. Initially, over 3,000 prints were quickly observed to gain an overview of China paper's use in French prints. Groups of prints, by artists selected for their innovative and creative contributions to printmaking, were more closely scrutinized. Individual impressions on unmounted China paper were examined to note the paper's various characteristics and were compared to other impressions taken from the same plate, when possible.

China paper, mounted and unmounted, is found extensively in published editions as well as in proofs printed by artists. For some artists, or at least for their printers, China paper was the paper of choice. For example, in a survey of 62 lithographs by Eugène Isabey (1803–86), over half of the impressions, some from *Voyages pittoresques*, were printed on *chine collé* with China paper. China paper was so popular that it was used for printing a posthumous impression of a 1651 etching by Claude Gellée (1600–82), even though the paper would have been easily detected as not being contemporary with the execution of the plate. Edgar Degas (1834–1917) frequently exploited the absorbent nature of China paper for his monotypes, and at least one monotype, from the Museum of Fine Arts in Boston, was printed on a thin China paper and mounted onto a stouter China paper. The popularity of China paper provoked its use for applications other than fine art or commercial printing. To create a decorative mount for a crayon-manner etching by Jean-Baptiste Isabey (1767–1855), the print was trimmed into an oval, placed onto China paper and cream laid paper and run through the press supported by a copper plate. Occasionally photographs were mounted on *chine collé* with China paper serving as a border between a golden-brown albumen print and a white wove paper. During the 1870s the print seller and publisher Alfred Cadart published several catalogues on China paper that listed his inventory of etchings and editions.

The earliest use of China paper in French prints may date from the late eighteenth century. An early state of J.B. de Grateloup's (1735–1817) engraved portrait of J.-B. Bosseut of 1771 is printed on *chine collé*, with subsequent impressions on both ordinary and Chinese papers.[47] Prints by the commercial engravers and portraitists Etienne Ficquet and Pierre Savart from plates drawn in the early 1770s are found on *chine collé* with the China paper trimmed to the full size of the mount, a format not seen in later mountings, where the China paper is trimmed along or just beyond the image. Jean-Jacques de Boissieu (1736–1810) of Lyon printed his etchings on various papers, some unusual, including unmounted Chinese papers and a paper he called *papier de soie* (silk paper).[48] Posthumous impressions of de Boissieu's plates from the 1820s are printed on *chine collé* with China paper.

Early lithographs and many etchings were printed on *chine collé*. In early lithographs, the thin China papers are often not squarely cut, their edges appear torn and uneven, and occasionally their corners are folded over. Most papers appear to be adhered with non-yellowing starch paste as recommended in the printmaking manuals, except for a few prints, such as some etchings by Rodolphe Bresdin (1821–85), in which the artist may have mounted the papers with a pale brown glue which has discoloured both the primary support and the mount. The presence of mends to fill holes in the China paper, as described in the lithography manuals, could not be detected in the prints examined.

Textures found on unmounted China paper include those inherent in the sheet from its manufacture and those produced during printing. Brush marks were found occasionally on the front of lithographs, sometimes interrupting the image, but were always located on the backs of etchings or relief prints. Pressure from printing, whether with metal plate, lithographic stone or wood

block, compressed the ridges of brush marks, often producing a smooth surface and a soft sheen observable in raking light. Despite the heavy pressures involved, the ridges still remain evident, although diminished, in thicker papers. The textured pattern of the printer's felts can be observed in the margins of some etchings. Sheets of China paper used for relief prints seem to have been calendered before printing — possibly by running the paper through a press — as even the prints' margins feel glazed. This may have been done to reduce bumps in the paper which could create dents in the woodblock and affect the print quality in later impressions.

Determining specifically the contribution of the paper support to the impression quality of the print is complicated by such factors as the dampness of the paper during printing, the consistency of the ink, the wiping of the plate, the amount of pressure from the press and the condition of the printing matrix. In general, when comparing impressions, especially etchings, on China paper with those on other supports, the impression quality seems to depend most on the nature of the print's production, that is, whether it was printed as an experiment or proof, or as part of a large edition. Etchings printed as part of an edition on China paper or Western papers tend to appear drier than early proofs or experiments, which show the more time-consuming techniques of special inking and selective wiping. Prints on unmounted China paper seem slightly flat compared to impressions on Japanese papers, where the silky translucence of Japanese paper lends an atmospheric quality to the images. More visual comparisons of prints on China paper with Western and Japanese papers need to be undertaken before more specific observations on impression quality can be described.

Acknowledgements

I am especially grateful to the following individuals: Debora Mayer, paper conservator, Portsmouth, New Hampshire, for invaluable assistance and support; Elaine Koretsky, papermaker and paper historian, Brookline, Massachusetts, for sharing her knowledge of Chinese papermaking; the staff of the Baltimore Museum of Art, especially Michelle Facini, conservation technician, for assistance in finding prints on China paper, Jay M. Fisher, deputy director and curator, for sharing his vast knowledge of French prints, and Jose Sanchez, for his fine photography skills; and Craig Williams, Washington, for his support. I also want to thank the many people who assisted in my research: Xiang-mei Gu, Akihiro Kato and Martha Smith, Freer and Sackler Galleries, Washington; Bryan Clarke, Fitzwilliam Museum, Cambridge; Yasuo Kume, Tokyo; Fei Wen Tsai, SCMRE, Smithsonian Institution; Bob Roberts, Tempe, Arizona; Betty Fiske and John Krill, Henry Francis du Pont Winterthur Museum; Philip Meredith, National Museum of Ethnology, Leiden; and Arsène Bonafous-Murat, Paris.

Notes

1. Chevallier, J.B.A., and Langlumé. 1838. *Traité complet de la lithographie, ou Manuel du lithographe*. Paris: Imprimerie de Mme Huzard. 97.
2. Jenkins, P. 1994. Plate papers and india proof prints. *The Quarterly, Review of the British Association of Paper Historians* 13 (December): 1–2.
3. Savage, W. 1822. *Practical Hints on Decorative Printing*. London: Longman. 31.
4. du Halde, J.B. 1736. *Description géographique, historique, chronologique, politique, et physique de l'empire de la Chine et de la tartarie Chinoise*, Vol. 2. Paris: Chez Henri Scheurleer. 287–93.
5. See Appendix by Debora Mayer for further information on the SEM imaging and EDS analysis.
6. Tsai, F. W., and D. van der Reyden. 1997. Analysis of modern Chinese paper and treatment of a Chinese woodblock print. *The Paper Conservator* 21: 54.
7. McClure, F.A., with preface by E. Koretsky. 1986. *Chinese Handmade Paper*. Newtown, PA: Bird and Bull Press. 35–36.
8. Hunter, D. 1936. *A Papermaking Pilgrimage to Japan, Korea, and China*. New York.
   McClure. 1986.
   Rumford, J. 1989. Out of the moving waves — Some notes on Chinese papermaking. *Hand Papermaking* 4(2): 6–9.
   Sung, Y.-H. [1637] 1997. *Chinese Technology in the Seventeenth Century, T'ien-Kung K'ai-Wu*. Mineola, NY: Dover. 223–34.
   Tsien, T.-H. 1985. *Paper and printing*. In *Science and Civilization in China*, ed. J. Needham. Vol. 5, Part 1. Cambridge: Cambridge University Press.
9. Koretsky, E. 1999. Personal communication. Brookline, MA.
   Tsai and van der Reyden. 1997. 49.
10. Engelmann, G. 1840. *Traité théorique et pratique de lithographie*. Mulhouse: Imprimerie de P. Baret. 134.
11. du Halde. 1736. 287–93.
    de Lalande, J. [1760]. 1976. *The Art of Papermaking*. Trans. R.M. Atkinson. Ireland: Ashling Press. 89–93.
12. Tsai and van der Reyden. 1997. 43–62.
    Mullock, H. 1995. Xuan paper. *The Paper Conservator* 19. 23–30.
13. All Japan Handmade Washi Association. 1991. *Handbook on the Art of Washi*. Tokyo: Wagami-do K.K. 119.
14. Dwan, A. 1993. A method for examining and classifying Japanese papers used by artists in the late nineteenth century, the prints of James Abbott McNeill Whistler. *Conservation Research, Studies in the History of Art* 41. Washington: National Gallery of Art. 111.
15. Kume, Y. 1980. *Tesuki Washi Shuho, Fine Handmade Papers of Japan*. Japan: Yushodo Booksellers Ltd. 31.
16. Kume, Y. 1999. Personal communication. Tokyo.
17. Desportes, J. 1839. Papier de Chine. *Le lithographe, Journal des artistes et des imprimeurs*. Paris: au Bureau du journal. 331–32.
18. Bouchot, H. 1895. *La lithographie*. Paris: Librairies–Imprimeries Réunies. 287.
19. Lemercier, A. 1896. *La lithographie française de 1796 à 1896 et les arts qui s'y rattachent*. Paris. 110.
20. Hammann, J.-M.-H. 1857. *Des arts graphiques destinés à multiplier par l'impression considérés sous le double point de vue historique et pratique*. Paris: Même Maison. 27.
21. Chevallier and Langlumé. 1838. 98.
22. Engelmann. 1840. 135.

23. *Centenaire de la lithographie 1796–1895, Catalogue officiel de l'exposition.* 1895. Paris: Imp. Paul Dupont.
24. Weisberg, G.P., et al. 1975. *Japonisme, Japanese Influence on French Art 1854–1910.* Cleveland Museum of Art. 3–4.
25. Berthiau and Boitard. 1837. *Nouveau manuel complet de l'imprimeur en taille-douce.* Paris: Roret.
26. Engelmann. 1840. 135–36.
27. Desportes. 1839. 335.
28. Cadart, A. 1878. *Catalogue complet d'eaux-fortes originales et inédites.* Paris. 23.
29. Engelmann, G. 1822. *Manuel du dessinateur lithographe ou Description des meilleurs moyens à employer pour faire des dessins sur pierre.* Paris.
    The earliest French lithography treatises appear to be:
    Mairet. 1818. *Notice sur la lithographie or l'art d'imprimer sur pierre.* Dijon.
    Raucourt de Charleville. 1819. *Mémoire sur les expériences lithographiques faites à l'École royale des ponts et chaussées de France.* Toulon.
30. See Note 10.
31. Houbloup, L. 1825. *Théorie lithographique, ou Manière facile d'apprendre à imprimer soi-même.* Paris: Chez Auguste Imbert. 61.
32. Engelmann. 1840. 135.
33. Engelmann. 1840. 325.
    Desportes, J. 1838. Transports d'épreuves lithographiques. *Le lithographe, Journal des artistes et des imprimeurs.* 329, 331.
34. Chevallier and Langlumé. 1838. 179–80.
35. Martial, A.P. 1873. *Nouveau traité de la gravure à l'eau-forte pour les peintres et les dessinateurs.* Paris: A. Cadart.
    Robert, K. 1891. *Traité pratique de la gravure à l'eau-forte (paysage et figure).* Paris: Henri Laurens.
36. Delâtre, A. 1887. *Eau-forte, pointe sèche et vernis mou.* Paris: A. Lanier and G. Vallet.
37. Lalanne, M. 1866. *Traité de la gravure à l'eau-forte.* Paris: Cadart et Luquet. A second edition was printed in 1878, and editions in English were published in London and Boston in 1880 by Dana Estes and Company. A reprint of the first English edition was published by Dover Publications in 1981 with an introduction by Jay M. Fisher.
38. Baas, J., and R.S. Field. 1984. *The Artistic Revival of the Woodcut in France 1850–1900.* Ann Arbor: University of Michigan Museum of Art.
39. Papillon, J-M. 1766. *Traité historique et pratique de la gravure en bois.* Paris: Simon.
40. Jackson, J., and W.A. Chatto. 1839. *A Treatise on Wood-Engraving, Historical and Practical.* London. 646.
41. Lemercier. 1896. 108–11.
42. Bouchot. 1895. 286.
43. Engelmann. 1840. 136.
44. Bouchot. 1895. 286.
45. Bry, A. 1835. *L'imprimeur lithographe, Nouveau manuel à l'usage des élèves.* Paris: Chez l'Auteur.
    Chevallier and Langlumé. 1838.
    Desportes. 1838.
    Engelmann. 1840.
46. Berthiau and Boitard. 1837.
47. Carlson, V.I., and J.W. Ittmann. 1984. *Regency to Empire, French Printmaking 1715–1814.* Minneapolis Institute of Arts. 206.
48. Clarke, B. 1999. Personal communication. Fitzwilliam Museum, Cambridge, England.

Fibre Analysis of Selected Oriental Printing Papers

Appendix to 'The Role of China Paper in Nineteenth-Century French Printmaking'

DEBORA D. MAYER

Introduction

Fibre analysis was performed on selected oriental printing papers used by French printmakers in the nineteenth and early twentieth centuries in order to classify these papers by fibre content. Fibre analysis was undertaken to explore how fibre content and method of manufacturing influence the physical properties observed in the paper, such as colour, absorbency, opacity and printability.

The papers were selected to assist Kimberly Schenck in her study of China papers. A modern Chinese paper (*xuan*) was also sampled to provide a modern comparison. Papers were examined in the conservation laboratory to assess physical properties such as colour and transparency. Small samples were removed from the edge of the paper for microscopic analysis. All samples were examined by optical microscopy. Two papers were analysed by SEM (scanning electron microscope) imaging and EDS (energy-dispersive spectrum) analysis for elemental analysis.

General observations

Visually, all the papers appeared to be very similar. The papers were handmade with a Chinese-style laid mould, white in colour, with fine to moderately fine fibre distribution. They were absorbent, soft, opaque or semi-opaque, and produced fine printed impressions. The papers varied in thickness from 3 to 5 mils. A few papers had a chalky feel. Although there were slight variations in the white tone, the most significant visual difference between the papers appeared to be the degree of opacity.

Optical microscopy: procedure

Samples were examined with a stereo binocular microscope to evaluate the general composition of the paper and fibre distribution, and to observe the properties of the paper when wet. The samples were dampened with water on a microscope slide to tease the fibres apart. Once dry, each sample was stained with Graff C stain and the fibres were evaluated for stain reaction and fibre morphology with brightfield microscopy at 100 to 400 times magnification. The colour reaction with Graff C stain accentuated fibre detail and provided information about the degree of chemical processing (cooking, bleaching) used in the making of the paper pulp.[1]

During the teasing-apart process two properties of the papers were revealed that are significant. The first was the inclusion of particulate material in many of the papers. During physical manipulation of the samples on the microscope slides, a fine, powdery dust silted from the samples. In some samples the quantity of particulate material was surprisingly high. Secondly, the samples immediately absorbed water and frequently delaminated into several distinct plies.

Optical microscopy: results

Based on fibre content, the paper samples fell into two distinct groups: papers made with 100% bamboo fibres, and papers made with a combination of two fibre types, bast and grass fibres.

Group 1: Papers made with 100% bamboo fibres

The fibres were identified as belonging to the family

GROUP 1: Papers made with 100% bamboo fibres

Artist	Date	Print
Eugène Delacroix	1833	lithograph, *Muleteers of Tetuan*
Eugène Bléry	1838	etching, *View taken at Granges in Cevennes*
Charles Meryon	1852	etching, *The Notre-Dame Pump*
Félix Buhot	1875	etching, *An Autumn Morning*
Edouard Vuillard	1899	lithograph, *The Two Sisters*
A. Cadart, pub.	1874	*Catalogue complet d'eaux-fortes originales et inédites*
Henri Matisse	1922	*Jeune fille à la chaise-longue dans un sous-bois**
Henri Matisse	1925	*Odalisque assise, à la jupe de tulle**

GROUP 2: Mixed-fibre papers — combination of bast and grass fibres

Artist	Date	Print
Jean-Michel Grobon	1800	etching, *The Forest of Rochecardon*
Alphonse Legros	c. 1860	etching, *Communion in the Church of St. Medard*
xuan paper	1999	modern paper used for comparative study**

Except where noted, the prints are from the collection of the Baltimore Museum of Art, Baltimore, MD.

* From the collection of the Weatherspoon Art Gallery, University of North Carolina at Greensboro

** From the Freer Gallery of Art, Smithsonian Institution. Identified as genuine *xuan* paper from Anhui province, composed of than bast fibre

Table 1 Printing Papers Sampled

Gramineae (grass) due to the presence of the variety of fibre and cell types which is the key diagnostic feature for identifying grass fibres. Grasses are closely related and their cellular elements are similar. Variations in the size and shape of cells and the presence or absence of specific features are used to differentiate the different genera from each other.

The specific identification of bamboo was determined by the presence of wide, thin-walled, ribbon-shaped fibres with longitudinal striations, the dimensions of the vessel segments and parenchyma cells, and the absence of epidermal cells.[2] The SEM image from the paper used by Delacroix (fig. 5) shows a ribbon-shaped fibre with longitudinal striations, and a vessel element on the surface of the paper.

The fibres and cell elements stained deep blue in Graff C stain, which indicated that the fibre pulp was cooked and bleached. The fibres appeared relatively intact (unshredded) and the moderate to high quantity of vessel elements and parenchyma cells present in the formed paper suggests that the pulp was not extensively beaten or aggressively washed during manufacture. The fibres in the Matisse papers stained blue with some green tones, suggesting that these papers were not as thoroughly bleached.

The particulate material observed during sampling was evident in many of the microscope slides. The particles were clear to pale yellow in colour, small (1 to 10 microns), forming larger agglomerates and with a refractive index of less than 1.66. The exact identification of the material was not determined, but thought to be silicate- or calcium-based.

Group 2: Mixed-fibre papers — combination of bast and grass fibres

The combination of two different fibre types was recognized by the stain reaction colours with Graff C stain. The bast fibres stained a ruddy red and the grass fibres stained blue. Fibre morphology was used to identify the specific fibre classification.

Bast fibres come from the inner bark of trees and herbaceous dicotyledons. The bast fibres in these printing papers were identified as *kōzo* or *kōzo*-like fibres known as paper mulberry (*Broussonetia papyrifera*). Many of the bast fibres were enveloped in a thin, transparent cuticle, which is the key diagnostic feature for the identification of *kōzo*.

It is probable that there are other bast fibres that appear similar to *kōzo* under the microscope. There are trees and shrubs used for papermaking in China that are not well recorded in western paper microscopy literature, and known samples of these fibres are rarely available for comparative study. An example of a fibre that is similar to *kōzo* is bast fibre from the than tree (*Pteroceltis tatarinowii maxim*), a member of the elm family also known as blue sandalwood or wing celtis. The bast fibre in the modern *xuan* paper from the Freer Gallery of Art matched well with a brief description of the than fibre, being uniform in width, slenderer than *kōzo* fibres (16 microns wide) and without nodes.[3]

As was true with the bamboo paper, the grass fibre component was identified as belonging to the family *Gramineae* (grass) because of the presence of a variety of fibre and cell types which are the key diagnostic features for identifying grass fibres. The specific identification of rice straw (*Oryza sativa*) in this group of papers was determined by the presence of very fine fibres and serrated, heavily-pitted epidermal cells, often found in clusters.[4] Trichomes, another diagnostic feature for rice fibres, were observed in the modern *xuan* paper. The grass fibres, like the bamboo fibres, stained deep blue with Graff C stain, indicating that the pulp had been bleached.

SEM imaging and EDS analysis

SEM imaging was performed on samples from Delacroix (1833) and Matisse (1922).[5] SEM images revealed the surface quality of the papers to be an open network of loosely bound fibres lying across one another, occasionally with vessels filling the pockets between fibres (fig. 5). There was no evidence of sizing in or on the paper. There was a fine distribution of small particles among the fibres. It is presumed that these are the same particles that were observed to sift out of the paper during sampling.

EDS analysis indicated that the paper used by Delacroix contained silicon and calcium, and the paper used by Matisse contained silicon, aluminium, calcium and potassium. The inorganic deposits in plants consist mostly of calcium salts and anhydrides of silica; in the *Gramineae* family these crystal-like formations (phlyoliths) are located in both the walls and the lumens of cells.[6] Therefore it is thought that the presence of silica and calcium in the paper results from the natural growth of the plant. It is also probable that the deposits may be residual materials from the use of lime or lye used in the processing of the fibre pulp. It has been noted that pulps in China are not always thoroughly washed of processing materials.[7] The presence of aluminium found in the Matisse print suggests there may be clay or clay-like materials in the paper as well.

Influence of fibre content on physical properties

The influence of fibre content and fibre processing on the physical properties of papers is complex. Listed below are summary observations and findings that helped in the understanding of these China papers.

One of the most interesting observations distinguishing the two groups of papers examined was the degree of opacity. The papers made with 100% bamboo fibres were opaque, while the papers of mixed-fibre composition were semi-opaque.

Grass fibres, due to their relatively short length and narrow diameters, tend to fill in the sheet, producing a smooth surface and an opaque sheet good for printing. Rice fibre is one of the shortest and narrowest fibres of the grass family that is used for papermaking. It is too short and fine to be used alone. Consequently, a long and wide fibre like *kōzo* is blended with the rice to make a stronger paper. Varying proportions of *kōzo* to rice fibres

will produce papers with different degrees of strength, smoothness and opacity. The bamboo fibre, however, has sufficient length and breadth to be made into paper without blending with other fibres.

The absorbent quality of these China papers seems to be related to the porosity of the sheet and the absence of a sizing agent. The fibres of the grass family are relatively short and smooth, and do not fibrillate readily, so that the bonding or felting between these fibres tends to be much less than with fibres from other plants. This decrease in felting causes the paper to be soft and easily torn.

The papers that were reported to have a chalky feel were the papers with the greater quantities of mineral inclusions. The mineral particles may also contribute to increased opacity and decreased felting between fibres.

The white colour of the bamboo paper is attributed to the bleaching of the pulp. Unbleached bamboo fibre produces a tan-coloured paper. Bamboo fibres are difficult to process, requiring extensive fermentation and cooking of the plant stem. Rumford lists various processing steps, including sun bleaching of the pulp, in his review of Chinese papermaking literature.[8]

Acknowledgements

The author would like to thank Kimberly Schenck for the opportunity to assist in her study of China papers; the Baltimore Museum of Art, the Weatherspoon Art Gallery, the Freer Gallery of Art and Elizabeth Coombs for permission to sample their China papers; and Bob Roberts for the SEM and EDS analyses.

Notes

1. Graff, J.H. 1940. *Color Atlas for Fiber Identification.* Appleton, WI: Institute of Paper Chemistry.
   Browning, B.L. 1977. *Analysis of Paper.* 2d ed. New York: Marcel Dekker.
2. Strelis, I., and R.W. Kennedy. 1967. *Identification of North American Commercial Pulpwoods and Pulp Fibres.* Toronto: University of Toronto Press. 80, 113.
3. Mullock, H. 1995. Xuan paper. *The Paper Conservator* 19: 27.
4. Strelis and Kennedy. 1967. 76.
5. Roberts, B. 1999. Personal communication. ASU, Tempe, Arizona. Samples were mounted on an aluminium stub with carbon tape and coated with carbon in a high-vacuum evaporator. Imaged and analyzed in a JEOL JSM-840 SEM with a Tracor-Northern EDS detector and Emispec System Inc. digital imaging system. The beam was 15KeV.
6. Edau, K. 1965. *Plant Anatomy.* 2d ed. New York: Wiley and Sons. 29–30.
7. Koretsky, E. 1999. Personal communication. Papermaker and authority on contemporary Chinese papers, Brookline, MA.
8. Rumford, J. 1989. Out of the moving waves — Some notes on Chinese papermaking. *Hand Papermaking* 4(2): 6–9.

Academic Studies of *Académies*: The Search for French Academy Paper

JOHN KRILL

Abstract

Deciding what name to use for a particular early paper is often difficult. The study of primary documentation and of early popular names for paper can prove helpful for us today. Between 1750 and 1850, a number of papers made especially for artists were introduced. Their names were generally understandable save but one: *silk paper*. Recent studies have uncovered the history of silk paper. It was an English paper made to imitate French Academy paper, a paper used for crayon drawing in chalks or pastels. An understanding of silk paper provided clues to what might be expected in Academy paper, which had not as yet been identified. A study focussing on brown paper, a class which includes silk paper, was undertaken to help document the qualities of brown papers used for crayon drawing. A form for recording the essential characteristics of brown papers — from the coarser wrappings to the finer brown silk and Academy papers — was drawn up, tested, refined and put to use. The form has successfully given focus to these studies for five years.

When a piece of paper is placed in front of you, the question of what to call it is often intriguing. Sometimes, other than seeing that it is a piece of paper, one is hard-pressed in finding a name for the paper type. As a young paper conservator, I was told by a curator that Edvard Munch printed the same image on different kinds of paper. What were the names of the papers? I was daunted.

Feeling, as many of us have, that there should be more information out there on the subject of names for paper, I began an inquisitive search. It led me to the Library of Congress, where an unpacked, let alone uncatalogued, collection of papers was stored. This was the Harrison Elliott Collection. From 1903 through 1951, Elliott worked in advertising for several noted American companies, including the International Paper Company, the Japan Paper Company and Andrews/Nelson/Whitehead. His collection contains many documented specimen sheets of artists' paper from the first half of the twentieth century. Among Elliott's papers I found a letter from J.S.G. Simmons, of All Souls College, Oxford, telling Elliott about a new association which might interest him: the International Association of Paper Historians (known as IPH). Being brazen and naive, I wrote to Simmons in 1974 asking about the IPH and about paper nomenclature. Simmons replied and suggested that I write to Edo Loeber, who was working on an IPH terminology project. I wrote to Loeber, saying 'I have jumped into the world of paper nomenclature from sheer need and importance in documenting works of art on paper.' Loeber politely responded and suggested that I contact IPH's then current president, Henk Voorn, for information. I did, writing 'Though I have been in paper conservation only five years, I feel that your organization could be a great benefit to us.' Voorn replied, encouraged me to join, and said that their next meeting was in Munich in three weeks; could I come? I did. The IPH meeting was enthralling. I found a small and devoted group who loved and studied paper and its history. At the heart of the research that was presented at the meeting were two things: the use of primary documentation, coupled with the intensive examination of paper. I chose to follow this lead.

Still looking for answers concerning paper nomenclature, particularly for early papers, I read everything I was able to find that was old and that described paper. It soon became apparent that there were two broad ways of speaking about paper — in the terms used by the papermaker or the terms used by the general public. These were quite different from one another. The first, those terms used by the papermaker, included *super fine fine fine fine*, *long double royal*, *ordinary lumber* or *whited brown elephant*.[1] These terms lacked the descriptive power that might be helpful to many in describing paper. For the most part they focused on paper sizes, and, after all, many an object that comes to us now has been trimmed. The second way of speaking about paper, that of the general public, was more direct. Chambers *Cyclopaedia*, second edition, 1738, simply states that 'Papers are of various kinds' and goes on to list them by colour, quality, use, size and country of origin. The words were readily understandable: *white*, *blue*, *brown*, *writing* and *printing* paper. Using this nomenclature, an appropriate paper might be described as being a fine white Dutch writing paper.

Over the years, with a direction in mind, I made lists and lists of common names for paper and their date of usage. Through this exercise, it became apparent that there had been a lot of new names emerging between 1750 and 1850. Most of these were understandable: *drawing paper*, *copperplate paper* and even *Bristol board* serve as examples. The latter, Bristol board, although an enigmatic name, was comprehensible because it is still made today and its basic characteristics remain, for the most part, the same as when it was introduced. But there was one name that stood out boldly and mysteriously. This was *silk paper*. Fortunately, an advertisement for it from 1810 described its use and contained a specimen of the paper tipped in next to the advertisement.[2] It was a bluish-grey colour, made from brown, blue, green and red fibres. Silk paper's recommended use was for crayon drawing, that is, for drawing with chalk or pastel.

Within the past ten years, the history of silk paper has unfolded.[3] In 1755, the London stationer John Stackhouse Styles received a request for a French drawing paper which his customer called 'brown Academy paper.' Academy paper, at that time, was a paper used in

France for drawing *académies*. An *académie* was a formal study drawn from a live model. The name for the drawing and for the type of paper used for it was derived from the senior and most challenging life drawing classes at the French Royal Academy. Brown Academy paper was a type of paper that the French called 'coloured paper.' 'Coloured paper' was simply defined as paper made from two or three different coloured pulps. The mix of coloured pulps produced papers of neutral tones, particularly browns and greys. It appears that Styles persuaded the newly formed Society for the Encouragement of Arts, Manufacturers, and Commerce (now known as the Royal Society for the Arts) to pursue the production of Academy paper in England. However, possibly in a spirit of independence, the English copy of Academy paper was called 'silk paper.' It may have been thought that French Academy paper contained silk, for the Society for the Arts requested that the paper be made only from silk rags.

In March 1757, the society began its work with silk paper and asked the papermaker Clement Taylor Sr, whom John Styles had recommended to them, to experiment and see if it was at all possible to make paper from silk rags. The society agreed to provide Taylor with the silk rags needed — although this proved easier said than done. On 23 March an exasperated James Davidson, who had been sent out by the society to find the rags, stated that his two afternoons of collecting were fraught with problems. Those who had silk rags didn't know what to charge him, and one party actually thought that he was in search of stolen goods. In the end, Davidson collected 28 pounds of silk rags from 13 different persons. Two months later Taylor presented the society with a ream and a half of his prototype of silk paper. He made two types, one thick and one thin. The thicker of the two papers was intended for crayon drawing. Within a month of receiving the papers, the society donated one sheet of each to the Society of Antiquaries of London. In 1997, the Society of Antiquaries kindly allowed the thicker to be sampled for fibre analysis.[4] Did Taylor truly make paper from silk? The answer is yes, but it was not made of silk alone. A straight visual fibre count found the paper to contain approximately 64% silk and 36% bast fibres.

Encouraged by success, the Society for the Arts sponsored a series of competitions specifically for the duplication of French Academy paper using only silk rags. The first-place award in 1759 went to Clement Taylor, and the 1760 competition was won by James Simmonds. The winning silk papers, although not exact duplicates of French Academy paper, were considered acceptable. No samples of the competition papers have been located. We can only trust in the two affidavits that Taylor submitted to prove that he used only silk rags—one from the man who beat the rags, the other from the vatman who formed the sheets.[5] Taylor was pleased with the project and said that he had learned quite a bit through it.

What is intriguing is that even before the Society for the Arts ended its competitions for silk paper, silk paper was already being marketed in London. It was a successful and innovative new product. In January 1759, Clement Taylor supplied 17 reams of silk paper to the stationer John Styles. These papers could be made to Taylor's specifications, as opposed to those of the society. Taylor found that working with silk took more time than working with linen; therefore, he incorporated up to one-third linen in his own silk papers. Coincidentally, this was the fibre count found in Taylor's silk paper prototype of 1757. As to colour, Taylor supplied Styles with a paper that was reddish, one that was greenish and one that was a stone colour. Not only did Styles and Taylor's collaboration launch silk paper as a viable product, it gave the modern scholar a rare look into eighteenth-century papermaking in England. It was Styles who provided us with the only known pre-nineteenth-century document in the English language that recounts how a particular artists' paper was made. It concerned silk paper. For every task described, the cost was also recorded. Silk paper continued to be manufactured for crayon drawing into the nineteenth century. By the mid-nineteenth century it became more commonly known as 'crayon paper.'

Once the history of silk paper was known, it became a personal challenge for me to find silk paper. It was one thing to locate a sample of the first silk paper ever made for crayon drawing, it had also been fascinating to find Ackermann's promotional sample of silk paper of 1810, but what would really be intriguing would be to find a drawing known to have been made on silk paper. This idea was put on my 'to do' list. Over the years I assembled a modest list of artists who used silk paper. The information came primarily from reading artists' diaries and letters. These were informative and, very conveniently, they bore dates.

It was with pure joy that one day I saw put in front of me a signed and dated drawing by the English artist Joseph Farington.[6] It depicted a view of the peak at Castleton drawn 24 August 1801. It had the qualities of the Ackermann advertising sample of silk paper. It measured up to the descriptions of silk paper found in eighteenth-century primary documents. It was known that Farington bought silk paper and planned to take it on this particular sketching trip. The drawing was on silk paper! Here are the qualities looked for in silk paper that helped to identify it: silk paper was a neutral brown or blue colour, made from a mixture of better-grade pulps. Although silk paper was at first made primarily of silk, linen eventually became the dominant fibre, with non-bast fibres such as silk and wool added for colour and texture. Silk paper was a strong paper, with a slightly rough surface and a regular grain.

Now, deep down inside, I wondered, 'What about finding French Academy paper?' It must have resembled somewhat the silk paper that copied it. What did Academy paper look like? With this new quest in mind, I prepared a form that would help me document and remember a particular paper's qualities (fig. 1). The form had to be relevant to the full range of brown coloured papers that would be found to have been used

BROWN PAPER

Artist _____ **Location** _____

Object _____ **Study Date** _____

No. _____ **Sheet Size** _____

Fabrication	☐ laid	☐ wove		
Type	☐ finer	☐ coarse	☐ brown	
Colour	☐ brown: warm cool		☐ grey: warm cool	
Surface	☐ rough	☐ cold-pressed		
Grain character	☐ uniform	☐ irregular	☐ true felt	☐ woven felt
Fibres in field	☐ uniform colour	☐ mottled colour	☐ pronounced mottled colour	
Darker individual fibres stand out sharply		☐ yes	☐ no	
Lengths of dark individual fibres	☐ short: less than 1mm		☐ medium: 1mm	☐ long: greater than 1mm
Fibre quality	☐ fine	☐ middling	☐ coarse	
Per cent colour distribution of fibres	☐ dark	10 20 25 30 33 40 50 60 66 70 75 80 90 100		
	☐ medium	10 20 25 30 33 40 50 60 66 70 75 80 90 100		
	☐ light	10 20 25 30 33 40 50 60 66 70 75 80 90 100		
	☐ white	10 20 25 30 33 40 50 60 66 70 75 80 90 100		
Specks	☐ yes	☐ no		
Shives	☐ yes	☐ no		
Lumps	☐ yes	☐ no		
Bits	☐ cloth	☐ thread	☐ string	☐ rope ☐ stone ☐ paper
Condition	☐ flattened	☐ mounted	☐ not treated	
Resembles	☐ sample no. _____	☐ colour no. _____	☐ thickness no. _____	

Fig. 1 Form used to document the characteristics of brown papers.

by artists — from the finer silk and Academy papers to the coarsest brown wrappings.

To better understand the form, we must first have an understanding of brown paper in general.[7] Brown paper, typically, was made from the coarser and poorer papermaking fibres and with less refined, or even inferior, papermaking procedures. It was the mainstay of the paper industry; it was easily produced, was inexpensive to buy and met a variety of needs — particularly as a wrapping paper. Over the centuries, brown paper, as well as blue paper, had been recommended for crayon work. Both paper types had a serviceable grain and provided a middle tint. The focus of this research is on browns, which could be brownish or greyish in colour.

On looking at both drawings and early drawing manuals, it would seem that eighteenth-century artists

preferred a somewhat better-grade brown paper, which was most likely sold through artists' supply shops. Some artists warned against the coarsest of brown papers. John Russell, an English artist who specialized in pastels, said that paper for crayons should be neither 'knotty' nor 'too coarse.' If knots were present, Russell felt that it was best to level them with a sharp blade. Inferior browns could have been made with the coarsest furnish, poor beating and quick papermaking procedures. They were generally made from mixed coloured pulps of irregular fibre lengths. There are, however, brown papers that look as though they were thoughtfully prepared. The pulp mixes of the better grades appear to have been purposefully, rather than randomly, selected. They contain a blend of dark, middle-tone and white fibres. In the better brown papers, the fibres are fairly uniform in length and approach fineness in quality. The texture of the sheet is not quite rough, not quite like a rough-surfaced watercolour paper of today, but a grain is evident. This grain may appear open and soft. The softening of the surface may have come from a more sparing use of size and from the inclusion of fibres with weak inter-fibre bonding — fibres like wool or silk. It is no small wonder that some artists, such as Russell, preferred the better brown papers.

The form designed to document the characteristics of brown papers went through several drafts. Trial runs made on site at various museums helped to identify the form's weaknesses. Confidence came when the information collected on the form was reasonably consistent when the same objects were studied on two different trips spaced two years apart. These trips had been to the Princeton University Art Museum, which houses an excellent collection of French *académie* drawings.

At the heart of the form's success were an understanding of the characteristics of the papers being studied and the succinct presentation of these characteristics. Here are some of the main points addressed by the form:

- Is there evidence that care was taken in the paper's manufacture? If so, it is a 'finer' brown. If it looks coarse, it is coarse.
- Being a neutral colour, is it closer to brown or grey? Is it warm or cool?
- Surface texture designates fibre height.[8] It relates to the smoothness of a sheet and ranges from rough to glossy. Is the paper rough, with perceptible depth to its texture, or does it resemble a cold-pressed paper, with apparent compression of a once higher texture?
- Paper's grain is the texture embossed into it by the woollen blankets, called felts, during couching and the first pressing.[9] The grain reflects the weave or texture of the felt. Is it uniform or does it have irregular qualities?
- Do darker fibres stand out noticeably in a field of lighter colour, or does the sheet read as a uniform tone?
- If there are dark fibres that visually stand out, are they small or large?
- What is the general quality of the fibre and the beating used to prepare it? Is it fine or coarse?
- What is the distribution of coloured fibres? Are they nearly all dark, or a mix of light and dark?
- Are there obvious inclusions such as specks, shives, lumps, or bits of cloth, thread or paper?
- Is the paper mounted? Has it been treated?
- With a picture being worth a thousand words, how does the sheet match up to known samples? For this, three sample sets were used. The first was of brown papers from my personal collection; they presented the range of qualities being considered. The second was a Sennelier colour chart for pastels; this contained many browns and greys, warm and cool. The third was a set of papers of differing thickness; these could be placed beside the object to assess the object's relative thickness.

Form in hand, there was only one thing left to do in the search for Academy paper — go to the Louvre. The kindness and efficiency of the Graphic Arts Department staff allowed me to study more than 200 French drawings made from about 1740 to 1760. Drawings from these years were specifically chosen, as it was during the 1750s that French Academy paper was being copied and developed into English silk paper. On the day, I could not have told you whether the form worked or not. It did assemble information, for which I am ever grateful, because my memory began to blur during the second hundred drawings. What did stand out with the finest of clarity was that I was finding examples of paper that resembled silk paper, hence its forerunner, Academy paper. Jean Restout's *académie* seemed the quintessence of the group.[10]

After returning home, I pulled together all of the forms for those papers thought to be Academy papers. Using the information on the forms alone, I could tell you that the colour of these papers was brown, their grain was slightly irregular and their texture was a somewhat softened, rough surface. As to the fibres, they were fine and presented a uniform field of colour, with a few short darker fibres standing out visually. The papers averaged about 10% dark fibres, 80% medium-hued fibres and 10% light fibres. As to colour, the majority matched Sennelier number 431. Should someone say to me, 'This information is all well and good, but what did the Academy paper really look like?' I would be able to answer, 'It resembles my paper sample number one. Have a look.'

The nomenclature of early papers has been, is, and will be tricky. Among our goals should be understanding the characteristics of particular paper types. Should we wish to study a particular type of paper, we must come to know its main properties and be able to write down the key elements that will help us to identify it — then go exploring.

Notes

1. Bagford, J. A Collection of title pages and fragments of printed books, formed by John Bagford. London: British Library. Harl. MS. 5942, items 24 and 35.

2. 1810. On water-colour painting and materials. *The Repository of Arts, Literature, Commerce, Manufacturers, Fashions and Politics* 4 (June): 52.
3. Krill, J. 1997. Silk paper for crayon drawing in the eighteenth century. In *IPC Conference Papers London 1997*, ed. J. Eagan. Institute of Paper Conservation. 15–19.
4. Mayer, D. 1999. Conservation report — Fiber analysis: Silk paper. Unpublished typescript. Winterthur, DE: Winterthur Museum.
5. Krill, J. 1996. Silk paper, an early artists' paper promoted by the Society. *RSA Journal*, 144 (March): 72.
6. Krill, J. 1994. Silk paper for crayon drawing in the eighteenth century. In *IPH Congress Book* 10:118.
7. Krill. 1994. 119.
8. Balston, J. 1998. *The Whatmans and Wove Paper*. West Farleigh, Kent: J.N. Balston. 24.
9. Balston. 1998. 23.
10. Louvre inventory number 34.543.

Observations on the Dating of the Fourth State of Degas's *Edouard Manet, Bust-Length Portrait*

ROY PERKINSON

Abstract

In the 1860s, Edgar Degas made three etched portraits of his friend and fellow artist Edouard Manet. One of these portraits, *Edouard Manet, Bust-Length Portrait*, exists in four states. While it was long assumed that all four states were done about the same time, close scrutiny of the paper used for the fourth state, enhanced by research on similar papers used for prints by Camille Pissarro, suggests that the traditional dating is inaccurate. The author proposes instead that a date from the 1890s at the earliest is more reasonable, and possibly a date from around the first decade of the 1900s. This study illustrates the value of close observation of paper structure and comparison of papers used by different artists working contemporaneously.

There are few resources for studying paper and watermarks from the nineteenth and twentieth centuries. Nevertheless, careful observation sometimes bears fruit. For example, the etchings and lithographs of Edgar Degas have presented a number of problems regarding not only the processes by which they were made but also their dating. While Degas's printmaking activities spanned much of his artistic career, he was notably 'private' in his graphic output. He only published four of his original prints during his lifetime, and until the studio sale after his death his prints were known mostly to his circle of friends and to collectors.[1] Proofs from this sale were widely dispersed, thus hindering a careful comparison of the impressions. In conjunction with the exhibition of Degas's prints at the Museum of Fine Arts, Boston, in 1984, the author collaborated with several colleagues in examining many of these rare works. Through close study of the physical characteristics of the paper supports, as well as any watermarks that were found, a number of conclusions could be drawn. The author assembled much of this information on the artist's papers and their watermarks in his essay 'Degas's Printing Papers,' in the catalogue of the exhibition.[2]

The most interesting instance of how close study of papers can reveal new information relates to Degas's etching *Edouard Manet, Bust-Length Portrait*.[3] Degas made three etched portraits of Manet, a friend and fellow artist, not long after Manet's paintings of modern life were exhibited in the Salon des Refusés of 1863, a watershed event in the history of French art. One of these images of Manet, a bust-length portrait, exists in four states. In the first state, Manet's personality is captured with a variety of etched lines that fully model his head, beard, and somewhat tousled hair. The clothing is indicated summarily with a few sketchy lines. In the second state, the modelling is refined slightly by the addition of a few drypoint lines, but in general differs only slightly from the first. In the third state, newly etched lines are added in order to create a mid-toned background and to more fully render the dark jacket and vest. In this version Manet's head and figure assume much more of a three-dimensional, physical presence.

Fig.1 Edgar Degas, *Edouard Manet, Bust-Length Portrait*, etching and drypoint, fourth state, Museum of Fine Arts, Boston, Katherine Eliot Bullard Fund, 1983.309.

In the fourth and final state of the portrait a layer of aquatint has been added throughout most of the image except for the head, producing a dramatically different interpretation (fig. 1). The relative lightness of Manet's head and the collar of his shirt stand out in stark contrast to their dark surroundings. The sitter now seems less like a corporeal being, a specific individual, than a spectral symbol of a great artist. Accompanying this change in interpretation, the paper on which it was done is markedly different from other papers used by Degas.

Using the Print Council paper-sample book as a guide, one can characterize the paper as laid, close in colour to 'cream 3,' slightly less thick (about 0.03 mm) than 'moderately thick' and similar in texture to 'moderately textured 3.'[4] The sheet measures 359 mm high by 277 mm wide and has deckle edges at the top and left sides. The chain lines are approximately 27 to 28 mm apart, running horizontally across the width of the sheet, and a watermark can be seen at the far right (fig. 2). While only part of the watermark is present (it is interrupted by the torn right side of the sheet), it is surely a portion of a countermark found in Arches papers.[5] When found

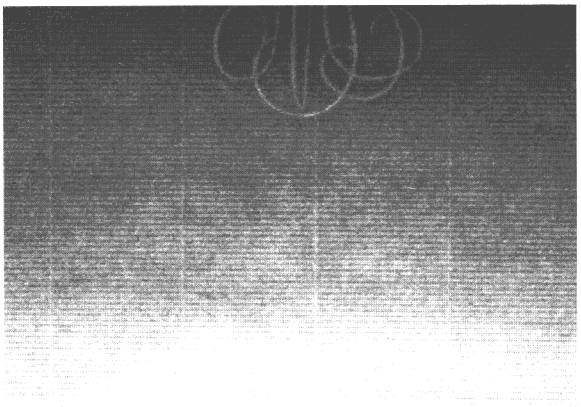


Fig. 2 Detail of figure 1 (Degas's portrait of Manet) viewed in transmitted light, showing laid pattern and partial countermark of initials *M* and *B*.

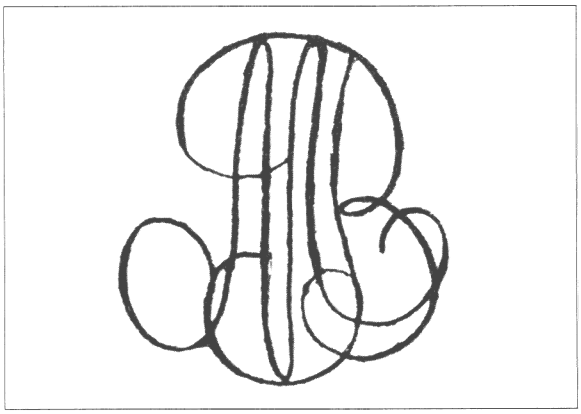


Fig. 3 Design of countermark in its complete form.

in its complete form, this mark consists of two letters, *M* and *B*, done in an elaborately cursive decorative style and intertwined with one letter on top of the other, as shown in the accompanying illustration (fig. 3). These letters refer to Morel and Bercioux, who were joint owners of the Arches paper mill after 1860–61. Perhaps because of the historical importance of these individuals to the Arches company, a countermark featuring their initials continued in use in Arches papers at least into the first decade of the twentieth century.

For the print in the museum's collection, the image is carefully centred, aligned parallel with the edges and printed on the top side of the sheet. The wire side (the verso of the print in this case) shows a pronounced laid pattern. The countermark appears to have been created not out of wires of uniform diameter but rather some kind of flattened metal pattern which, while narrow in some places, tapers and swells in a calligraphic manner (fig. 4). When viewed in transmitted light, the entire sheet displays a remarkably mechanical and uniform formation. While difficult to see, each of the chain lines shows a feature which, while subtle and rather difficult to discern, is noteworthy (fig. 5). Chain lines in most handmade papers are relatively linear, but in this case they appear to have been formed by two wires side by side, with one wire rising to the top of the screen while its mate goes beneath. The result is that, at a casual glance, the path of each chain line seems to move minutely back and forth as the two wires alternately dive below and rise above the screen.

The deckle edges are also quite uniform in their width, without the irregular perimeter commonly seen in handmade papers; and under raking light it is possible to discern a subtle but abrupt change — a slight drop-off in the thickness of the sheet marking the transition to the deckle (fig. 6). It appears that the deckles were created by paper fibres lapping over onto a mask that determined the outer dimensions of the sheet, rather than by the irregular and random seeping of fibres between a deckle and the surface of the mould. Taken together, all these clues suggest that the sheet is not handmade but was made on a cylinder machine.

Paper with these characteristics stands out as atypical in Degas's work of the 1860s. Indeed it is not found in any other of Degas's prints. In the period from about

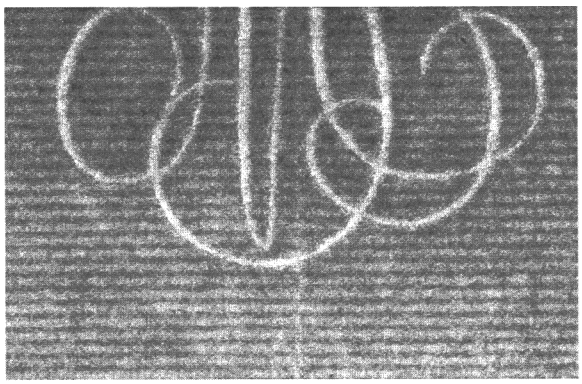


Fig. 4 Detail of countermark (Degas's portrait of Manet) viewed with transmitted light.

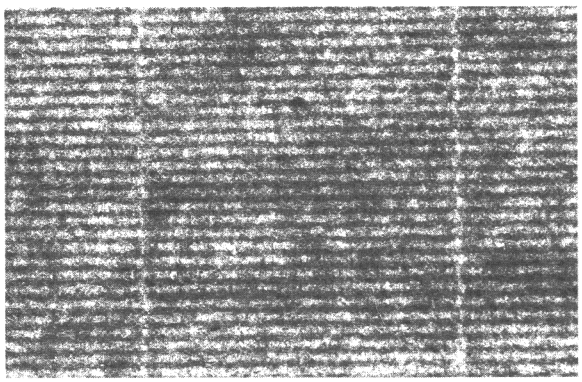


Fig. 5 Detail showing structure of chain lines in paper used for Degas's portrait of Manet.

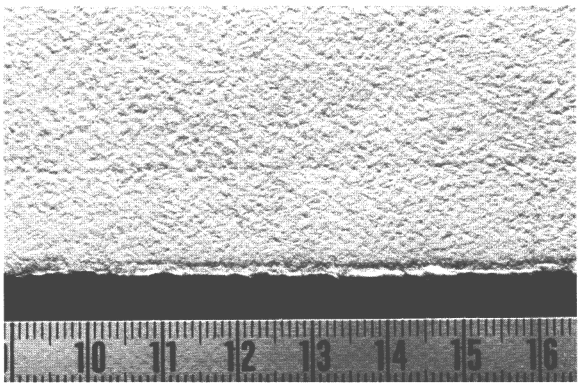


Fig. 6 Deckle edge of paper (Degas's portrait of Manet) viewed in raking light.

Fig. 7 Camille Pissarro, *Faneuses*, etching, eleventh state, Museum of Fine Arts, Boston, Katherine Eliot Bullard Fund, 1972.994.

Fig. 8 Camille Pissarro, *Faneuses*, etching, twelfth state, Museum of Fine Arts, Boston, Maria Antoinette Evans Fund, 1932.095.

1856 to 1875, he used wove or thin white oriental papers nearly twice as often as laid paper. For the first two states of this etching, Degas employed a rather nondescript smooth wove paper. He frequently printed his etchings on white or dull grey-white papers, sometimes called 'plate paper,' that were often used by printmakers for working proofs of intaglio prints. Unlike his close friend Camille Pissarro, who generally preferred the 'personality' and character of antique papers obtained from old ledger books and other sources, Degas may have found the soft, absorbent and unassertive qualities of machine-made wove papers effective in expressing the tonal effects he sought while not calling too much attention to the support.[6]

In the author's experience, a paper with a very similar appearance to the one Degas chose is found in certain posthumous impressions of Pissarro's etchings. A comparison of two of Pissarro's prints is relevant. He printed the eleventh state of *Faneuses* (haymakers) in a rich black ink on a sheet of handmade laid paper that possesses the visually interesting qualities he preferred (fig. 7). In contrast, the twelfth state, which is distinguished only slightly from the eleventh by the addition of a few lines, is printed rather thinly and dryly in brown ink (fig. 8). The result is an overall flattening of the image and loss of much of the sense of light and mood in the former version. Close examination of the paper for this state reveals that it is virtually identical to the paper used for the fourth state of Degas's portrait of Manet (fig. 9).

Some years ago, in a study of the papers used by Pissarro for his prints, the author found no instance in

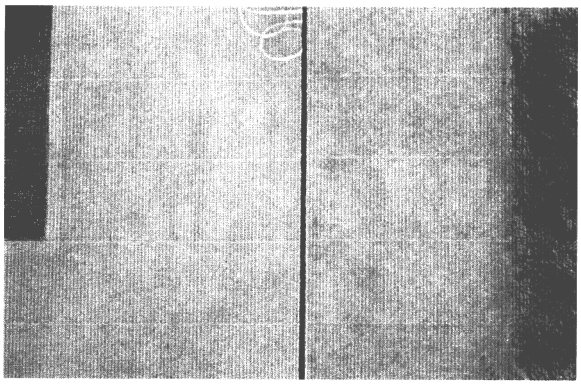


Fig. 9 Detail of paper used for twelfth state of Pissarro's *Faneuses*, on right, and fourth state of Degas's *Edouard Manet*, on left, viewed with transmitted light.

which this kind of paper was used for any impressions made during Pissarro's lifetime, that is, prior to 1903.[7] On the other hand, the paper is quite similar to the paper used for the edition of Pissarro's *Vachère au bord de l'eau* which appeared posthumously in the spring 1904 volume of the *Gazette des beaux-arts*. In more recent research, the author also noticed a paper of this kind, although somewhat thinner, with a portion of the same *M B* countermark, used for an impression of a print by Emile Besnard in the 1906 volume (opposite p. 438) of the *Gazette des beaux-arts*. Indeed, the paper for both the fourth state of Degas's portrait of Manet and the twelfth state of Pissarro's *Faneuses* fits very easily into the category of papers employed for large editions of prints found in mass-produced books such as the *Gazette*

The Prints and the Papers: Whistler's Venice Sets at the Freer Gallery of Art

VICTORIA BUNTING

Abstract

James McNeill Whistler had an interest in different kinds of paper from early in his etching career. Whistler is particularly known for liking and using old paper for his etchings. In this study of Whistler's aesthetic interest in paper, the 102 impressions of the two Venice Sets at the Freer Gallery of Art serve as a representative group.

Much of the literature about Whistler's etching career mentions his near obsession with finding and using old paper for his prints, especially 'old Dutch' paper. This study of Whistler's two Venice Sets at the Freer Gallery is an attempt to reconcile some of the ideas previously presented concerning Whistler's interest in paper with the physical evidence presented in the Freer etchings, by examining mould impressions, thickness, colour and watermarks.

Some of the techniques used in this study include testing the practicality of a portable colorimeter, in comparison to visual examination, to define paper colour; the use of high-kilovoltage electron radiography, rather than the traditional beta radiography, to record watermarks; and the use of computer imaging software to store the radiographed watermarks for study and reference.

Whistler's interest in Japanese papers was not studied, as it has been previously researched.

History

In 1879 the Fine Arts Society of London contracted James McNeill Whistler to produce an edition of 12 etchings of Venice. Whistler wrote to Ernest G. Brown at the Fine Arts Society in early 1880, asking for 'old Dutch paper' along with other etching supplies. His letter states

> ... send me some pieces of old Dutch paper for in Venice nothing can be had of any kind. You might see to this yourself, as you know what I like. Where to look for it I can't exactly tell you. Goulding may have some. You ought to send me about 20 or 30 pieces — rolled up properly and sent by post would be the way. ... for it would be a great pity if anything were to happen to what I value so much ...[1]

Of course, Whistler was not alone in his interest in using old papers for his prints. The poor quality of much contemporary paper, made from chemically processed wood pulp and bleached with harsh chemicals, prompted many nineteenth-century artists to find old paper made from cotton and linen rags. The Etching Revival, with its interest in Rembrandt, also influenced discussions about the quality of paper among etchers of the mid-nineteenth century. As early as 1859 the *Gazette des Beaux Arts* published an article describing different types of old paper and watermarks.[2] Old paper could still be found in the 1850s, but it became increasingly difficult to find as the Etching Revival produced a greater demand for it in the 1860s.[3]

Many Whistler biographers and scholars have written about Whistler's particular fascination with and taste for old paper. His first biographers, Elizabeth and Joseph Pennell, and his fellow etchers Otto Bacher and Mortimer Menpes all wrote humorous anecdotes about Whistler searching for old paper in bookshops all over Europe. More recently, Katharine Lochnan of the Art Gallery of Ontario has described Whistler's 'old Dutch' paper as

> ... a very high quality white paper made in the eighteenth century in enormous quantities in Holland, and exported all over the world. ... It had the finest texture of any hand-made antique paper, and is characterised by its thin, well-drawn laid lines, its translucency, and its smooth surface.[4]

Martha Smith, paper conservator at the Freer and Sackler Galleries, has continued the survey of all the Whistler prints in the Freer collection which began with this project. Her general observations on the types of paper Whistler used were summarized in her presentation at the 1997 American Institute for Conservation annual meeting in San Diego.[5] Most recently, Harriet Stratis of the Art Institute of Chicago published her research on Whistler's choice of papers for his lithographs.[6]

The Venice Sets

During my post-graduate fellowship at the Freer and Sackler Galleries' Department of Conservation and Scientific Research I had the unique opportunity to investigate Whistler's choice of paper, using the most comprehensive collection of his prints, housed in the Freer Gallery of Art.[7] Charles Lang Freer, the founder of the Freer Gallery of Art, began collecting Whistler's work with a purchase of the Second Venice Set in 1887, after viewing Howard Mansfield's extensive Whistler print collection.[8] Shortly after, Freer formed an agreement with Whistler that 'he would purchase impressions of all future etchings and lithographs directly from the artist.'[9] Whistler once wrote to Freer, 'I wish you to have a fine collection of Whistlers!! — perhaps *the* collection.'[10]

The Venice Sets consist of 38 different scenes (12 in the First Venice Set and 26 in the Second Venice Set), and there are 102 impressions of the Venice Sets in the Freer Gallery of Art. These prints are a good representative group for studying Whistler's choice of paper, for several reasons. Whistler made the Venice etchings at the midpoint of his printing career. While printing the Venice Sets Whistler established a personal style with a variety of techniques. These include wiping the plates to make each

image unique, drawing his butterfly monogram as sign of his approval (or actual pulling) of the prints, trimming the prints, leaving a tab for his monogram, and a continued interest in obtaining old papers on which to print. The quality of printing in these etchings suggests Whistler took great care in creating them. Indeed, Katharine Lochnan wrote, 'The Venice etchings constitute Whistler's most important work in the medium, and are ranked with the greatest achievements in the history of etching.'[11]

This study of Whistler's two Venice Sets at the Freer Gallery is an attempt to reconcile the ideas previously presented about Whistler's interest in paper with the physical evidence, found by examining mould impressions, thickness, colour and watermarks in the prints themselves.

Paper morphology

Using a survey form designed in FileMaker Pro to record my observations, I first examined the etching papers for the usual characteristics: whether they were western or Japanese, laid or wove; the paper thickness;[12] and the presence of watermarks. For laid papers, the distance between chain lines and the number of laid lines per centimeter were recorded. All of these characteristics were compiled into a database, organized by print impressions (see Table 1).[13]

In describing the paper morphology of the Venice prints I differentiated not only between laid and wove papers, but also between so-called antique laid and modern laid papers. The distinction between antique and modern laid papers is based on the dates of changes in structure of the papermaker's mould (roughly the end of the eighteenth century). However, the type of laid paper cannot be used exclusively to date paper, because antique laid paper may have been made any time after the invention of the modern laid mould by using older moulds, or moulds made intentionally to imitate the antique laid look. In this study the distinction between antique and modern laid paper was done only to classify and describe paper morphology, not to date the papers used by Whistler.

Colour

The paper colour for the Venice prints has been described by various people as ivory, cream, off white and tan. These terms mean different things to different people. For the Venice prints any method of colour description is difficult, for several reasons. In most cases the ink shows through to the verso, changing the overall tone of the paper. Most of the prints are trimmed to the margin, leaving only a small tab where there is no printing ink. Even in areas with no etched lines there is a thin film of printing ink from the plate tone. In addition, many of the prints have surface dirt on the verso or are unevenly discoloured by previous mounts. Most importantly, the present colour does not necessarily represent what Whistler saw or liked in the paper. All of these factors complicate any type of colour measurement or description, and limit its use or value.

In this study, I had hoped to find a method to measure the colour of the paper that could be used consistently from one collection to another. Three methods were available to me during my research: Munsell colour chips, the human eye and a colorimeter.

Using the Munsell colour system, one compares the colour-standard chips to the paper or object to be classified. Munsell does not provide enough colour chips in the lighter hues to compare to the light-coloured paper of the Venice prints.[14] Sorting the prints by eye seemed to be too subjective and thus not useful to other people. The Freer and Sackler Department of Conservation and Scientific Research (DCSR) has a Minolta CR-221 Chroma Meter, a portable colorimeter. A colorimeter measures the amount of light that is reflected from the sample, using its own light source and red, green and blue filters. One problem with this system is that its filters can vary from unit to unit, or can change over time, making comparisons of exact measurement very difficult.

I began with test measurements on eight prints from the Venice Sets which were relatively clean and opaque. The readings were quite different for each print because of the precise nature of the instrument, but all readings were within a certain range because of the similarity of the papers. After examining the data with the objects I was able to divide them into two groups: one that looks pinkish and one that looks yellowish (see Table 2).[15] Considering that it would be difficult to find clean and opaque areas to measure in all of the prints, I decided to sort the remaining prints visually into the two groups, using the eight measured prints as the standards.[16]

After sorting, I chose six prints from each category to measure with the Chroma Meter in order to test my visual sorting. Again, I chose only prints which were opaque enough to show no printing ink through to the verso, and/or that had margins where I could take measurements. In most instances the measurements of the Chroma Meter agreed with my visual sorting (see Table 3).[17]

Two other paper conservators were asked to sort the Venice prints visually by colour in the same light that I had used. Working independently, they each chose the same two categories (pinkish and yellowish off white) to define the paper colour, without knowing the number or types of categories I had chosen. Most of our choices for the two categories agreed.

The fact that three people could independently choose the same categories demonstrates that a visual comparison can be used when standards are chosen from within the group. For this survey, visual sorting was a better method than measurement with the Chroma Meter because I wanted to find a few broad categories of paper colour. The Chroma Meter detects many individual categories instead of a few, broad but separate categories. Consequently I found it best to sort visually as much as possible, using the Chroma Meter where necessary as a final judge.

Techniques for recording watermarks

There are many techniques used for recording watermarks. These include:

- tracing or photography using transmitted light

K#	Title	State	Watermark	Location	X-ray #	Freer #	Thickness	Chain Lines	Laid Lines	Ant./Mod	Trimmed/Not
183	Little Venice	?	Hunting Horn (bottom)	top edge	3064	93.22	.13 mm	2.9 cm	12/cm	A	trimmed, tab
183	Little Venice	?	Arms of Amsterdam	central	3071	92.16	.16 mm	2.4–2.5 cm	9/cm	A	trimmed
183	Little Venice	?				05.179	.20 mm	wove		Japan	not
183	Little Venice	?				98.378	.25 mm	wove		Japan	not
183	Little Venice	cancelled				94.40	.095 mm	2–2.9 cm		Japan	not
183	Little Venice	cancelled				92.25	.09 mm	3.0–3.1 cm		Japan	not
184	Nocturne	1	[Van Ge]lder	LL edge	3110	04.17	.30 mm	2.5 cm	8–9/cm	A	trimmed
184	Nocturne	2				03.51	.15 mm	3.2 cm	10/cm	A	not
184	Nocturne	3*				98.379	.23 mm	wove		Japan	not
184	Nocturne	btw 3&4				03.90	.18 mm	2.9 cm	8/cm	A	trimmed
185	The Little Mast	1*				02.131	.16 mm	2.5–2.7 cm	8/cm	A	trimmed, tab
185	The Little Mast	1*				98.380	.27 mm	wove		Japan	not
185	The Little Mast	3				94.24	.095 mm	2.2–2.3 cm	14/cm	M	trimmed, tab
186	The Little Lagoon	2*				98.381	.115 mm	2.8 cm	9/cm	A	trimmed, tab
186	The Little Lagoon	2*	Hunting Horn (?) bottom	TL corner	3070	94.41	.12 mm	2.7–2.9 cm	10/cm	A	trimmed, tab
186	The Little Lagoon	2*				05.180	.22 mm	wove		Japan	not
187	The Palaces	1				98.382	.13 mm	2.9–3.1 cm		Japan	not
187	The Palaces	2*	(unrecorded)			98.383	.22 mm	3.2 cm	9/cm	A	trimmed, tab
188	The Doorway	2	Atlas (partial)	L edge	3109	98.384	.22 mm	2.7 cm	10/cm	A	not
188	The Doorway	3				98.385	.22 mm	2.4–2.7 cm	8/cm	A	not
188	The Doorway	3				05.181	.473 mm	wove			not
188	The Doorway	3	Pro Patria/LVG	centre	3060	02.45	.12 mm	2.5 cm	10/cm	A	not
188	The Doorway	7				04.92	.075 mm	3.2–3.3 cm	9/cm	Japan	not
189	The Piazetta	3				98.386	.165 mm	2.6–2.8 cm	9/cm	A	trimmed, tab
189	The Piazetta	3	Strasbourg Lily (part)	L edge	3068	97.52	.18 mm	2.6–2.7 cm	9/cm	A	not
189	The Piazetta	3	Foolscap	centre	3068	02.133	.17 mm	2.5–2.6 cm	12/cm	A	not
189	The Piazetta	early	(lined)			05.182	.225 mm	2.3 cm	12/cm	A	not
191	The Traghetto #2	4	Arms of Amsterdam	centre	3061	05.183	.15 mm	2.4–2.5 cm	10/cm	A	trimmed, tab
191	The Traghetto #2	4				98.387	.275 mm	2.6–2.8 cm	8/cm	A	not
191	The Traghetto #2	cancelled	Strasbourg Lily (top)	bot. ctr.	3075	02.277	.195 mm	2.9 cm	9/cm	A	trimmed, tab
192	The Riva #1	1				01.169	.21 mm	2.7 cm	12/cm	A	not
192	The Riva #1	3*				98.388	.23 mm	2.6 cm	8/cm	A	
192	The Riva #1	btw 1&2	PD (unrecorded)			01.170	.185 mm	2.5 cm	12–13/cm	A	not
192	The Riva #1	cancelled				93.92	.095 mm	2.9 cm	9/cm	A	trimmed, tab
193	Two Doorways	1	Strasbourg Lily/VGZ	top ctr.	3108	03.148	.20 mm	3.0 cm	9/cm	A	not
193	Two Doorways	2				98.389	.27 mm	2.6 cm	12/cm	A	not
193	Two Doorways	3*	HD VE	central	3111	91.1	.18 mm	2.6 cm	10/cm	A	trimmed, tab
193	Two Doorways	3*				98.390	.20 mm	wove		Japan	
194	The Beggars	1	handshake/shield	central	3065	03.149	.13 mm	2.4–2.5 cm	11/cm	A	trimmed, tab
194	The Beggars	2				98.391	.12 mm	3.1 cm		Japan	not
194	The Beggars	4	1814/2	BR edge	3067	98.392	.185 mm	2.7 cm	9/cm	A	not
195	The Mast	1				98.393	.15 mm	3.0–3.1 cm		Japan	not
195	The Mast	2	KF	central	3112	02.135	.135 mm	2.5–2.6 cm	11/cm	M	not
195	The Mast	3				08.258	.115 mm	2.0–2.3 cm		Japan	not
195	The Mast	5*	P/L [van der Ley]	top left	3074	94.19	.13 mm	2.7–2.9 cm	12/cm	A	trimmed, tab
195	The Mast	5*				98.394	.24 mm	wove		Japan	not
196	Doorway & Vine	3	Hunting Horn/WR	bot. ctr.	3069	02.231	.17 mm	2.3–2.5 cm	11/cm	A	trimmed, tab
196	Doorway & Vine	5*				87.2	.085 mm	2.3 cm	14/cm	M	trimmed, tab
197	San Biago	1				08.3	.295 mm	2.5–2.8 cm	11/cm	M	not
197	San Biago	3	Hunting Horn/WR	central	3064	06.238	.15 mm	2.4–2.5 cm	10/cm	A	trimmed, tab
197	San Biago	4*				87.4	.11 mm	2.2–2.3 cm	12/cm	M	trimmed, tab
197	San Biago	9				98.395	.13 mm	2.8 cm	9/cm	A	trimmed, tab
198	Bead-stringers	4*				87.5	.11 mm	2.8–3.1 cm	8/cm	A	trimmed, tab

Table 1 Paper Characteristics of the Freer Venice Sets

K#	Title	State	Watermark	Location	X-ray #	Freer #	Thickness	Chain Lines	Laid Lines	Ant./Mod	Trimmed/Not
198	Bead-stringers	4*				02.120	.085 mm	2 2–2.3 cm	14/cm	M	trimmed, tab
198	Bead-stringers	8				05.185	.089 mm	2.2–2.3 cm	13/cm	M	trimmed, tab
199	Turkeys	1*				05.336	.14 mm	2.1 cm	14/cm	M	not
199	Turkeys	1*				87.6	.11 mm	2.7 cm	10/cm	A	trimmed, tab
200	Fruit Stall	6*				87.7	.135 mm	2.9 cm	9/cm	A	trimmed, tab
201	San Giorgio	2	Van G[elder] (partial)	top rt.	3063	04 18	.265 mm	2.6–2.7 cm	10/cm	M	trimmed
201	San Giorgio	2				05.186	.115 mm	2.8 cm	8/cm	A	trimmed, tab
201	San Giorgio	4*				87.8	10 mm	2.3 cm	13/cm	M	trimmed, tab
202	Nocturne: Palaces	1	Strasbourg Lily/VGZ		3076	06.39	18 mm	3.0 cm	8/cm	M	not
202	Nocturne: Palaces	7*	Strasbourg Lily (top)	ctr. rt.	3066	87.9	.19 mm	2.8–3 cm	9/cm	A	trimmed, tab
202	Nocturne: Palaces	8	DHK	top ctr.	3071	93.23	.11 mm	2.7–3 cm	9/cm	A	trimmed
203	Long Lagoon	1*	Hunting Horn/WR	ctr. left	3062	05.5	.156 mm	2.4 cm	11/cm	A	trimmed, tab
203	Long Lagoon	1*	Strasbourg Lily/LVG	centre	3062	87.10	.14 mm	2 6–2.7 cm	9/cm	A	trimmed, tab
204	The Bridge	8*	Strasbourg Lily/GR	ctr. left	3065	87.12	.21 mm	2.9 cm	8/cm	A	
204	The Bridge	8*				98.396	.12 mm	2.3 cm	13/cm	M	trimmed, tab
205	Upright Venice	2*				87.13	.10 mm	2.8 cm	10/cm	M	trimmed, tab
205	Upright Venice	2*	Pro Patria (on lining?)	centre	3062	05.187	.17 mm	2.6–2.7 cm	9/cm	A	trimmed, tab
206	The Riva #2	1*	Hunting Horn/WR	centre	3066	05.6	.127 mm	2.3–2.5 cm	11/cm	A	trimmed, tab
206	The Riva #2	1*				87.16	.093 mm	2.2–2 3 cm	13/cm	M	
206	The Riva #2	1*				98 397	.115 mm	2.8–3 cm	8/cm	A	trimmed, tab
207	The Balcony	btw 1&2	handshake/shield	centre	3074	05.189	.17 mm	2.6 cm	10/cm	M	trimmed
207	The Balcony	5*				87.18	.125 mm	2.9 cm	9/cm	A	trimmed, tab
207	The Balcony	5*				05.190	.115 mm	2.8–3 cm	9/cm	A	trimmed, tab
207	The Balcony	9				98 398	.22 mm	2.7–2.8 cm	9/cm	A	trimmed, tab
208	Fishing-boat	2	WW	centre	3067	98.399	.15 mm	2.4 cm	11/cm	A	trimmed, tab
208	Fishing-boat	3*				87.19	.09 mm	2 2–2.3 cm	14/cm	M	trimmed, tab
209	Ponte del Piovan	1				08 4	.10 mm	2.1–2 3 cm	9/cm	Japan	not
209	Ponte del Piovan	5*	Hunting Horn/HG	centre	3069	87.2	.12 mm	2.4–2.5 cm	12/cm	A	
210	Garden	7*	Arm of Amsterdam	centre	3061	02.121	.115 mm	2.5 cm	9/cm	A	trimmed, tab
210	Garden	7*				87 21	.09 mm	2.7–3 cm	9/cm	A	trimmed, tab
211	The Rialto	1	WW (not recorded)	centre		05.7	.125 mm	2.4 cm	12/cm	A	trimmed, tab
211	The Rialto	2*	Strasbourg Lily/LVG	centre	3111	87.22	.15 mm	2.6–2.7 cm	9/cm	A	trimmed, tab
212	Long Venice	4				05.191	.105 mm	2.7–2.9 cm	9/cm	A	trimmed, tab
212	Long Venice	5*				87 23	.085 mm	2 3 cm	13/cm	M	trimmed, tab
212	Long Venice	5*				98 400	09 mm	2.3 cm	13/cm	M	trimmed, tab
213	Nocturne·Furnace	2	TI	centre	3110	05 192	.11 mm	2.6 cm	11/cm	A	trimmed, tab
213	Nocturne:Furnace	4*				87.24	095 mm	2.3 cm	13/cm	M	trimmed, tab
214	Quiet Canal	1				05.193	.16 mm	wove			not
214	Quiet Canal	5*				87.25	.08 mm	2.8–2.9 cm	10/cm	M	trimmed, tab
214	Quiet Canal	5*				05.194	.109 mm	2.8 cm	11/cm	M	trimmed, tab
215	La Salute· Dawn	4*	LVG (Strasbourg Lily?)	bot. ctr.	3069	87.26	.13 mm	2.6–2 7 cm	8/cm	A	trimmed, tab
216	Lagoon: Noon	3*				87.27	085 mm	2.3 cm	13/cm	M	trimmed, tab
233	Wheelwright	5*				87.3	.09 mm	2.3 cm	13/cm	M	trimmed, tab
233	Wheelwright	5*				05.184	.099 mm	2 2–2.4 cm	14/cm	M	trimmed, tab
234	Temple	only*				87.11	.10 mm	2.2–2.3 cm	13/cm	M	trimmed, tab
235	Lobster-pots	1*	Strasbourg Lily (?)	bot. ctr.	3070	87.15	14 mm	2.6–2.7 cm	8/cm	A	trimmed, tab
236	Little Court	only*	Strasbourg Lily	LL corner	3075	05.188	.136 mm	2.6–2.7 cm	8/cm	A	trimmed, tab
236	Little Court	only*	Arms of Amsterdam	top edge	3070	87 14	.13 mm	2.4–2.5 cm	8/cm	A	trimmed, tab
237	Drury Lane	only*				87.17	.14 mm	2.7 cm	9/cm	A	trimmed, tab

Table 1 Paper Characteristics of the Freer Venice Sets (cont'd.)

Acc. Number	L*	a*	b*	d L*a*b*	Chroma
F94.14	83.13	-0.39	19.21	0.36	19.21
	83.55	-0.54	19 04	0.33	19 05
	83.45	-0 34	19.91	0.58	19.91
	84.07	-0.57	19.56	0 65	19.57
	83.13	-0.37	18.99	0.49	18.99
Average	**83.47**	**-0.44**	**19.34**	**0.48**	**19.35**
Standard Error	**0.15**	**0.04**	**0.16**	**0.06**	**0.16**
F93.22	83 61	-0.39	19.02	0.24	19.02
	83.74	-0.20	18.82	0.43	18.82
	82.90	-0.29	19 20	0.52	19.20
	82.61	-0.22	19.89	1.18	19.89
	84.01	-0.58	18.07	1.15	18.08
Average	**83.37**	**-0.34**	**19.00**	**0.70**	**19.00**
Standard Error	**0.24**	**0.06**	**0.26**	**0.17**	**0.26**
F94.41	82.76	-0.79	19.85	1.02	19.87
	83.06	-0.81	19.06	0.21	19.08
	84.38	-1 09	19.02	1.28	19.05
	83.13	-1.09	18.31	0.61	18.34
	82.21	-0.97	18.30	1.08	18.33
Average	**83.11**	**-0.95**	**18.91**	**0.84**	**18.93**
Standard Error	**0.32**	**0.06**	**0.26**	**0.17**	**0.25**
F06.39	84 71	0.07	18.09	0.67	18.09
	84.64	-0.05	17.05	0.42	17.05
	85.02	-0 05	17.52	0.25	17.52
	84.87	0.04	17.75	0.33	17.75
	84.73	0.09	16.74	0 70	16.74
Average	**84.79**	**0.02**	**17.43**	**0.47**	**17.43**
Standard Error	**0.06**	**0.03**	**0.22**	**0.08**	**0.22**

Acc. Number	L*	a*	b*	d L*a*b*	Chroma
F05.181	83.60	-0.31	16.66	0.30	16.66
	83.89	-0.35	16.75	0.03	16.75
	83 76	-0.35	16.80	0.14	16 80
	84.39	-0.55	16.57	0.56	16.58
	83.78	-0.32	16.87	0.18	16.87
Average	**83.88**	**-0.38**	**16.73**	**0.24**	**16.73**
Standard Error	**0.12**	**0.04**	**0.05**	**0.08**	**0.05**
F08.3	78.69	1.92	16.96	0 55	17.07
	78.65	1.75	17.14	0.64	17.23
	80.34	1.29	16 12	1.41	16.17
	79.75	1.64	16 33	0.74	16.41
	78.37	2.00	17.26	0 97	17.38
Average	**79.16**	**1.72**	**16.76**	**0.86**	**16.85**
Standard Error	**0.34**	**0.11**	**0.20**	**0.14**	**0.21**
F04.18	84.98	0.25	13 44	0.49	13.44
	84.71	0.16	13 48	0.74	13.48
	85.64	-0.01	13.42	0 22	13.42
	85.94	-0.05	13.26	0 54	13.26
	85.96	0.10	13.49	0.52	13.49
Average	**85.45**	**0.09**	**13.42**	**0.60**	**13.42**
Standard Error	**0.23**	**0.05**	**0.04**	**0.07**	**0.04**
F05.189	87.56	1.23	13.02	0 28	13.08
	87.65	1.20	13.26	0.09	13.31
	87 53	1.38	13.27	0.14	13 34
	87.58	1.32	13.48	0.19	13.54
	87.65	1.19	13.45	0 18	13.50
Average	**87.59**	**1.26**	**13.30**	**0.18**	**13.36**
Standard Error	**0.02**	**0.03**	**0.07**	**0.03**	**0.07**

Table 2 Colorimeter Readings of Eight Sample Prints

- Dylux 503 (a photosensitive paper)
- beta radiography
- low-voltage radiography (also known as Grenz radiography)
- electron radiography

Tracing or photographing watermarks using transmitted light is a very imperfect method, and gives an incomplete and often inaccurate image because of interference from the design medium.

Dylux 503 has sometimes been used successfully to get an accurate, one-to-one image of watermarks much as in radiography. However, many people have had difficulty with this method, and it was not readily available to me.

Beta radiography is perhaps the most commonly used radiographic technique today because the equipment is simple. It has the distinct disadvantage of being limited in size to 10 square centimetres, making it sometimes necessary to record larger watermarks in successive steps. Another disadvantage is that the exposure time for beta radiography can be a few hours or even longer. Both of these aspects, along with the added difficulty of buying and licensing a beta plate during my time at the Freer, made it an impractical technique for this project.

Low-voltage radiography and electron radiography require an x-ray machine. In low-voltage radiography the kilovoltage (kV) range is from 4–10. This technique was originally considered for recording the Whistler watermarks. However, it would have required placing the unexposed film and the prints in a darkened x-ray room, and the x-ray room at the Freer conservation department is not set up to enter or exit without exposing the room to light. In addition, the design medium can interfere in a radiograph of the watermark if it contains metallic pigment.

For practical purposes, electron radiography using a high kilovoltage was the easiest technique to use for this project. It also has the advantage of taking a radiograph of a whole sheet of paper up to the size of the film and the vacuum envelope — 35.5 × 43 cm. It will not record the medium on the surface of the paper, thus avoiding any interference in the image of the watermark.[18] In addition, because the whole print is radiographed you can see the orientation and location of the watermark within the print.

Electron radiography process

In the process of electron radiography, high-kilovoltage, filtered x-rays irradiate a lead foil and produce electrons. As these electrons pass through a specimen of low atomic weight, such as paper, they are absorbed differently according to the density or structure of the paper. The differential absorption is then recorded on a sheet of film placed beneath the paper.[19]

For an electron radiograph, the film, print and lead foil are placed together in a vacuum envelope to promote good contact between the components. Because of the small size of most of the Venice etchings, I was able to fit one, two or three prints on each sheet of film inside the vacuum envelope.

Acc. Number	L*	a*	b*	d L*a*b*	Chroma
F03.148	85.17	0.43	16.67	0.48	16.68
	84.98	0.53	17 08	0.14	17.09
	85 34	0.57	16.89	0.44	16.90
	84.19	0.99	17.81	1.13	17.84
	84.97	0.73	16.69	0.35	16.71
Average	**84.93**	**0.65**	**17.03**	**0.51**	**17.04**
Standard Error	**0.18**	**0.09**	**0.19**	**0.15**	**0.19**
F98.387	85.30	-1.32	15 45	0.90	15.51
	85.82	-0.99	15.81	0.59	15.84
	87.21	-1.32	15.19	1.05	15.25
	86.35	-1.24	15.53	0.20	15.58
	86 29	-1.15	15.08	0.35	15.12
Average	**86.19**	**-1.20**	**15.41**	**0.62**	**15.46**
Standard Error	**0.28**	**0.06**	**0.12**	**0.14**	**0.11**
F02.45	87 44	-1.28	16.99	0 34	17 04
	87.86	-1.35	16.85	0.23	16.90
	87.24	-1.76	16.24	0.76	16.34
	87.92	-1.34	16.76	0.27	16.81
	87.83	-1.33	17.01	0.31	17.06
Average	**87.66**	**-1.41**	**16.77**	**0.38**	**16.83**
Standard Error	**0.12**	**0.08**	**0.13**	**0.09**	**0.12**
F98.385	86.59	1.30	13.87	0.69	13.93
	86.53	1.37	13.91	0.76	13.98
	86.64	1 33	13.07	0.32	13.14
	87.03	1.23	12 67	0.60	12.73
	87 70	1.27	12.74	0.95	12.80
Average	**86.90**	**1.30**	**13.25**	**0.66**	**13.32**
Standard Error	**0.20**	**0.02**	**0.24**	**0.09**	**0.24**
F98.392	87.89	1.22	13.09	0.17	13.15
	87.45	1.29	12.98	0.29	13.04
	87.91	1 21	12.76	0.33	12 82
	87.80	1.33	13.17	0.16	13.24
	87.64	1.26	13.18	0.17	13.24
Average	**87.74**	**1.26**	**13.04**	**0.23**	**13.10**
Standard Error	**0.08**	**0.02**	**0.07**	**0.03**	**0.07**
F02.135	89.74	0.95	13.35	0.44	13.38
	88.80	0.65	12 72	1.03	12.74
	89.52	1.03	13 48	0.64	13.52
	90.51	0.85	12.45	0 87	12.48
	90.35	0.85	12.60	0.65	12.63
Average	**89.78**	**0.87**	**12.92**	**0.72**	**12.95**
Standard Error	**0.27**	**0.06**	**0.19**	**0.09**	**0.19**

Acc. Number	L*	a*	b*	d L*a*b*	Chroma
F03.149	90.07	0 51	11.68	0.33	11 69
	90 28	0.50	11.38	0.27	11.39
	90 20	0.49	11 35	0.19	11.36
	89.28	0.20	11.08	0.83	11.08
	90.26	0.55	11.32	0.27	11.33
Average	**90.02**	**0.45**	**11.36**	**0.38**	**11.37**
Standard Error	**0.17**	**0.06**	**0.09**	**0.10**	**0.09**
F02.133	89 40	1.00	10.98	0.50	11.03
	89.71	0.95	11.39	0 74	11.43
	88.10	0 87	11.11	0.90	11.14
	88.72	0.85	11.12	0.32	11.15
	88.98	1.15	11.69	0.47	11.75
Average	**88.98**	**0.96**	**11.26**	**0.59**	**11.30**
Standard Error	**0.25**	**0.05**	**0.11**	**0.09**	**0.12**
F87.26	87.75	1.15	13.21	0.15	13.26
	88.17	1.18	13.49	0 38	13.54
	87.73	1.27	13.35	0.12	13.41
	87.37	1.18	13.14	0.49	13.19
	88.13	1.27	13.40	0.32	13.46
Average	**87.83**	**1.21**	**13.32**	**0.29**	**13.37**
Standard Error	**0.13**	**0.02**	**0.06**	**0.06**	**0.06**
F87.10	87.76	1.26	13.43	0.57	13.49
	88 13	1.27	12.77	0.25	12.83
	87.77	1.12	12.16	0.74	12.21
	87.86	1 29	12.37	0.51	12.44
	88.01	1.23	13.65	0.78	13.71
Average	**87.91**	**1.23**	**12.88**	**0.57**	**12.94**
Standard Error	**0.06**	**0.03**	**0.26**	**0.08**	**0.26**
F98.389	85.46	-0.36	13.42	0.35	13.42
	85.20	-0.45	13.43	0.21	13.44
	84.98	-0.47	13.59	0.23	13.60
	84.82	-0.15	13.68	0 38	13.68
	85.28	-0.13	13.79	0.31	13.79
Average	**85.15**	**-0.31**	**13.58**	**0.30**	**13.59**
Standard Error	**0.10**	**0.07**	**0.06**	**0.03**	**0.06**
F04.17	85.95	-0.01	14.62	0.74	14.62
	85.38	0.03	15.20	0.19	15.20
	85.25	0.25	15 81	0.66	15.81
	85.58	0.17	15.12	0.12	15.12
	85.54	0.23	15.37	0.17	15.37
Average	**85.54**	**0.13**	**15.22**	**0.38**	**15.22**
Standard Error	**0.11**	**0.05**	**0.17**	**0.12**	**0.17**

Table 3 Colorimeter Readings of Prints Sorted Visually

In order to make handling of the prints safe and convenient in the darkroom, I made a Mylar polyester folder to place around the prints. In the darkroom with a safelight on I lifted up one side of the polyester and placed the lead foil in contact with the recto side of the prints. Then I flipped the package and lifted the other side of the polyester to put the film next to the verso of the prints. With the prints aligned and enclosed in the polyester sleeve I could safely slip the whole package into the vacuum envelope. I had originally hoped that I could put the lead foil and the film outside the polyester sleeve, but experimentation with the x-ray technique proved that the print had to be in direct contact with both the lead foil and the film in order to get an image.

Fifteen of the 102 prints in the Venice Sets are on Japanese paper.[20] A remarkable 42 of the 87 prints on western paper in the two Venice Sets at the Freer Gallery do have watermarks. Using electron radiography I was able to expose and develop all of the watermarks in less than four days.[21] Because of the ease, speed and thoroughness of the electron radiography technique for recording watermarks, I urge anyone who has access to a high-kilovoltage x-ray machine to use this technique for recording watermarks on medium to small works on paper which can be placed safely in a vacuum envelope without damage to the support or media.

Computer imaging

To study the watermarks with the reference materials in other libraries, rather than photographing all of the radiographs, I made use of the computer imaging technology available at the Freer DCSR. The radiographs were

placed on a light box on an easel, and a CCD video camera recorded the watermark. The image was saved and manipulated by the computer imaging software in order to enhance or decrease the contrast and thus sharpen the image. After manipulation, the desired image was printed out on thermal paper. Although this offers a quick and easy reproduction of watermarks, the thermal paper printout is not a 1:1 image of the radiograph. Watermark size is very important for exact identification. However, this technique did provide me with enough image information to find similar examples in watermark reference sources at other libraries, which I later checked for size with the radiographs.[22]

Watermarks

Although thousands of different watermark designs have been recorded, many are slight variations on the same design. This fact, along with allowing for inaccuracy in copying watermarks by tracing (as was done by most of the published watermark compilers), makes watermark identification difficult. In addition, watermark designs may have been used for centuries by the same paper mill with only slight variations.

Initials on watermarks or countermarks are usually those of the papermaker or the patron of the paper mill. They were used to help distinguish one mill's paper from another's when watermark designs became commonly used by many papermakers. Sometimes when a design or initials became associated with a fine-quality paper from one mill, it was used by different mills in combination with their own designs or initials.

Watermarks that contain dates are not reliable sources for dating paper manufacture, because the papermaking mould could have been used for many years after the date. Papermaking moulds had an average lifespan of 30 years, during which changes may have occurred due to movement of the wires from cleaning the screens with stiff brushes and resewing of broken wires.

In the published sources for identifying watermarks (Charles Briquet, William Churchill, Edward Heawood and Thomas Gravell),[23] the authors have dated most of the watermarks by looking at the publication or printing dates of the books in which the watermarked paper was found. In order to identify exactly a watermark on a given paper, using the published guides by the above-mentioned authors, one must match the design, the sewing attachments, the location of the design within the laid and chain lines of the mould and the spacings of the laid and chain lines. Rather than dating specifically each of the watermarks found in Whistler's prints, I wanted to use the watermarks to investigate the possible age and origin of the papers Whistler had used.

Watermarks found in the Venice Sets

I identified many watermarks in the Venice Sets at the Freer Gallery. I also found several designs which appear repeatedly in several different prints. For the reasons stated above I have not been able to date any of the watermarks conclusively, but I found some which match roughly dated watermarks in some of the reference texts, such as Churchill and Heawood. I found watermarks that are nearly identical or identical in size among several prints. I also researched the history of different watermark designs represented in the Venice etchings to provide some basis for the general age of the papers.

The watermarks themselves seemed to have been important to Whistler, not only for the quality of paper that they represented, but also for aesthetic reasons. In 24 of the 42 watermarked prints in the Venice Sets, the watermark or countermark is complete and located close to the centre of the print. Since Whistler often trimmed his prints, the location of the watermark must have been thought out carefully before printing so that it would not be trimmed off. This must have involved wasting paper, considering that watermarks and countermarks are often located in the centre of one-half of the sheet of paper.

All of the watermarks that could be identified in the Freer Gallery Venice Sets can be associated with Dutch paper. The Dutch had a long reputation for supplying good-quality paper. There were many Dutch papermakers who continued to make paper by hand, using the same symbols with slight variation in their watermarks into the nineteenth century.[24] In all likelihood, some of what Whistler called 'old Dutch' paper was nineteenth-century paper with these established watermarks. Whistler may have thought the paper he was using was old because the watermarks had been in use for centuries. He may also have used the term 'old Dutch' to mean any handmade paper with the qualities of old paper.

Venice Sets and other Whistler etchings in other institutions contained several of the same watermarks as those I found in the Freer Venice Sets. This indicates that the Freer collection is a good representative sample of Whistler's choice of papers.[25] Clearly Whistler had access to good-quality watermarked paper such as is found in these collections. (For a detailed description of the identifiable watermarks, see the Appendix to this paper).

Conclusion

The information provided by this study of paper helps to clarify much of what has been written about Whistler's interest in paper. In addition to the watermarks that appear repeatedly, other trends are apparent. Whistler liked to use Japanese paper (both laid and wove) of different thicknesses, but the majority of the prints examined (60) were done on western antique laid paper. He used western wove paper only twice in these 102 impressions. There are many papers with watermarks, most of which can be identified as Dutch. In the Venice etchings Whistler used only off-white paper, either by preference or because it was available.

It has been surmised by some scholars that Whistler chose certain papers for certain proofs.[26] The Freer collection demonstrates that Whistler printed both artist's proofs and published sets of etchings on Japanese paper (often of poor quality), watermarked paper that may be called 'old Dutch,' and antique and modern laid papers with no watermarks. There are no consistent patterns connecting Whistler's choice of paper with the choice or state of the print on it.

The techniques that I used in this study of paper helped me to organize a mass of details about the individual characteristics of a large collection of prints. Through this organization I was able to see both trends and variations in Whistler's choice of printing papers. Further study of the Whistler prints in the Freer and other collections may continue to reveal details about Whistler's interest in paper, and what papers were available to printers in the second half of the nineteenth century.

Acknowledgements

This project was completed while I was a Post-Graduate Conservation Fellow at the Freer and Sackler Galleries (1994–95). I wish to thank the Conservation Analytical Laboratory (SCMRE) of the Smithsonian Institution for funding my fellowship, and the Freer and Sackler Department of Conservation and Scientific Research (DCSR) for sponsoring my fellowship. I am most grateful to my supervisor, Martha Smith, for her endless encouragement, support and advice. Janet Douglas and John Winter of the DCSR taught me electron radiography. Chris Maines (National Gallery of Art, Washington, DC) taught me the computer imaging techniques and the use of the Chroma Meter and colour measurement theory. Marjorie Cohn (Fogg Art Museum, Harvard University) and Georgianna Bishop and Kimberly Schenck (Baltimore Art Museum) assisted me with my examination of their Whistler etchings. Dan Kushel (Art Conservation Department of the State University College at Buffalo) gave me advice on radiographing paper.

Appendix

Watermarks found in the Freer Venice Sets

Hunting Horn

The Hunting Horn watermark is found on eight prints in the Venice Sets at the FGA. None of the Venice Set examples match the many similar examples in Heawood. In four of the examples there is a *WR* underneath and there is a bell-and-clapper shape within the shield above the rope on the horn. Two examples (94.41 and 93.22) show only the bottom of the shield with a number *4* and an inverted *V*. These two are like Heawood's no. 2770, which dates from the late eighteenth century.

Arms of Amsterdam

The Arms of Amsterdam watermark appears in four of the Venice prints. This symbol was used for over 150 years, and was imitated in many countries.[27] Prints 05.183 and 02.121 have the full watermark with the countermark *RK*. Print 92.16 has just the full watermark. These three are very similar in that the two lions have their heads turned to face frontally and have curly manes, and there is a straight bar below the lions and shield. The details of the crown and shield are also similar among the three watermarks, but none matches the others perfectly. These three are very similar to Heawood's nos. 413 or 415, but do not match in size. The fourth watermark (87.14) shows a more elaborate design, with swirls below the bar that comes beneath the lions' feet. This is somewhat like the bottom of Heawood's no. 416. The watermarks cited for comparison in Heawood date from the first half of the eighteenth century.

Pro Patria

Churchill lists this design as a Dutch watermark used between 1683 and 1799.[28] According to Heawood, the Pro Patria watermark was characteristic of the Dutch from the early eighteenth century onwards.[29] The two examples in the Venice Sets (05.187 and 02.45) are very different from each other in size and details. Print 02.45 has a countermark *LVG* in block letters. Two other Pro Patria watermarks have been found in other Whistler etchings at the Freer (98.324 and 98.325), but these two examples have initials beneath the fence. These two prints are from the Thames Set, indicating that Whistler had a long-standing interest in good-quality paper and that it continued to be available. None of these examples matched Heawood's tracings, which were very loose in comparison.

Strasbourg Lily

Some form of the Strasbourg Lily watermark appears in 10 of the Venice prints. Print 97.52 is unique to this group because it is the only one with no crowned shield around the fleur-de-lys. This one matches very closely Heawood's no. 1681, which dates from the late seventeenth century. Although not all of them are complete, 05.188, 87.10, 87.22 and 87.26 all match each other in size. These four all have the lily in the crowned shield. The letters *LVG* in block capitals are below three of the four. LVG is the initials of the Lubertus van Gerrevink family, which ran paper mills in Holland from 1698 to 1819.[30] One of the complete watermarks of this group matches closely Heawood's nos. 1825 or 1826, which date from the mid-eighteenth century. Two identical marks in the Strasbourg Lily design are in 06.39 and 03.148. They have a lily within a shield (presumably crowned — the top is missing) with the letters *VGZ* in capital script below. None of the examples in Churchill or Heawood had letters in script. The use of cursive letters started in the mid-eighteenth century. The mark on 87.12 is very close to Heawood's nos. 1846 or 1849, which are from the late eighteenth century. The last two of this group (02.277 and 87.9) are identical in size, but some of the details (the outer horns) do not match perfectly. It is possible that either of these is the top half of the watermark for 87.12 (or one like it), as they also match Heawood's nos. 1849. The letters *GR* (on 87.12) probably refer to one of the King Georges, but not knowing which one makes it difficult to date the paper. One of the Heawood examples that it may relate to is from the late eighteenth century.

Foolscap

The Foolscap is probably one of the best-known and longest-used watermark designs. It was originally used to denote a certain size of paper (approximately 13 × 17 inches / 33 × 43 cm), and dates back to the late fifteenth century.[31] The design was used by many papermakers because it symbolized good-quality paper.[32] This Foolscap, with a seven-pointed collar, does not match any of the examples in Heawood, Churchill, or Briquet, but is

very much like several examples found by Harriet Stratis in Whistler's lithographs.[33] In Heawood, it is most like the examples which date from the early seventeenth to early eighteenth centuries.

Atlas

This partial watermark (98.384) looks like a human head and arms supporting a globe with a cross on top. The shape of the globe is very distorted. The shapes of the eyes and the arms of the figure are very similar to Churchill's no. 512, which dates from the mid-seventeenth century, or like Heawood's no. 1362, from the same period. Heawood places this watermark in Amsterdam. Dard Hunter says the Atlas watermark was used for paper measuring 26 × 34 inches (66 × 86 cm), which was a drawing and printing paper originally used for maps and atlases.[34]

Van der Ley

The *P* and the *L* in this countermark (94.19) are joined and have a decorative stem coming out of the corner of the L. According to Heawood this was the mark of the Van der Ley family, and was common in the late seventeenth century.[35] There are many different watermarks in Heawood and Churchill which use this countermark, but all of the examples are less refined than the example in the Freer Venice etching.

LVG and IV

Gravell suggests that the initials *LVG* and *IV* originally indicated Lubertus van Gerrevink and Jean Villedary, the papermakers, but in the eighteenth century these marks became 'symbols of quality paper and were used indiscriminately by mills all over western Europe.'[36] According to Churchill, 'The name or initials of Jean Villedary as watermarks cover a period of 150 years. ... The initials IV, of Jean Villedary, appear on many papers for books and manuscripts in the public archives and libraries of England and Holland. They also appear in conjunction with the names and watermarks of Lubertus van Gerrevink, C.I. Honig, Adrianne Rogge, and Van der Ley. The initials IV and LVG together have been found on paper dated from 1736 to 1812. It is not known whether Villedary worked in conjunction with the other Dutch papermakers, or whether they made use of his initials, which had become a hall-mark of excellence.'[37] In the Venice Sets the countermark LVG was found alone, with the Pro Patria watermark and with the Strasbourg Lily. There is one print in the Venice Sets (98.398) that has the countermark IV. There were 33 examples in Heawood with IV. With only the countermark, it is impossible to date the paper or to know from which mill it came.

The remaining watermarks (see Table 1) in the Venice Sets are initials or dates which were not listed in the referenced texts. I later found watermarks on three more Venice Set prints (making the total 42): K187, *The Palaces* (98.383), K192, *The Riva No. 1* (01.170) and K 211, *The Rialto* (05.7), but I did not have time to radiograph these.

Notes

1. Lochnan, K. 1988. *Whistler's Etchings and the Sources of His Etching Style, 1855–1880.* New York and London: Garland Publishing, Inc. 300.
2. Lochnan. 1988. 269.
3. Lochnan. 1988. 271.
4. Lochnan. 1988. 271–72.
5. Smith, M. 1997. Hunting for old paper with James McNeill Whistler. *The Book and Paper Group Annual* 16: 89–90.
6. Stratis, H.K. 1998. Whistler's papers: Their appearance, selection, and use; Watermarks in Whistler's papers: Methods of identifying lifetime and posthumous lithographs; Compilation of watermarks. In *The Lithographs of James McNeill Whistler.* Vol. 2. *Correspondence and Technical Studies*, ed. M. Tedeschi. Chicago: Art Institute of Chicago. 298–433.
7. There are 745 etchings and 196 lithographs and lithotints in the Freer collection. See T. Lawton and L. Merrill. 1993. *Freer, A Legacy of Art.* Washington, DC: Smithsonian Institution. 257 note 15.
8. Lawton and Merrill. 1993. 18.
9. Lawton and Merrill. 1993. 42.
10. Lawton and Merrill. 1993. 46.
11. Lochnan. 1988. 242.
12. Paper thickness was measured with a Starrett thickness gauge no. 1010M.
13. Table 1 lists all of the prints in the Venice Sets, grouped together by Kennedy number. The following are indicated for each impression: the state of the etching, the type of watermark (if present), the watermark location, the x-ray number in the Freer DCSR, the Freer accession number, the paper thickness, the distance between chain lines, the laid lines per centimeter, whether the paper is antique or modern laid and whether the print is trimmed or not. (Prints on Japanese paper are also noted, and appropriate measurements given as available.) The state numbers with an asterisk (*) indicate that it is the state printed for the published sets.
14. Munsell Book of Color, Glossy Finish Collection, Kollmorgen Corp., Baltimore, MD 1966. Munsell chips were useful for distinguishing between the different shades of brown and grey papers used by Whistler for his pastels.
15. The method of measurement was as follows: The Chroma Meter was first calibrated to all nine colour plates and the white standard. For each print the verso was measured in five different areas that were chosen by eye for their similarity in tone. All the readings were taken with the prints face down on the same white matboard, using CIE L*a*b* Color Space. (For a complete description see F.W. Billmeyer and M. Saltzman. 1981. *Principles of Color Technology.* 2d ed. New York: John Wiley and Sons. The data were entered into a statistics program (Quattro Pro, Version 4.0 for Windows, Borland International, Inc., 1992) and the average and standard error were calculated for each reading (L*, a* and b*). Delta L*a*b* and the chroma with their averages and standard errors were calculated.
16. The verso of the remaining Venice prints were examined by window light combined with full-spectrum overhead lights.
17. One difficulty with using the Chroma Meter was that the average chroma values in the prints measured gave no clear numerical division point to distinguish the pinkish and yellowish papers. This is to be expected, since all of the prints are on off white paper. The average chroma values for the

pinkish papers tend towards the lower values (11) and for the yellowish papers the values tend towards the higher values (19). The average chroma must be looked at with the a* and b* values to get the full picture. The pink papers had a* values from 0 to +1.2 and b* values from 11 to 15.2. Most of the yellow papers had a* values from 0 to -1.4 and b* values from 12.9 to 19. (For the a* values, any number between 1 and -1 is rounded to zero.)

18. For discussions on Dylux 503 and beta radiography see T.L. Gravell. 1975. A New method of reproducing watermarks for study. *Restaurator* 2: 95–104, and N.E. Ash. 1986. Watermark research: Rembrandt prints and the development of a watermark archive. *The Paper Conservator* 10: 64–69. For low-voltage and electron radiography see C.F. Bridgman. 1965. Radiography of paper. *Studies in Conservation* 10: 8–17, and Eastman Kodak Co. 1980. *Radiography in Modern Industry*. 4th ed. Rochester: Eastman Kodak Company. 127–29.
19. The following supplies and equipment were used to carry out the electron radiography:
    Gemini 320 industrial x-ray unit by Diano Corp., New Haven, CT
    Raydex Super Smooth 0.005 inch lead screen, by Roentgen Industrial Corp., Highland Park, IL
    E-Z EM's VAC-U-PAK
    Kodak SR 5 14 × 17 inch film (Industrex R)
    Kodak GBX developer and fixer
    Glacial acetic acid and water stop bath
    Heico Archival Speed Perma Wash
20. For a complete study of Japanese paper in Whistler prints see A. Dwan. 1993. A Method for examining and classifying Japanese paper used by artists in the late nineteenth century: The Prints of James Abbott McNeill Whistler. *Studies in the History of Art* 41, *Conservation Research*. Washington: National Gallery of Art.
21. All of the exposures were made using a 50-inch focal distance, 250 kV, 10 mA, wide focus for 5 minutes while a vacuum was pulled on the envelope package. The following guidelines are recommended in order to record watermarks and structure of paper: The x-rays used should be at least 250 kV, with a filter at the tube port of about 6–8 mm. Copper is recommended for the tube filter, but for this project a 6 mm lead filter was used with good results. The paper to be radiographed is placed face up on top of the film with the emulsion side of the film face up (Kodak SR film was used), and a lead foil (0.005 inches thick) is placed on top of the paper. Note: the following three watermarks were radiographed by someone other than the author: FGA 05.7, 01.170 and 98.383.
22. The computer imaging was carried out using the following equipment and software:
    Image Technology Methods Corp. CCD camera (model 262)
    JAVA Jandel video analysis software by Jandel Scientific
    Seikosha VP-1500 thermal printer
23. Briquet, C.-M. 1966. *Les filigranes: dictionnaire historique des marques du papier dès leur apparition vers 1282 jusqu'en 1600*. Reprint. New York: Hacker Art Books.
    Churchill, W.A. 1965. *Watermarks in Paper in Holland, England, France, etc. in the XVII and XVIII Centuries and their Interconnection*. Reprint. Amsterdam: Menno Hertzberger and Company.
    Heawood, E. 1969. *Watermarks, Mainly of the 17th and 18th Centuries*. 2d rev. ed. Hilversum: The Paper Publications Society.
    Gravell, T., and G. Miller. 1983. *A Catalogue of Foreign Watermarks Found on Paper used in America, 1700–1835*. New York: Garland Publishing, Inc.
24. Churchill. 1965. 13–18 lists Dutch papermakers, location of mills and dates, including: van Gelder — Schouten & Co., Wormer, 1803; van Gelder — Zonen, Wormer, 1855; Jan van der Ley, Zaandyk, Fortuyn, 1703–1894; van der Ley, Wormer, Wevermill, 1698–1815; Lubertus van Gerrevink, Egmond an der Hoef, Phoenixmill, 1690–1819.
25. In the Venice Sets at the Baltimore Museum of Art (George Lucas Collection) there are three Arms of Amsterdam (RK countermark on one), two Strasbourg Lily (LVG and WR countermarks), six 1814/2, and one bottom of the Hunting Horn, among others. The Fogg Art Museum, Harvard University, has the Hunting Horn on a Venice etching and an 1814/2 on an earlier drypoint (K95), among others. The University of Michigan Museum of Art has a WW on a Venice etching, and on other Whistler prints: Pro Patria (3), IV, Arms of Amsterdam (4), Foolscap, Strasbourg Lily (3), van der Ley, and others.
26. Lochnan. 1988. 273, 300.
27. Nicholson, K. 1982. Making watermarks meaningful: Significant details in recording and identifying watermarks. *Postprints: Book and Paper Group*, American Institute for Conservation of Historic and Artistic Works, Milwaukee, Wisconsin. 117.
28. Churchill. 1965. 28.
29. Heawood. 1969. 26.
30. Churchill. 1965. 18.
31. Hunter, Dard. 1978. *Papermaking, the History and Technique of an Ancient Craft*. Reprint. New York: Dover. 137, 262.
32. Churchill. 1965. 43.
33. Stratis. 1998. 373–74.
34. Hunter. 1978. 136–37.
35. Heawood. 1969. 34.
36. Gravell and Miller. 1983. xiii.
37. Churchill. 1965. 21–22.

Additional references

Bacher, O. 1908. *With Whistler in Venice*. New York: The Century Company.

Lochnan, K. 1984. *The Etchings of James McNeill Whistler*. New Haven and London: Yale University Press.

McNamara, C., and J. Siewert. 1994. *Whistler, Prosaic Views, Poetic Vision: Works on Paper from the University of Michigan Museum of Art*. New York: Thames and Hudson.

Menpes, M. 1904. *Whistler as I Knew Him*. London: Adam and Charles Black.

The Lithographs of James McNeill Whistler: Methods of Identifying Lifetime and Posthumous Impressions

HARRIET K. STRATIS

Abstract

Within a typical edition of any given lithograph, James McNeill Whistler insisted that a variety of papers be used, including an assortment of western laid papers and various Japanese papers. It is unfortunate however, that Whistler did not sign every impression of every lithograph printed during his lifetime, since an extensive posthumous printing was carried out. Inaccurate record-keeping, inconsistent use of a posthumous-collection stamp, and the existence of a great many unsigned lifetime impressions make the task of differentiating posthumous impressions from those printed during the artist's lifetime extremely difficult.

By turning to the evidence provided by the papers themselves, it is possible to categorize and differentiate a number of lifetime papers from posthumous papers. Moreover, it is even possible to identify several papers that were used during Whistler's lifetime and left over in his studio to be made available for the printing of posthumous impressions. A comprehensive study of Whistler's papers, comprising the cataloguing of thousands of impressions and beta radiography of all the watermarks found among a core group of collections, was recently included in the Art Institute of Chicago's newly published catalogue raisonné of the artist's lithographs. Objective criteria were used for the first time to resolve long-standing questions about differentiating between the prints produced posthumously and those produced during Whistler's lifetime. In a systematic manner, this paper reviews the methods and summarizes the findings presented in the catalogue raisonné.

The catalogue raisonné is without a doubt one of the most essential tools of art-historical scholarship. In its most basic form, it functions as a compendium of an artist's work in a given medium. Used as a means to document prints, the catalogue raisonné must also effectively address the paradoxical fact that prints exist as multiples, even though impressions of the same image may vary significantly in appearance. The lithographs of James McNeill Whistler present a perfect case in point, since the artist deliberately sought variation among impressions within a single edition. He achieved this in large part by choosing a variety of papers to print a given image. He also encouraged his printers to vary the inking and use ink that was not intensely black, resulting in airy, evanescent lithographs that closely resemble drawings. For cataloguers of Whistler's 'drawings on stone,' as the artist himself called his lithographs, the task of examination, documentation and accurate compilation of such images is, to say the least, daunting. Moreover, the posthumous printing of a great many stones in 1903 and 1904 further complicates matters, as the character and quality of the posthumous images closely approximate Whistler's own.

With this in mind, a team of scholars was assembled over a decade ago to produce a revised catalogue raisonné of Whistler's lithographs.[1] Art historians asked a simple, but at the time almost incomprehensible question, given the vast number of individual impressions that would have to be examined to answer it: Would it be possible, by turning first to the evidence provided by the papers themselves, to categorize them and then to differentiate the lifetime papers from those used posthumously? Ten years, 3,000 impressions, and nearly 500 beta radiographs later, the answer is, quite simply, yes.[2] By bringing together extensive, object-based, technical examination with iconographic, contextual art historical research, a concise picture of Whistler's lithographic achievement and its chronological development was established. In addition, considerably more is now known about the papers used in the printing of the posthumous editions.

Central to developing methods to answer this long-standing question was the abiding recognition among Whistler scholars that the artist ascribed tremendous aesthetic importance to the papers on which his lithographs were printed. It is unfortunate that Whistler did not sign every impression of every lithograph printed during his lifetime, since an extensive posthumous printing was later produced. Whistler's executrix (and sister-in-law), Rosalind Birnie Philip, commissioned the posthumous printing and hired the printing firm of Frederick Goulding to carry out the work. Birnie Philip's sometimes inaccurate record-keeping, her inconsistent use of a posthumous-collection stamp and the existence of a great many unsigned lifetime impressions make the task of differentiating the posthumous impressions from those printed during the artist's lifetime extremely difficult. Visual evidence contained in various papers, including their watermarks, could, however, be combined with information from primary source material to establish more accurate dates of usage. Among these sources are the correspondence between Whistler and his London printers, Thomas and T.R. Way; the Ways' invoices that provide dates for some of the lifetime printings; and Birnie Philip's own inventory of Goulding's printing of posthumous editions, that records the date on which each stone was printed, the number of impressions pulled and whether the stone was subsequently destroyed or retained.[3]

Whistler spent a great deal of time seeking out fine Japanese papers (fig. 1) and sheets of old handmade western laid papers. When placing orders with the Ways in London, Whistler provided them with his desired sheets. Within a typical edition of approximately 25 impressions, Whistler insisted that an assortment of western laid papers and various Japanese papers be used. While working in France with the printers Henry

Fig. 1 James McNeill Whistler, *Tête-à-Tête in the Garden*, 1894, Mansfield-Whittemore-Crown Collection, Art Institute of Chicago. The lithograph was printed on a fine sheet of thick golden-toned Japanese paper with the pronounced deckle favoured by Whistler.

Fig. 2 James McNeill Whistler, *Gants de Suède*, 1890, Art Institute of Chicago. Detail of the foxing and staining that is so common in many of Whistler's chosen sheets.

Belfond, Alfred Lemercier and Auguste Clot, Whistler placed a similar emphasis on paper, again providing each of his Parisian printers with some of his own choice sheets. Similar, if not identical, papers have on rare occasion been found among the lithographs printed by all three. In one example, a paper used in the fall of 1895 by Lemercier, for a proof of the first version of *The Duet*, has also been identified among impressions of the second version, printed by Way only several weeks later.

The handmade papers chosen by Whistler impart unique visual qualities to the prints because of their warm tones and the patina that they developed as they aged. For Whistler, the flaws, discolouration, staining and foxing that commonly appear in old paper only added to its desirability (fig. 2). The Ways often disagreed and complained bitterly when they felt the condition of Whistler's papers detracted from the lithographs and made them unsuitable for printing. In one instance, upon examining a group of proofs sent to him by T.R. Way in September 1893, Whistler wrote, 'I am delighted with the proofs. ... I don't know what you mean by finding the paper dreadfully stained — I like it.'[4] Anecdotal evidence of this sort is crucial, given that similar patterns of foxing, staining, and grime appear in multiple sheets of the same type of paper, and can be used to identify them as 'lifetime' regardless of whether or not they are watermarked or signed by the artist. Conservation treatment could have significant repercussions, since the present-day conservator may erroneously view as damage the surface dirt, staining and foxing that Whistler found so desirable. It should be kept in mind that even minimal alteration of these sheets may destroy evidence of their original appearance, and hence, their lifetime status.

Whistler shunned most contemporary papers in favour of what he called 'old Dutch' paper for printing his lithographs.[5] Indeed, most of his sheets of western laid paper that were removed from bound volumes and ledger books retain evidence of their origins. Often one, two or three edges of a sheet of paper bear coloured ink or gilding; sewing holes from the binding can be located and measured; inscriptions and pagination unique to a specific book can be identified; and on occasion, two halves of a torn sheet can be reunited (fig. 3). This has often resulted in identification not only of the watermark but also of its adjoining countermark. There are examples in which one of the two separated halves of a sheet was signed by the artist, thus allowing the other to be assumed to be lifetime as well, even though the marks look nothing alike. Papers of eastern origin, although they do not bear watermarks, do have certain characteristics that can, albeit infrequently, provide enough visual evidence to allow categorization of them also. Finally, the presence or absence of Whistler's graphite butterfly monogram and the appearance of Rosalind Birnie Philip's distinctive stamps (square for lifetime and round for posthumous) often help to confirm a given identification (figs. 4, 5). Yet because Whistler did not sign every impression by hand, and Birnie Philip would occasionally apply her stamps incorrectly, these two factors cannot always be relied upon unquestioningly in the absence of other evidence. In

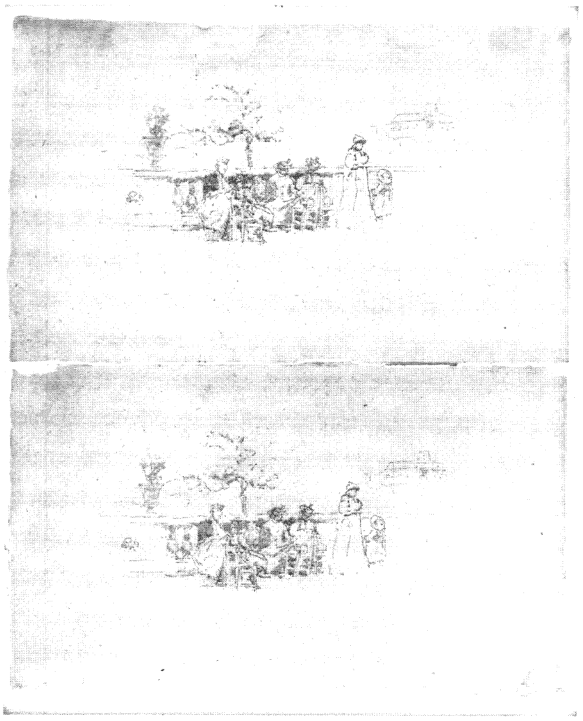


Fig. 3 Two impressions of James McNeill Whistler's *The Terrace, Luxembourg*, 1894, A. Steven Crown Collection and the Estate of Pauline K. Palmer Collection, Art Institute of Chicago. The two halves of a torn sheet used to print these two impressions were reunited, resulting in identification of the watermark (ProPatria MVD) and its adjoining countermark (Crowned GR with crossed branches in a circle). Signed impressions with both marks have been identified.

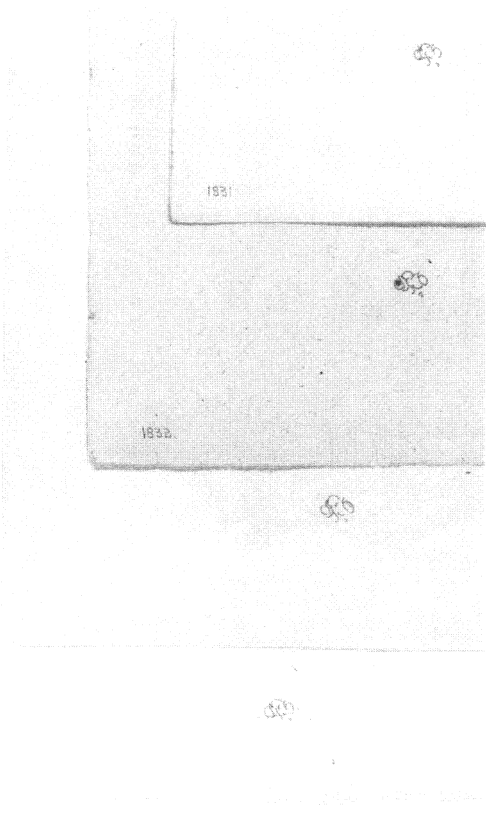


Fig. 4 Whistler's distinctive graphite butterfly monogram appears on numerous examples of his lithographs. However, he did not sign every impression of every lithograph printed.

fact, on rare occasions Birnie Philip herself, upon realizing that she had erroneously applied a 'posthumous' stamp to lifetime impressions, returned to the sheets to correct her error by placing her 'lifetime' stamp adjacent to or over it.

Perhaps because the sheets of old paper that Whistler was able to procure for his printers were so rare, he had a great deal to say about their use. He was extremely concerned with the correct placement of the images on the sheets, and sheet size was chosen or altered to achieve desired spatial effects. Street scenes, for example, were often printed on long, narrow, vertical sheets, well above centre, with the artist's graphite butterfly monogram placed well below centre, so that the expanse of paper between image and signature would suggest a sunny, light-filled foreground. Portraits were often printed on smaller sheets, and in 1894 Whistler was fortunate enough to find for this purpose a large number of sheets of small, nearly square paper in a set of botanicals (fig. 6). Many of these sheets bear a Strasbourg Lily watermark (fig. 7) and display the offset of the botanical illustration from the facing page.[6] As a result, portraits printed on this paper fill the sheets and appear quite intimate.

Whistler summarized the manner in which he envisioned his paper being used for printing in a December 1893 letter to T.R. Way, as follows:

> Now in printing, I think that some of the sheets are perhaps too big — The pretty size is the smaller Dutch — and print always a *little* higher up in the paper than down. … Another little thing to notice is that when

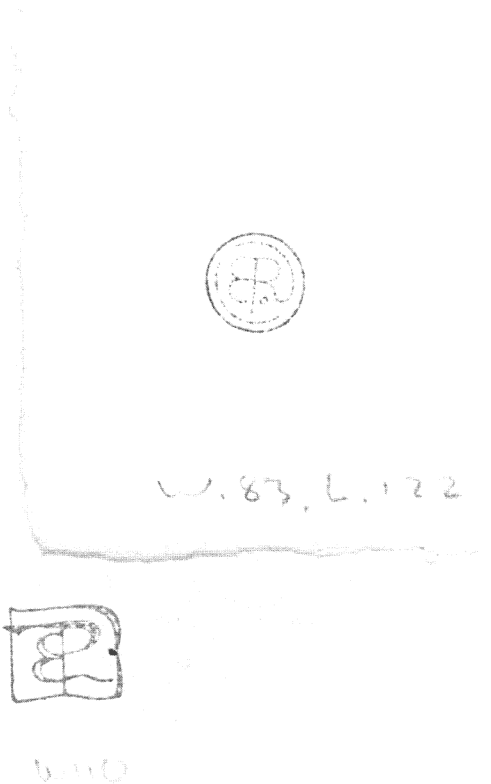


Fig. 5 The stamp with the initials *RBP* in a square is meant to indicate a lifetime impression and the stamp with the initials in a circle denotes a posthumous impression (Lugt 406 and 405 respectively).

> the sheet has a cut edge and a rough one, I would always put the straight cut edge at the top. Also when, as is often the case, there are written figures — numbers — in the corner of the page, tell your printer to be careful to choose the other side of the paper for his impression.[7]

Examination of impression after impression, sheet after sheet, reveals aspects of Whistler's decision-making process regarding the use of paper, and confirms the extent to which his printers respected his advice (fig. 8).

When Whistler died on July 17, 1903, his estate included 103 original stones and 18 transfer drawings. Later that year Rosalind Birnie Philip commissioned Frederick Goulding's firm to print posthumous editions of many of Whistler's lithographs from these stones and transfer drawings. Between October 1903 and May 1904, Goulding pulled impressions from 94 stones and transferred and printed 10 previously untransferred lithographic drawings. The posthumous impressions printed by Goulding, in addition to lacking the artist's signature, do not fully display Whistler's sensitivity to paper type and size, or to image placement. Goulding, by virtue of his collaboration with Birnie Philip, was certainly aware of some of Whistler's preferences. Like Whistler and Way, Goulding varied the papers he used to print a single stone, pulling his proofs on a variety of old and new, laid and wove, western and Japanese papers. He was cognizant of the fact that Whistler favoured old Dutch paper or the finest Japanese sheets he could find. Goulding must have examined the many lithographs inherited by Birnie Philip, and it appears that he too sought old paper that he could remove from bound volumes. Such sheets must have been scarce, since Goulding's impressions are so often printed on older sheets marred by text, or on contemporary papers. This is no wonder, given that Whistler and Way themselves had difficulty finding fine old papers as much as a decade earlier.

While Whistler very deliberately chose papers of a specific size for specific subjects, and placed the images strategically on the paper to achieve desired spatial effects, Goulding did not cut down his large sheets of contemporary paper, and always more or less centered the images on the sheets. As a result, posthumous impressions are often easily recognizable as such by virtue of their large sheet-size and the central placement of the image on the paper. The papers Goulding chose most often are watermarked *D&C Blauw*; they are rather large and have a slight greenish cast. He also printed a great many impressions on large sheets of contemporary papers watermarked *OWP & ACL* or *M/C* with a lion in a shield.[8] All lack the warm tonalities and surface inconsistencies favoured by Whistler, and it is clear that the artist would have considered some of the papers used by Goulding as too stark and devoid of character.

In fact, large quantities of contemporary wove sheets and lesser numbers of contemporary laid sheets, which were used infrequently by Whistler and Way for this very reason, remained in the artist's estate only to be provided to Goulding, who made extensive use of them in his

Fig. 6 James McNeill Whistler, *La Belle Dame Endormie*, 1894, A. Steven Crown Collection, Art Institute of Chicago. Small, square sheets such as this were favoured for the printing of intimate portraits.

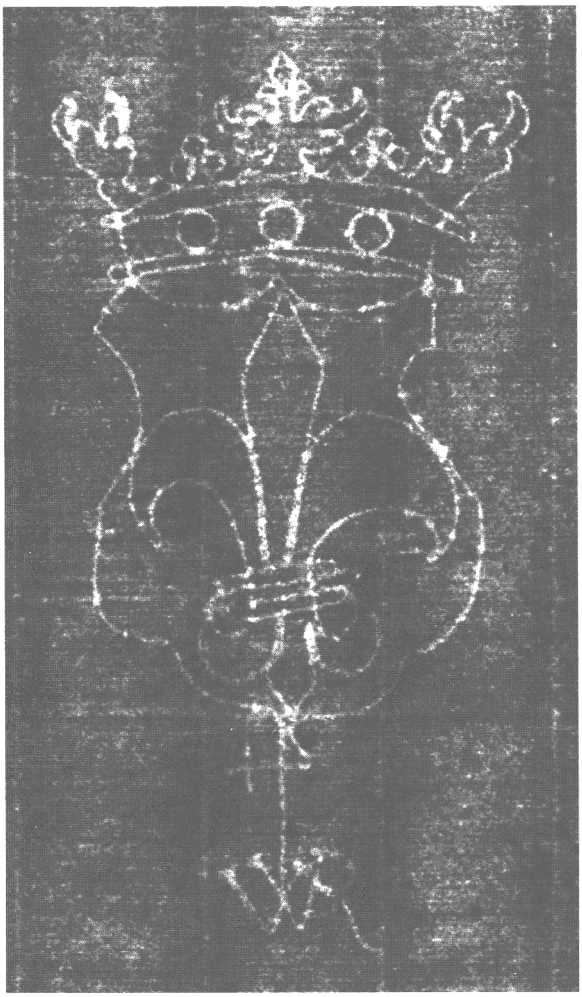


Fig. 7 This Strasbourg Lily watermark (actual size) appears in numerous sheets identical to that used to print *La Belle Dame Endormie* (fig. 6).

posthumous printings. In several instances Goulding even used the same type of paper that had appeared in the lifetime edition of a lithograph to print posthumous impressions of the same lithograph. The leftover papers that have been identified include three rather nondescript wove papers watermarked *R Munn & Co*, *J Simmons*, and *H Smith & Son*. A laid paper set aside by Whistler, only to be used later by Goulding, is watermarked with a tree in an elaborate shield and countermarked *IW* with a flower.[9]

The watermark present in a given sheet of paper does not often provide sufficient evidence in and of itself to make a definitive assessment as to whether a lithograph is lifetime or posthumous. Any number of physical characteristics must be taken into consideration, together with information about the printings derived from archival sources. In the earliest phases of this study, compilations of the watermarks found in those lithographs printed only during Whistler's lifetime and those printed only posthumously were used as a first means of categorizing the watermarks found among lithographs printed both before and after the artist's death. Similarly, the watermarks found in impressions of early states of multiple-state lithographs could be immediately confirmed as lifetime. This core group of papers and their watermarks were used repeatedly to categorize impressions on the same paper that either were unsigned or lacked any other evidence to identify them as lifetime or posthumous.

The chronologies of both the lifetime and posthumous printings are a critical component of this study. It is unlikely that a printer would keep small amounts of fine paper to use over a long period of time. Because it was in short supply, it is more likely that as paper was bought, it was used almost immediately for printing. This was certainly the case with Way's printing of Whistler's lithographs over a number of years. Correspondence between the two men reveals how desperate Way became when he lacked the good-quality papers Whistler insisted upon. During the late summer of 1894, T.R. Way wrote to the artist:

> I hope you will like [the proofs] but what you will think of the mixture of papers I dont [sic] know! ... How much harder our lot, when you reject our paper and supply us 13 dutch and 8 Japaneese [sic] sheets to print 4 proofs and 42 impressions!!! I have mixed up all sorts of old rejected stuff to spin out enough, and now have *nothing at all left*.[10]

Amounts were certainly limited, and sheets of identical or nearly identical paper removed from a book and used by Way at one point in time are not likely to be found years or even months later, the supply having been quickly exhausted. In contrast, during the eight months in which Goulding printed his posthumous editions, he followed a different chronology, printing lithographs that were originally printed years apart on sheets of paper that he removed from the same book or took from the same stack of loose sheets. For example, *The Marketplace*, *Vitré* and *Fifth of November* were posthumously printed by Goulding on the same type of paper on 3 May and 13 April 1904 respectively, while Way's printings of them on decidedly different papers occurred in the summer of 1893 and the fall of 1895.

Fig. 8 James McNeill Whistler, *Study: Maude Seated*, 1878, Art Institute of Chicago. The irregularly cut edge of this sheet was deliberately placed at the bottom of the image. Whistler preferred that straight cut edges be oriented at the top.

Within the well-established genre of the catalogue raisonné, the presentation of paper evidence and the conclusions drawn from it must be seamlessly integrated with art-historical fact. Each catalogue entry in Volume 1 of *The Lithographs of James McNeill Whistler* includes a series of watermark and posthumous watermark numbers that brings the reader to a compilation of the watermarks, reproduced at actual size and grouped alphabetically by type in Volume 2. Numbered captions that correspond to each visual image are intended to provide accurate descriptions of the visual characteristics of the papers. First and foremost, it is stated whether a watermark is lifetime or posthumous, with evidence for making this determination immediately following. It was important to convey the original appearance and function of the papers, so sheets are often described as being removed from books or as loose sheets, with approximations of their full sheet-sizes given as necessary.[11] Idiosyncratic physical characteristics are also described. For example, a number of lifetime impressions of *Little London Model* were printed on papers with an elaborate blind stamp that the printer curiously placed right over the model's head in several impressions.[12]

This comprehensive study has resolved a number of long-standing questions regarding the lifetime and posthumous printings of Whistler's lithographs. The present work is not a complete census of all existing life-

time impressions. As art historians, print connoisseurs and paper conservators take up these volumes to catalogue additional examples, more impressions will emerge, with credible signatures or other evidence to establish the paper on which they were printed as lifetime. Whistler gave much thought to the use of paper, and because of his choices we now have a better understanding of his lithographic production. It is likely that he would never have fathomed the depth of evidence that sheets of paper provide.

Acknowledgements

With heartfelt thanks to David W. Kiehl at the Whitney Museum of American Art and Britt Salvesen, Barbara Hinde, Martha Tedeschi and Margo McFarland at the Art Institute of Chicago for their encouragement and participation in this project. Financial support provided by the Andrew W. Mellon Foundation, the International Fine Print Dealers Association and the Print and Drawing Club of the Art Institute of Chicago is also gratefully acknowledged.

Notes

1. Stratis, H.K., and M. Tedeschi, eds. 1998. *The Lithographs of James McNeill Whistler. Vol. 1, A Catalogue Raisonné.* Chicago: Art Institute of Chicago.
   Tedeschi, M., ed. 1998. *The Lithographs of James McNeill Whistler. Vol. 2, Correspondence and Technical Studies.* Chicago: Art Institute of Chicago. See specifically H.K. Stratis, *Whistler's papers: Their appearance, selection, and use.* 298–304; *Watermarks in Whistler's papers: Methods of identifying lifetime and posthumous lithographs.* 305–11; *Compilation of watermarks.* 312–433 (with images).
   Excerpts from these volumes are reprinted here with the permission of the Art Institute of Chicago.
2. Impressions in the collections of the Art Institute of Chicago; the Hunterian Art Gallery, University of Glasgow; the British Museum and the Victoria and Albert Museum in London; and the Freer Gallery, Library of Congress and National Gallery in Washington, D.C., were comprehensively catalogued. This was augmented with the cataloguing of watermarks found in the collections of 11 additional public institutions. Over 170 lithographs were brought to Chicago from the Hunterian Art Gallery for comprehensive study, radiography and direct comparison with Chicago's holdings.
3. Tedeschi. 1998. 32–195 for the Whistler-Way correspondence; 434–37 for a chronology of the posthumous printing.
4. Tedeschi. 1998. 62–63. Letter 45, 20 September 1893.
5. One particular type of contemporary paper does appear quite often. It is a Van Gelder Zonen paper countermarked as such with a fortune figure watermark. Sheets were usually cut into quarters or smaller for printing. The paper was used extensively for a printing carried out in 1895–96 in preparation for an exhibition at the Fine Arts Society. See Tedeschi. 1998. 323, 370, no. 151; 335, 427, nos. 309, 310.
6. Tedeschi. 1998. 334, 422, nos. 296, 297.
7. Tedeschi. 1998. 82–83. Letter 69, 11 December 1893.
8. Tedeschi. 1998. 316, 353–55, nos. 50–56; 328–29, 393, nos. 219–21; 328, 391, no. 211.
9. Tedeschi. 1998. 316, 353–55, nos. 50–56; 328–29, 393, nos. 219–21; 328, 391, no. 211.
10. Tedeschi. 1998. 108. Letter 102, 11 August 1894.
11. Sheets were usually cut into halves and quarters, and occasionally into sixths and eighths. Half sheets removed from books were often torn in half again.
12. Tedeschi. 1998. 317, 356, no. 63.

Contemporary Artists' Papers: An Overview of Works at the National Gallery of Canada

ANNE F. MAHEUX

Abstract

The increasing occurrence, over the last couple of decades, of paper as the support of choice among contemporary artists can be attributed to aesthetic changes in contemporary art as well as, perhaps, to more obvious and basic concerns such as ease of storage and cost. While artists continue to draw on paper to work out concepts and produce preliminary studies, works on paper have also taken on a more public role, marked especially by their ever-increasing size. Whether seeking to confront or envelop the spectator in a public context, or to evoke an aura of fragility and vulnerability which reflects the changing and sometimes ephemeral nature of the artistic process, artists have employed a diverse and extensive array of papers.

This essay provides an overview of the types of paper supports found within the contemporary art collection at the National Gallery of Canada. Issues of preservation, mounting, presentation and storage are discussed. The conservator must work with both curator and artist to ensure that the intentions of the artist are appropriately presented and preserved, without distortion. Examples demonstrate the conservation challenges.

Introduction

A contemporary renaissance of drawing has contributed to the evidence that paper is increasingly the support of choice among contemporary artists. The great interest in the medium of drawing that artists have shown recently comes not only as a result of the renewed preoccupation with representation, but is also a sign of a focus on the subjective — a reaction perhaps against the intellectual orientation of much contemporary art.[1] While drawings still serve as studies and may still be seen as the works that best convey that sense of intimacy and immediacy inherent in the artist's touch, they have also taken on a much more public role. Drawing is, above all, where the idea is worked out, where traces of the intellectual process remain visible, and is valued as such in a contemporary aesthetic. The large public scale assumed by some contemporary works of art on paper may have opposing effects, on one hand serving to challenge or envelop the spectator, while on the other serving to impart a sense of fragility and vulnerability (fig. 1).

Contemporary artists have employed a diverse and extensive array of papers, more often than not choosing their supports with some deliberation. A survey of works of art on paper in the contemporary art collection of the National Gallery of Canada illustrates that these objects represent a broad range of type and intent, from preparatory sketches which provide insight into the creative process concealed behind finished works of art, to supports for conventional techniques, to components within installations and elements of more unorthodox object-making.

History of contemporary art at the National Gallery of Canada

The National Gallery of Canada has been committed to the collecting of contemporary art since its inception. On 6 March 1880, the first exhibition of the Canadian Academy of Arts (later the Royal Canadian Academy of Arts), was opened in Ottawa at the Clarendon Hotel by

Fig. 1 John Scott, *100 Workers*, photo-serigraph, oil paint, and text on rag board. Acc. no. 39258.1–100. National Gallery of Canada, Ottawa. Gift of the artist, Toronto, 1997.

the Governor General of Canada, the Marquis of Lorne. Most of the paintings and sculptures in the exhibition were the work of contemporary Canadian artists; they included diploma works that were gifts to the nation from newly appointed academicians. These diploma works formed the nucleus of the National Gallery's collection. They marked an early commitment, maintained to this day, to feature the work of living Canadian artists in the gallery's exhibitions and in the collections that grew from them.

The gallery continued to collect Canadian art of the period largely through the purchase of paintings and sculptures, but also of prints and drawings from exhibitions in Toronto and Montreal. This acquisition of contemporary Canadian art laid the foundation of what would become today's collection of historical Canadian art.

In 1966, under the directorship of Dr. Jean Sutherland Boggs, the curatorial staff at the gallery underwent a major reorganization and expansion in order to meet a perceived need to intensify and develop the collections. Dr. Boggs created specialized areas of collecting which included, for the first time, Canadian contemporary and non-Canadian contemporary art. A notable outcome of the reorganization was the adoption of a policy to collect American contemporary art. In fact, this policy complemented earlier commitments to purchase avant-garde art in both Canada and abroad and was, in that sense, in line with the gallery's earliest traditions.

The National Museums Act of 1990 empowers the National Gallery of Canada both to continue its collecting traditions and to encourage a deeper appreciation of the visual arts throughout Canada. Embracing both historical and contemporary art, the mandate recognizes the gallery's roots in the past and its role in the visual arts today.

In the contemporary area, as in others, works of art on paper are essential to complement and enhance purchases of paintings, sculptures and other works in a variety of new media, and they have increasingly gained importance as autonomous objects.

Scope and nature of the contemporary art collection

Contemporary art at the National Gallery of Canada is, for purposes of acquisition, defined as art executed from after 1970 to the present. In recent years, the emphasis has been on buying work of the moment by Canadian artists. The corporate plan states:

> It is essential for the integrity of the Canadian collection to continue this practice. In fulfilling its national role, the National Gallery has a primary responsibility, to the public and to the artists themselves, to acquire and exhibit contemporary Canadian art; and, once it has acquired them, to maintain these works as part of the permanent collection.[2]

To date, there are 5,829 works in the contemporary category — that is, created since 1970 — making up 13% of the entire National Gallery collection. Of these, 1,963 are works of art that are executed on paper or that include a paper component, representing 34% of all works in the contemporary category, or approximately 10.5% of the total number of works of art on paper in the collection.

For contemporary Canadian art, the gallery is committed to collecting the work of artists who have achieved a marked degree of artistic and intellectual maturity, while also supporting younger artists who bring new points of view and different systems of artistic thought to their work. The gallery collects outstanding works in all media by significant European and American artists, allowing it to show a range of contemporary activity.

With its limited budget for acquisitions, the gallery remains a minor player in the international arena. However, choice Canadian art continues to be less expensive than international art, and the budget goes accordingly further in this collecting area. Therefore it is not surprising to note that works by contemporary Canadian artists account for 62% of the entire contemporary collection. Of these, works with paper components by contemporary Canadian artists comprise the majority of the collection of contemporary art on paper, at 68%.

Categories of contemporary works on paper

Contemporary works on paper in the National Gallery collection can be broadly assigned to four categories: traditional works such as prints and drawings on relatively standard-size papers; oversize works on paper; works that incorporate paper as an element in an installation or multiple-medium work; and three-dimensional works made with paper in various ways — both conventional and new. A description of the materials used for a work of art is normally supplied by the artist during the acquisition process, and verified by conservators during the mandatory examination that objects are subjected to before approval of the purchase is finalized.

Traditional applications

It is a widespread practice for printmakers to choose good-quality rag papers for print editions, and there are numerous examples in the gallery's contemporary print collection that demonstrate this fact. The predilection for using good-quality paper seems to be the result of the so-called print renaissance that occurred in North America in the late 1950s, when the demand for a greater variety of printing papers, particularly for lithography, raised the consciousness of paper among artists. The Tamarind Lithography Workshop was very active at that time in testing fine papers, and the firm of Andrews/Nelson/Whitehead was instrumental in searching out quality papers for artists.

The most commonly used printing substrates found in the gallery's collection are Arches and BFK Rives mould-made rag papers. The full range of good-quality rag papers also includes, for example, the heavy, handmade Hayle Mill paper selected by Eduardo Paolozzi for his portfolio of 24 etchings entitled *Conditional Probability Machine*.[3] Lithographs by Jim Dine are

printed on Hodgkinson handmade orange wove paper (*Hammers [A Diptych]*),[4] and Harold Klunder favoured a robin's-egg-blue handmade sheet for his lithographs (*Elderslie*).[5] John Scott chose a four-ply rag board for the supports for *100 Workers*,[6] a series of photo-serigraphs with temporarily adhered, changeable texts which chronicles occupation-related deaths of Canadian workers (fig. 1).

Inuit works on paper comprise a large group of works within the contemporary category; they currently number over 500. Most of these are prints executed in co-op printmaking workshops in Canada's North. Printmaking is a fairly recent phenomenon among the Inuit of Canada, beginning in the late 1950s in Cape Dorset and later spreading to other Inuit communities across the Arctic. For the most part, Inuit prints are executed on good-quality papers. Intaglio prints and lithographs are routinely printed on Arches and BFK Rives papers, which are particularly suitable for intaglio because of their good wet strength and their ability to conform to the planar differentials of the printing plate.[7]

Japanese papers are used for Inuit stonecuts, as they provide a soft yet strong surface for the hand rubbing that is required to transfer the image-ink from the stone. As paper conservators know, all Japanese papers are not equal to the pure, strong-fibred sheets that we have come to know and love. The Japanese papers used for early stonecut prints made between the late 1950s and 1970 were executed on papers of mixed quality, doubtless because the printmakers used whatever stock they could quickly acquire. The scarcity of tools and equipment can still be a problem for artists in the Arctic today because of the distance from southern suppliers, shipping complications and other related factors. The early papers contain mixtures of wood pulp and *kōzo*, or Manila, hemp and *kōzo*.[8] The presence of inferior fibres, combined with the particulate iron deposited by the large iron dryers once used in Japan, has contributed to the foxing sometimes observed in these early prints. Then, as now, the major concern for Inuit printmakers was to locate a paper that was suitably white — which must be the most natural colour imaginable for artists from the North — and sufficiently strong to withstand the hand rubbing employed in the printing of stonecuts (fig. 2).[9]

Since the mid-1980s, conscientious suppliers have made more pure Japanese papers available to northern co-ops. *Ise*, a very white *kōzo* with a small amount of wood pulp, and *kizuki kōzo*, or pure *kōzo*, have been used in Cape Dorset in more recent years. These are of as good a quality as seems possible, given the requirement for whiteness.[10]

Japanese papers have been used as supports by contemporary artists, not only for these more traditional printmaking techniques, but also for more innovative printmaking applications. The Canadian artist Yves Gaucher has been incorporating Japanese papers into his complex, layered relief prints for the last 30 years. In early works of 1963, such as *Hommage à Weburn No. 2*,[11] Japanese paper, solidly adhered to Arches paper, forms the substrate of the print. The localized staining

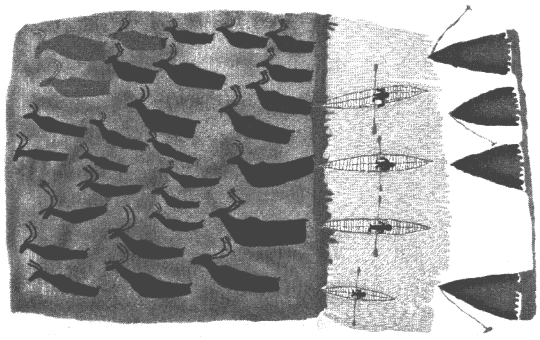


Fig. 2 Luke Anguhadluq, *Hunting Caribou from Kayaks*, colour stonecut and stencil on Japanese paper. Acc. no. 36446. National Gallery of Canada, Ottawa. Gift of the Department of Indian Affairs and Northern Development, 1989.

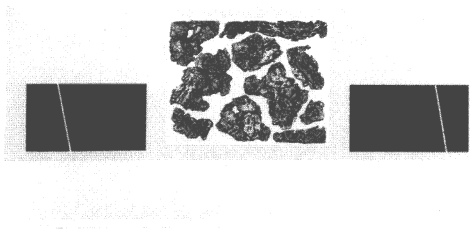


Fig. 3 Yves Gaucher, *Silences*, colour etching and woodcut on Japanese papers, laminated on wove paper. Acc. no. 38192. National Gallery of Canada, Ottawa.

and foxing evident in these supports was likely caused by particulate iron. The artist admits that he used commercial wallpaper paste as an adhesive, sometimes adding salt to retard decomposition of the paste. He recalls seeing small, dark specks in the salt that he now assumes were iron particles which have caused the foxing stains evident in the relief laminates of this period.

Gaucher has continued to experiment with Japanese papers. A recent print entitled *Silences* is a colour etching and woodcut (fig. 3).[12] The etched central portion was printed on Japanese *moriki* paper in three colours, using ten plates; the two-colour woodblock was printed on *goyu* paper. The various components were then positioned on a full sheet of *kai* paper with a horizontal band of *usunezumi* paper, then all of these layers were finally laminated onto a sheet of BFK Rives paper. A thin layer of adhesive was airbrushed onto the verso of the various paper components before final positioning. The elements were pressed into contact with a roller, then the entire piece was passed through an etching press. Gaucher's adhesive of choice is now Rhoplex N-580, a pressure-sensitive acrylic polymer emulsion.

Storage, framing and exhibition of the more traditional types of art on paper are relatively straightforward. When possible, works are matted and stored in Solander boxes. When required for exhibition or loan, works are framed in standard-size beech or birch frames.

Works that enter the collection in frames selected or fabricated by the artist are permanently stored in those frames, after it has been ensured that the works are archivally mounted. Backings and hinging systems are upgraded as necessary. Where an artist has employed poor-quality materials or has constructed an unstable frame, or a work is entering the collection unframed, the artist is consulted so that housing can be designed to meet gallery standards without compromising the intent or appearance of the original.

Compared to the papers associated with printmaking, the supports used for drawings are more varied in size, type and quality. John Scott — despite the previously cited example of photo-serigraphs produced on archival-quality matboard — is more inclined to work with papers of lesser quality. His series of tempera paintings on cheap bond paper seems to demonstrate a disregard on the part of the artist for the supports' inherent fragility; the sheets are severely dented, creased, wrinkled, crumpled and soiled from the regular wear and tear of studio traffic (fig. 4). The condition of the paper is, in fact, an intrinsic part of the work; should the conservator attempt to clean, repair and flatten such a work, something of the artist's intent would be lost. Similarly, several works by Greg Curnoe, composed of bond-paper sheets with typewritten text and collages of drawings, sandwiched between plexiglass by the artist, are in a format which is questionable from a conservation perspective, but which is maintained as the artist intended.

Fig. 4 John Scott, *Horror Files ...*, acrylic and red crayon with collage of gouache on wove paper, on wove paper. Acc. no. 37221. National Gallery of Canada, Ottawa.

Oversize works on paper

Oversize works on paper in the National Gallery contemporary collection are executed on diverse supports. Some artists have appropriated papers of various qualities, which are available in wide rolls and are used principally in the printing, textile and graphic arts industries. Nevertheless, rag and Japanese papers in large formats and in rolls have been used for a surprisingly large proportion of the oversize works in the collection. In the early 1970s, 100% rag matboard and paper in rolls 72 inches wide were manufactured by Buntin Gillies in Canada according to specifications developed by the National Gallery. This Harumi paper, named for scientist Jim Hanlan, conservator Mervyn Ruggles, and curator Mimi Cazort, was favoured by several Canadian artists working in large format at that time. Greg Curnoe was fond of boasting that all of his oversize works on paper of the 1970s and 1980s were executed on Harumi paper. Unfortunately, production of this paper was discontinued sometime in the 1980s.

Large sheets of handmade Japanese paper sometimes figure in the work of Shelagh Keeley since she was artist in residence at a Japanese papermaking studio in Imadate, where the tradition of *washi* is still practised. In two drawings, entitled *Neurologia Tab. XLVII* and *Neurologia Tab. XLVIII*,[13] the paper — which has the look of skin and displays a wonderful responsiveness to the drawing media of wax, pigment, graphite, charcoal and wax crayon — has become an important aesthetic element of the work.

The oversize drawings of Betty Goodwin present a challenge for display, handling and storage. Goodwin's strong printmaking background laid the foundation for her devotion to paper. 'I didn't choose paper, it chose me,' she recently stated, explaining that, after a self-imposed two-year period of working in black-and-white media on paper and other drafting supports, she could never go back to canvas.[14] Her large drawings of swimmers were initially produced in the late 1970s on long, abutted pieces of thin wove rag paper (manufactured by the Akubee Co., New Jersey) and were intended to be tacked to the wall for display. A mounting method developed at the National Gallery provides a hidden hanging system, composed of an extended margin of Hollytex (a non-woven polyester web) applied at the top edge, which retains the immediacy of the original presentation while protecting the drawing from undue manipulation and risk of damage.

Goodwin's serendipitous discovery of translucent drafting materials, as used in *Carbon*,[15] marked the introduction of large mylar (polyester film) substrates into the collection (fig. 5). Products such as Geofilm are not paper, but very durable films of polyethylene terephthalate, coated with quartz in a highly cross-linked binder to achieve a frosted appearance. Goodwin now favours this material above all others for its character — likening it to skin or to the transparency of water — for its receptivity to various media such as graphite, oil stick and tar; and for its resilience to the aggressive working and reworking to which her drawings are subjected. The photomechanical

reproductions that the artist also uses as drawing supports are printed on Cronaflex, which has a mylar base similar to Geofilm and is coated with a silver gelatin emulsion. These mylar films are subject to irreversible dents and creases, and it is therefore strongly recommended that handling and manipulation of the works be minimized. To date, the artist prefers to have the large drawings on Geofilm framed. This minimizes the possibility of damage, but it also presents the challenges of securing storage space and of handling the mammoth crates that must be built to protect the works while in transit.

Cathy Daley's seductive oil-pastel drawings are executed on a substrate commercially known as Vidalon Vellum. This product has the appearance of Geofilm but is in fact a rag paper manufactured by Canson. The natural transparency comes from a proprietary beating process that produces a high-density paper with no chemical additives or coatings.[16] Daley likes the durability of the paper, which allows her to work and rework her drawings with smudging and erasure. The paper is highly reactive to moisture, but the Nupastel drawing medium can be dissolved and diluted with petroleum distillates which do not cause planar deformations in the sheet.[17]

Several oversize works on kraft-type wood-pulp paper, of dimensions that preclude the possibility of framing, are tacked directly to the wall for installation and are rolled for storage. Hinges incorporating tabs of Velcro are sometimes used to avoid repeated piercing of the support. Because the Velcro remains affixed to the work, storage becomes somewhat problematic; the works cannot be rolled onto themselves for fear of planar deformations which would develop as a result of the localized bulk. When dimensions permit, these works are stored flat in custom-made boxes. Otherwise, they are rolled onto Sonotube fibre tubes with slits through which the Velcro hinges pass, thus protecting the work from being rolled over an uneven surface.

Large composite supports in the collection have been assembled using a variety of methods. Roland Poulin works on sheets of Arches paper centrally abutted to create large supports for his charcoal collages. By contrast, the artists Lyne Lapointe and Martha Fleming compose their supports by adjoining smaller sheets. Lapointe favours reviving old materials for her work, regularly making selections from her vast collection of antique papers. She admits awareness — with a certain degree of guilt — of the instability of some of her working methods, but she places strong faith in the ability of conservators to service her works and preserve them for future generations.[18] The large screen *I Have Been Abandoned by the World*,[19] by Lapointe and Fleming, is made up of 24 smaller sheets of Canadian-made Rockland bond paper that have been slightly overlapped, adhered and reinforced at the seams with layers of various poor-quality pressure-sensitive tapes. The paper has been deliberately abraded by sanding to create thin, translucent areas, visible when the screen is installed with a single, dangling light-bulb illuminating the work from behind. When this work was acquired, the tape was removed with the artists' permission and the entire verso was lined with Cerex (a spun-bonded nylon gossamer web) for overall support, resulting in a marked decrease in planar deformations. The result of the treatment was acceptable to the artists. It was also essential for preservation of the work. The screen can now be rolled safely for storage without undue creasing and wrinkling.

Fig. 5 Betty Goodwin, *Carbon*, oil pastel, charcoal, pastel, wax and gouache on translucent Geofilm. Acc. no. 35976. National Gallery of Canada, Ottawa.

Interventions such as these will occasionally exert a positive influence on an artist. The assembly of a recent large drawing by Martha Fleming, entitled *Cardinals*,[20] is a case in point: the artist used non-woven polyester strips and an acrylic emulsion adhesive to join a number of smaller sheets, working with the assistance of National Gallery conservator Richard Gagnier.

Multiple-medium works incorporating paper

There is an increasing number of installation works in the collection that incorporate paper. As already indicated, Fleming and Lapointe often employ paper. For *Miasma/Hyena and the Valve* (fig. 6),[21] old laid sheets were pieced together and adhered directly to plywood supports; three-dimensional elements were secured to the substrate with wires and adhesive. Their *Oriental Bearded Ladies* incorporates an old wove paper as support for a drawing in oil paint which is ornamented by a mounted scorpion specimen in a frame fabricated by the artists.[22]

The handmade wove paper components in Joanne Cardinal-Schubert's work *Preservation of a Species: Shroud — Spill*[23] are arranged into a cross and attached to the wall with nails inserted through metal grommets

which were punched into the top of each sheet for this purpose. PVC strips are attached to the verso of the work with grey duct tape and pressure-sensitive surgical tape. The artist does not wish to have the strips or the tape replaced with more stable materials.

Three-dimensional applications of paper

Paper also takes the form of three-dimensional, and sometimes unorthodox, objects in the collection. There is a limited number of artists' books, including one by Shelagh Keeley entitled *Notes on the Body*,[24] a volume of grey BFK Rives paper with drawings executed in graphite, dry pigment, wax, gouache and ink on transfer prints (fig. 7).

Liz Magor's *Production* is a work of and about paper, rather than being on paper.[25] It is composed of a wall of papier-mâché bricks made from newsprint, which varies in its installation according to the nature of the specific exhibition space, and the pulp-covered mould machine used to fabricate the bricks. The artist is agreeable to the production of new bricks in the event of decay or destruction of the existing bricks.

A final example is Jeannie Thib's delicate piece entitled *Manual 1* (fig. 8).[26] Pairs of gloves were sewn from *kōzo* paper bearing a serigraph inspired by nineteenth-century textile designs, and lightly coated with Danish oil to impart some translucency to the printed paper. Thib is particularly sensitive to issues of permanence and durability and uses good-quality Japanese papers for her projects.[27] This work has been archivally framed by the artist.

Conclusion

A survey of contemporary works on paper in the National Gallery of Canada's collection has revealed that a surprising proportion of the objects executed since 1970 incorporate papers of reasonably good quality. Recent conversations with a number of contemporary artists reveal their increased awareness of the durability of their chosen materials. The decision to use good-quality paper is sometimes informed by economic realities associated with the saleability of fragile art objects, but other factors such as working properties may override such concerns. The use of poor-quality materials or unstable mounting methods may also reflect deliberate choices based on a certain contemporary aesthetic. Moreover, preliminary drawings and sketches have been executed on a wide variety of papers of differing qualities, implying a degree of spontaneity that may or may not preclude the artist's concern for the longevity or future of the drawing. The examples discussed represent only a fraction of the variables encountered when dealing with contemporary works on paper. These variables ensure that the dialogue between artist, conservator and curator will continue to be an essential ingredient in the care of these objects for many years to come.

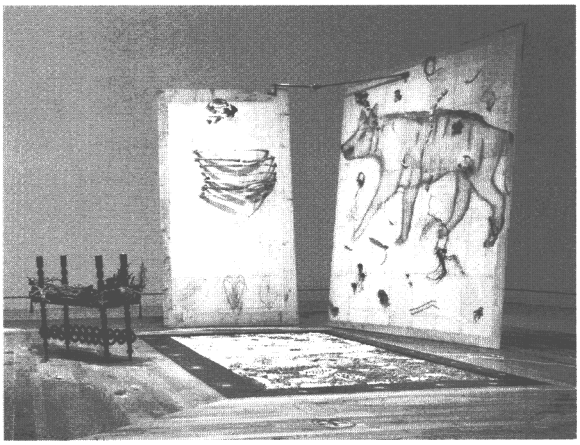


Fig. 6 Martha Fleming and Lyne Lapointe, *Miasma/Hyena and the Valve*, wood, paper, pencil, oil paint, moose bones, organic matter, tree root, glass balls, cushion and cloth. Acc. no. 37378.1–3. National Gallery of Canada, Ottawa.

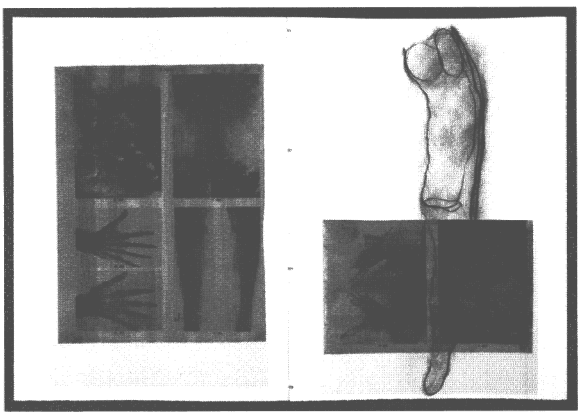


Fig. 7 Shelagh Keeley, *Notes on the Body*, book bound with red paper covers, containing 22 pages of grey wove paper with 36 drawings in gouache, black ink, black wax crayon, dry pigment and wax, with transfer prints. Acc. no. 38521. National Gallery of Canada, Ottawa.

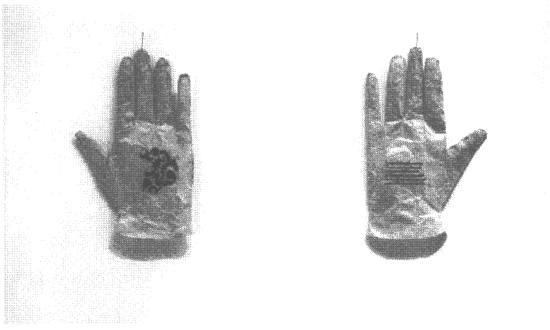


Fig. 8 Jeannie Thib, *Manual 1*, serigraph with thread on oiled and sewn *kōzo* paper. Acc. no. 99.0432.1. National Gallery of Canada, Ottawa.

Acknowledgements

The author would like to thank the following people for their invaluable help in the preparation of this paper: Raven Amiro, Richard Gagnier, Gregory Hill, Charles Hupé, Nancy Jacobi, Daria Keynan, Catherine McGregor, Leslie McKay, Erika Mosier, Linda Sutherland and David Tremain.

Notes

1. Nemiroff, D. 1984. Acquisition justification for Shelagh Keeley, *Fragments of the Wall for Pasolini*. Ottawa: National Gallery of Canada.

2. National Gallery of Canada. 1996. National Gallery of Canada Corporate Plan. 8.
3. NGC acc. no. 17054.1–26.
4. NGC acc. no. 18244.1–2.
5. NGC acc. no. 23758.
6. NGC acc. no. 39258.1–100.
7. Sutherland, L. 1991. *The Printmaking process at Cape Dorset: A technical guide.* In *In Cape Dorset We Do It This Way: Three decades of Inuit printmaking*, J. Blodgett et al. Kleinburg: McMichael Canadian Art Collection. 42.
8. Okawa, A. 1998. Personal communication. Ottawa.
9. Jacobi, N. 1999. Personal communication. Toronto.
10. Jacobi. 1999.
11. NGC acc. no. 37235.
12. NGC acc. no. 38192.
13. *Neurologia Tab. XLVII*: NGC acc. no. 35859. *Neurologia Tab. XLVIII*: NGC acc. no. 35860.
14. Goodwin, B. 1999. Personal communication. Montreal.
15. NGC acc. no. 35976.
16. Doyle, D. 1999. Personal communication and product information. Canson-Talens, Inc., South Hadley, MA.
17. Daley, C. 1999. Personal communication. Toronto.
18. Lapointe, L. 1999. Personal communication. Montreal.
19. NGC acc. no. 30044.1–4.
20. NGC acc. no. 38246.
21. NGC acc. no. 37078.1–3.
22. NGC acc. no. 39727.
23. NGC acc. no. 36130.
24. NGC acc. no. 38520.
25. NGC acc. no. 28453.
26. NGC acc. no. 99.0432.1.
27. Thib, J. 1999. Personal communication. Toronto.

An Introduction to the National Gallery of Art's Paper Sample Collection

JUDITH WALSH AND MARIAN PECK DIRDA

Abstract

In 1991, the Paper Conservation Department of the National Gallery of Art in Washington began a project to collect documented samples of artists' papers. The archive now contains over 2,000 groups of papers. The single sheets, sample booklets, broadside advertisements and bound volumes date primarily from the twentieth century. The samples have been used in designing conservation treatment strategies, as experimental samples for scientific analysis and for authentication of works of art.

Details of the papers' fabrication have been catalogued in a computer database. Information on the maker, date of manufacture, manufacturer's intended use, distributor and watermark are noted. The prototype database on CD-ROM, covering the first 300 items in the collection, with a like number of images of watermarks seen in the sheets, was to be introduced at the conference.

The scope of the collection will be suggested by the presentation of overviews of two groups of items in the archive: a major gift from the Strathmore Paper Company of approximately 900 sample books and related material dating from 1892 to 1992, and ephemera produced by the Japan Paper Company and its successor companies, including Andrews/Nelson/Whitehead, from 1901 to 1986. The histories of these two companies tell much of the story of the distribution and manufacture of paper for artists' use in the U.S. during the twentieth century.

Introduction

In 1991, the Paper Conservation Department of the National Gallery of Art in Washington began collecting documented samples of artists' papers. This paper will describe the scope of the collection, how it was formed, where it is housed, its uses and how the catalogue database of the collection is being made available.

The Paper Sample Collection began in 1991 as a tool to identify the papers in works of art that were being treated or studied in the conservation laboratory. One might, for instance, identify exactly the smooth wove unwatermarked paper in a 1917 Georgia O'Keeffe drawing by comparing it with actual samples of similar papers from the period. The conservators decided that all samples had to be identified by the manufacturer or distributor in order for researchers to draw valid conclusions from them. The scope of the collection would cover any paper that an artist was likely to use. Decorative papers, however, were excluded. In 1992, we requested samples and information from all the papermakers listed in Silvie Turner and Birgit Skiold's book, *Handmade Paper Today*.[1] We subsequently solicited donations from the major manufacturers of mouldmade and machine-made artists' papers in the United States and Europe. The collection also includes Japanese papers and, to a lesser extent, exotic papers from less obvious papermaking countries such as India, Nepal and Mexico. In addition to requesting papers from manufacturers, we have purchased some older samples and received a number of gifts from the estates of artists, from paper distributors and from generous friends. At this time, the collection contains about 2,000 sample booklets, single sheets, bound volumes, broadsides and pieces of ephemera. The material dates primarily from the twentieth century, but our earliest sample is a sketchbook of paper watermarked *Whatman 1830*. Over 90 companies from 30 countries are represented.

The collection is stored in a room near the archives of the National Gallery of Art. The samples are housed in archival envelopes and storage boxes, in flat file drawers or on bookshelves, depending upon their format. The researcher consults the collection through a FileMaker Pro computer database. FileMaker is a strong and flexible program that allows a user to search, list and sort by any combination of fields. The booklets are arranged and requested by sample numbers, which are assigned consecutively when the material is catalogued. An extensive group of books about papermaking and paper history is catalogued separately and stored in the National Gallery of Art library and in the paper conservation office library.

Strathmore sample books

By far the largest number of samples from a single manufacturer comes from the Strathmore Paper Company. Strathmore was founded in 1892 as the Mittineague Paper Company, located in Mittineague, Massachusetts. Strathmore began by making all-cotton Fourdrinier papers for writing and record-keeping. In 1894 and circa 1900 they imported two cylinder-mould machines. Almost immediately, Strathmore established a niche producing papers with interesting colours, textures and finishes for the new field of advertising. All-rag drawing, watercolour and charcoal papers for artists soon followed. Strathmore has been, and still is, the most important American paper company for the manufacture of high-quality artists' papers.

Paper manufacturers prior to the Strathmore Paper Company produced sample books. However, Strathmore took the bold step of using the sample books to demonstrate the possibilities of its unfamiliar products to printers. Horace Moses, the founder of Strathmore, hired the famous designer Will Bradley, of the Wayside Press, to illustrate the creative effects that could be obtained by printing text, photographs and line blocks on the sheets he manufactured. In the same promotional vein, Moses printed testimonials from artists such as Charles Dana Gibson inside the front covers of his artists' swatch sets.

Strathmore's innovation was to use illustrated sample books to instruct and inspire potential users of its papers.

In 1996, Strathmore invited representatives from the National Gallery of Art to gather sample booklets from the company archives housed in the basement of its warehouse in Westfield, Massachusetts. More than 800 items were taken, from every decade from the 1890s to the 1990s. Among the treasures of the collection is a booklet of Photo Mount Paper, dated 1904. This is the paper used by Alfred Stieglitz in *Camera Work*. The collection is so extensive that it is possible to trace the introduction, history and demise of many named varieties of paper. Five examples of the booklet *Strathmore Drawing Papers* (renamed *Strathmore Artists' Papers and Boards*), dating between 1900 and 1912, record the company's name change to Strathmore in 1911, the redesign of the blind-stamped thistle used on artists' papers, the increased importance of illustration boards, and the introduction of Strathmore Detail Drawing paper. The glory days of expressive advertising papers ended with the Depression and World War II, and Strathmore's drawing papers became an important source of income for the company in the postwar recovery. The introduction of pads of a single kind of paper in 1951 was a revolution in art materials. Except for a few imported watercolour blocks, artists' papers had always been sold as single sheets. The new pads appealed to the amateur artist and proved to be a runaway success.

The Paper Sample Collection contains sample books designed for a variety of recipients. Most are relatively simple booklets containing limited information on only one type of paper and were meant to be given away by the thousands to printers and artists. Those destined for paper distributors or major customers are bigger, provide more detailed information about manufacture and use, or compare a wider range of papers. Over three-quarters of the booklets in the Strathmore collection are devoted to high-quality commercial papers for printing pamphlets, advertisements and reports, with the rest devoted to artists' papers. Part of Strathmore's success derived from the synergy between the two types of paper. Graphic designers, having cut their teeth using Strathmore artists' papers in school, tended to specify the familiar brand once they were employed.

Promotional flyers, clippings of advertisements in artists' magazines, sales posters, catalogues, price lists and annual reports also came from Strathmore, and serve to highlight changes in the company's products. Strathmore closed its last rag-cutting room in 1972, and converted the last of its cylinder-mould papers, including Strathmore Charcoal Paper, to Fourdrinier production in the late 1960s and early 1970s. After International Paper purchased Strathmore in 1986, it reformulated the commercial paper lines, to the accompaniment of intense publicity. Interestingly, International Paper's ownership heralded the return of mouldmade papers to Strathmore, when it acquired the Lana Mill in France in the 1990s and then marketed those papers through Strathmore.

Some of the most interesting items in the collection are not sample books at all, but unique objects, such as the leather binder which belonged to Mr Moses. In it are odd assemblages of printed and manuscript materials valued by the president of the company. One of the most interesting is a typed letter from one of his managers, sent from a hotel room in France, describing in detail his observations on the process of making photographic papers at the Rives Mill. Evidence of other practical research includes several test patches of the hard rubber blankets used to emboss paper and the papers so embossed, dandy-roll covers, and test runs of experimental finishes.

Some of the items appeared to be a little obscure at first, but as the large gift was organized and catalogued, connections between objects could be made. For instance, the centenary history published by Strathmore Paper Company contains the comment that at the turn of the century Mr Moses was profoundly disappointed because, although he could make mouldmade paper with four true deckles, he could not make it economically and had to abandon the idea.[2] A sample group of three sheets of paper with true deckles all around were found in the collection. Attached to them is a memo to Mr Moses indicating that these are the samples of four-sided deckle-edge paper made 29 November 1898.

Other manufacturers

The National Gallery's Paper Sample Collection contains examples from other commercial manufacturers of the early twentieth century, such as the Reading Paper Company and the Worthy Paper Company, that attempted to reproduce the colours and textures of fine European papers. At this time we are not actively seeking more samples of modern commercial printing and correspondence papers. We do continue to collect large American manufacturers of student-grade artists' papers, such as the Bee Paper Company and the Bienfang brand of paper in pads manufactured by the Hunt Corporation.

Members of the hand-papermaking revival movement occupy the other extreme of contemporary American papermaking. Papermakers such as John and Kathy Koller of HMP Papers, Sylvie Gosin and Bruce Wineberg of the Dieu Donné Papermill and Howard and Kathryn Clark of Twinrocker Handmade Paper produce beautiful papers in the traditional manner, using the finest materials. They make artists' drawing, watercolour and printmaking papers, and specialize in custom production. Elaine Koretsky of the Carriage House Press and Paper Mill is represented by *Color for the Hand Papermaker*, a manual and boxed set of tinted paper samples. We also have vintage examples of the Aardvark paper dyes that she discusses in her text.

Not least, the collection includes about 25 entries from each of the major traditional European artists' paper mills, such as Canson et Montgolfier, J. Barcham Green, Arches, Fabriano and Whatman. In 1925, Canson and Montgolfier met the challenge posed by the Strathmore Paper Company and produced their own illustrated sample book for the American market. The collection contains several examples of the famous Canson Ingres and Mi-Teintes lines of coloured drawing

papers imported from the 1970s by the Morilla Company, now part of Canson. Hayle Mill / J. Barcham Green is represented by several sample books and by a large group of single sheets of paper dating from the 1940s to the 1980s, all acquired from New York Central Art Supply. Among these are examples of the different runs of Renaissance paper. We have many vintage single sheets of paper made by defunct English mills such as Hodgkinson and Company. Other mills, such as Whatman, that revived their artists' paper lines after a period of dormancy are represented in both incarnations. The archive owns a few examples of papers from the original Arches, Rives and Marais mills (such as an Arches Ingres from *circa* 1911), but most samples date from the second half of the century and were produced after the mills had combined under the Arjomari name. Reflecting the modern trend towards consolidation in the fine paper industry, the most recent additions to the collection come from the multinational giant, Arjo Wiggins Appleton, PLC. For all manufacturers, we have attempted to gather as much supplementary material as possible, such as catalogues, price lists and mill brochures. The historic Fabriano Paper Mill in Italy is particularly well represented by a large collection of Italian-language histories published by the mill.

Several paper mills represented in the collection exist primarily as museums of papermaking, deriving a portion of their income from tourism, which is supplemented by sales of the paper they produce. Examples are Wookey Hole Mill in England, La Papeterie Saint-Gilles in Canada and Moli de Gelida in Spain.

Sample booklets from Japan display both plain and decorative papers. Some materials have been prepared for the American market by regional associations of papermakers, such as the Fukui-ken Japanese Paper Industrial Cooperative. However, some of the most glorious books (donated by Aimée Kligman of the Victoria Paper Company) are annotated entirely in Japanese and are untranslated at this time.

A robust style of paper (both decorative and for fine arts) comes from the Xylem company and Sri Aurobindo Ashram, both in India. Similar papers, made of leaf fibres and bark, are imported by the Victoria Paper Company and originate from Colombia, Costa Rica, Brazil and the Philippines. These papers are produced as the result of initiatives in those countries to revitalize local economies by reintroducing cottage industries using indigenous materials.

The final trend found in twentieth-century paper-sample books is quite new. Since 1994, many small hand-papermakers and giant paper conglomerates have begun to operate Web sites that contain vast amounts of information about their companies and products. The most sophisticated sites, such as those run by Canson (www.canson.fr) and Arjomari-Diffusion (www.arjomari-diffusion.fr), are capable of interactive searches for papers such as '300 g/m^2 rough artists' watercolour' paper. We collect information from these Web sites, but at the same time worry that the virtual sample books will someday replace real, beautiful and tactile swatch books.

Sample books from distributors and retailers

As sample books are essentially commercial tools, both distributors and retailers of paper also produce them. The best of these help foster the market they hope to capture. Some display extravagant printing or give details of the manufacture or furnish, if these are the selling points of the particular product. Art-paper samples tend to be quite straightforward, as the manufacturer cannot predict the range of uses the artist might apply to any given sheet.

The earliest commercial sample book in our collection is dated 1860. *The Varieties and Relative Values of Paper,* by Richard Herring, is a salesman's compendium of sheets offered for export from Britain. It holds numerous large samples and some data on the sheets, but unfortunately does not identify makers. Herring's collection comprises a wide range of paper types, including some of brilliant colour. Bright yellow, bright green and raspberry red sheets are all found among the expected cream, white and pale-coloured samples. Compared to another nineteenth-century sample book, a sketchbook of pastel-coloured Whatman drawing papers dated 1830, the 1860 Herring papers are positively garish. Papermakers must have rushed to use synthetic coal-tar dyes, first produced in 1854, when making these sheets. Artists and book designers, however, were more conservative; they did not use these highly coloured sheets for another 20 to 30 years. In the U.S. the Herring book has become quite rare, no doubt in part because of the historical accident that its use coincided with a paper shortage caused by the American Civil War (1861–65). Examples of paper scavenged from this book can be found in municipal archives throughout the southern United States, having been used to record transfers of property or other civic events.[3]

Japan Paper Company

By far the finest distributor's sample booklets are found among the advertising work done by the Japan Paper Company. Founded in 1901 by Richard Tracy Stevens, the legendary Japan Paper Company survives today as Andrews/Nelson/Whitehead – Crestwood, a division of the Willmann Paper Company. The Japan Paper Company began by importing *Tosa* tissue from Kōchi for use in Elizabeth Arden cosmetics and in the manufacture of tea bags. In 1911 George A. Nelson joined the JPC and focussed on the importation of fine paper for artists' use. Spurred by Horace Moses' success with Strathmore advertising, the JPC created many hundreds of posters, folios, broadsides, sample books and keepsakes printed on their paper stock. By 1930 they were importing hundreds of sheets from over 15 countries.

The Japan Paper Company also took a lead in disseminating information about papermaking itself, motivated both by hope of commercial success and a sincere love of the product. The first of many informative publications was an account of vellum papermaking in Japan. In 1905, Richard Tracy Stevens traveled to Japan for 10 weeks to observe the making of vellum in both the Imperial Mill in Ōji, near Tokyo, and the newer commercial mill at Shizuoka, and to visit traditional papermaking villages in Kōchi and in north-western Japan.

Upon his return, he wrote a monograph, *The Art of Paper Making in Japan*, privately published in 500 copies. Free from the overt racism found in some contemporary travel accounts of Japan, Stevens notes with pleasure the skill of the papermaking men and women and, with some concern, their low wages.[4] Photographs from the trip document the contemporary tension between technology and tradition in papermaking.[5] In contrast to the tradition of farming and papermaking in villages, the big factory mills at Ōji and Shizuoka used modern technology as much as possible to increase production. *Mitsumata* fibre was purchased from farmers and transported to the mill, where it was macerated and washed by hand, the bark picked off by hand, bleached in large iron cauldrons, then washed in man-made pools of running water. Beaten by machine in a row of hollander beaters, the fibre was hand-cast into sheets in a modified factory system in which rank upon rank of vats extended across a huge mill floor. The sheets were dried and polished indoors against metal tanks filled with piped steam. They were then wrapped and trimmed by hand for market.

In about 1910, the Japan Paper Company began to showcase its fine printing and art papers by issuing advertising folios of each sheet as it was added to the line, or as new ideas for advertising came up. The individual folios were gathered in a folder of handsome grey Japanese-paper-covered boards with a vellum spine. Each bore a Japan Paper Company label, either *Hand Made Papers* or *Printing Papers*. The portfolios extant today are numbered and carry folios printed within a period of a few years. Apparently the grey folders were kept separately from the sample sheets, and groups of papers were made up with current folios as needed for presentation. The folios displayed printing on two of the four surfaces so the buyer of paper could see printing, bleed-through and blank paper in each sample. The folios bear numerical codes on the back that run chronologically, perhaps to indicate the printing job number. Some also have indications of the press and designer of the folio.

In 1953, George Nelson, then president of the Stevens-Nelson Paper Company, embarked on a sample-book project that has never been equalled. He published 5,000 copies of *Specimens*, the *non plus ultra* of sample books. Quarter-bound in leather with various decorative paper covers, this book was presented to paper company executives, papermakers, pressmen, fine press libraries and directors of museums. It contains 109 sample sheets, all demonstrating paper use by well-known designers and presses. *Specimens* is often found with a price list of the sheets for 1953. Vera Freeman, who began working at Stevens-Nelson as Mr Nelson's assistant in 1955, remembers well the comments about the huge expense incurred in making *Specimens*, and jokes that another book like that would ruin the company.

Perhaps it was a renewed sense of fiscal responsibility after the cost overruns incurred by the publication of *Specimens* that made single-sheet samples the rule at Stevens-Nelson for the remainder of the 1950s and '60s. In 1962, the company changed its name, to reflect the new reality of ownership and partnership, to Andrews/Nelson/Whitehead. During the 1970s, modest booklets of various types of paper were produced annually by the fine paper group, of which Vera Freeman was then vice-president. These bore simple descriptive titles — *Oriental papers, European Printing, Papers for Conservation* — and did not vary much from year to year. However, taken together, the small booklets chart the expansion of the fine printmaking papers stocked by A/N/W. In 1960, June Wayne, the founder and director of the Tamarind Lithography Workshop, complained to Vera Freeman that she could not buy in the U.S. many of the finest printmaking papers she had found in Europe. Mrs Freeman corrected that. The range of printmaking papers offered by A/N/W grew steadily through the 1960s and '70s as the fine paper division negotiated with the principals of the fine-print renaissance and the owners of mills with whom they had a long relationship. Together the makers, sellers and users of paper developed new products, including mouldmade printing paper in rolls, mouldmade papers in 30 colours and high-quality archival printing papers.[6] Some of these could also be used in the conservation of historic or artistic materials. In fact, the company donated papers for the repair of books damaged by the floods in Florence. Other products were specifically marketed for conservation, including the first coloured archival-quality matboard, introduced in 1976.

In 1982 the *A/N/W Art Paper Catalog* was published. Although this plastic-covered ring binder did not contain actual samples of sheets, it did collect information of interest to artists on the individual papers, including weight, colour, dimensions of the sheets, number of deckles and suggested uses. A short narrative described each sheet, such as this entry for Rives Heavyweight:

> Mouldmade in France, 100% rag. Watermarked.
> The heavy version of Rives: about 50% heavier than Rives Lightweight. Both weights are made exclusively for the U.S., hence the distinguishing 'RIVES' watermark rather than the usual 'Rives BFK.'
> Off-white and very light buff. Acid free.

In 1986, A/N/W's last gorgeous sample book was issued to coincide with Vera Freeman's retirement. Using paper donated by the papermakers, 1,000 copies of *Hand Made Papers* were designed and printed by Henry Morris at the Bird and Bull Press. Recently A/N/W Crestwood has put together *The Sourcebook*, a sample package that displays all the products available from the company. Aimed at designers and advertisers, it displays the attention to design that is the legacy of the Japan Paper Company.

Retailers

In 1994 Edward and Zora Pinney donated their collection of artists' materials to the National Gallery of Art.[7] Since they had run an art supply store in Los Angeles for a number of years and had been active in the National Art Materials Trade Association, their collection comprises most of the paints, brushes, media and varnishes commonly sold in the last quarter of this century. They

also donated many papers sold to artists in the form of pads, blocks, single sheets and sample books. Their in-house sample notebook and handwritten card file was consulted by the staff and patrons of the store for paper selection. Other mail-order retailers have made formal sample books or collections of their stock. Among the most valuable for us have been the sets put together by Falkiner's Fine Paper in London and Daniel Smith in Seattle, since we also have examples of their printed mail-order catalogue. We need to find similar printed and physical paper sample sets for German, French and Italian art supply houses to round out the collection.

Collectible books on books

The last major category of samples in our collection can be classified as 'paper specimen' books. Often grouped with 'Books on Books' in dealers' catalogues, these books are designed for the lover of paper, but not necessarily the purchaser of it. Such collectible publications follow in the tradition of Dard Hunter's *Papermaking Journey to . . .* series, which we do not currently own. These books bring together sample papers of a particular type, with instructive text. One of our most spectacular samples of this type is *Japanese Hand-Made Paper*, by Seikichiro Goto (1958), which was a gift from our paper conservator colleague, Murray Lebwhol. This book contains hand-stencilled two-colour prints of papermaking villages and processes, along with text and samples of the paper produced. It is a wonderful object, in addition to being informative. We hope someday to own the second volume of the set also. Other samples of this type are the tiny books made in the 1970s and '80s by Asao Shimuro and Timothy Barrett, which highlight papermaking in the countries of East Asia. There are also fine-press books published by small presses, such as *English Hand Made Papers Suitable for Bookwork*, by Geoffrey Wakeman (Plough Press, 1972) or *A Collection of Paper Samples from the Hand Papermills of the United States of America*, by Peter and Donna Thomas (Santa Cruz, 1993).

The Paper Sample Collection catalogue

The Paper Sample Collection has been of great use to the staff of the Paper Conservation Department at the National Gallery. We have used it to identify papers used by artists and forgers, to devise treatment strategies, to interpret the artist's intent in changed works of art and to contribute test samples to projects of the Scientific Research Department at the National Gallery of Art. We found the collection to be so valuable for all our work that we became determined to make the collection better known and more readily accessible to our colleagues.

We thought about putting the catalogue of the collection on line along with the National Gallery of Art's library catalogue, but our systems of classification were not as minimally and rigidly defined as those of a well-run library. The gallery's Web site (www.nga.gov) might have provided a home, but our particular hardware could not support the amount of free-text searching we thought imperative to the successful use of the catalogue. Happily, we found that FileMaker Pro RunTime allows us to present the information as a nonchangeable, cross-platform, completely searchable database.

The database is in a developmental state. We have put 296 of our current 2,000 catalogued record groups on the CD beta copy of the database, along with transmitted, light images of watermarks and raking-light images of blind stamps found in those papers. Our *Paper Sample Collection Catalogue* provides completely searchable fields for date and name of the sample, method of manufacture, manufacturer's suggested use for the sheet and watermark images and text. Extensive information on the paper manufacturers and distributors has been entered into the catalogue for use as finding aids. We distributed 100 copies of the *Paper Sample Collection Catalogue* CD at this conference. We hope that those who use the beta version will offer us suggestions for ways that it might be improved. By the spring of 2001, we hope to have more than 500 items available on a CD, in version 1.0, that we will sell through the Conservation Division at the National Gallery. We will update the CD as we get significant numbers of samples into the CD format.

Our *Paper Sample Collection Catalogue* provides a lot more information on each item than a simple listing of titles would provide, but much less information, or pleasure, than one senses when handling a piece of paper. We hope the *Paper Sample Collection Catalogue* will help users answer some simple questions about paper, but also identify the sample record groups that are of the most interest to them. We look forward to accommodating users of the physical samples at the National Gallery in Washington. Please contact us to make an appointment.

Acknowledgements

The authors are pleased to acknowledge the vast amount of technical support rendered by Michael Skalka, Coordinator of Conservation Programs. In spite of a phone that never stopped ringing, he responded kindly each time we asked a question, and he solved some problems before we even knew they existed. The CD could not have been completed without his help.

Notes

1. Turner, S., and B. Skiold. 1983. *Handmade Paper Today*. London: Lund Humphries.
2. Roseman, M. 1992. In *The Strathmore Century, the 100th Anniversary Issue of The Strathmorean*. 6.
3. Harrison Elliott, VP of the Japan Paper Company, was a paper salesman, papermaker and friend of Dard Hunter. He left his paper-history material and memorabilia to the Library of Congress. Within the Harrison Elliott Collection are several bits of security papers showing a herringbone watermark upon which are written property transactions. These bits were retrieved by Elliott from the records of a town in South Carolina. Elliott believed them to be inscribed on papers made during the Civil War. In fact, they are from pages of the Herring sample book.

   John Krill published a biography of Elliott, along with an overview of the Harrison Elliott Collection, in 1978. It contains much information about the collection, and

importantly, a listing of the papers imported by the JPC in 1927. See Krill, J. 1978. Harrison G. Elliott: Creator of handmade paper. *Quarterly Journal of the Library of Congress* 35(1): 4–26.

4. See for example, LaFarge, J. 1897. *An Artist's Letters from Japan*. New York : The Century Company.
5. Some photographs from the trip are now found in the Harrison Elliott Collection at the Library of Congress. I want to thank Holly Kreuger for making these available to us and Andrew Robb for photographing the pictures that pertain to the Japan Paper Company.
6. A/N/W worked with Gemini GEL in 1967 to develop an oversized printing paper for Robert Rauschenberg, and in 1973 facilitated his sojourn at the Richard de Bas Mill in Ambert, France, to create his first paper-pulp pieces.
7. The Modern Materials Collection is housed and catalogued at the National Gallery of Art, Conservation Division, Washington, DC.

From Sketch to Presentation: A Study of Drawing, Tracing and Speciality Papers Used by American Architects

LOIS OLCOTT PRICE

Abstract

Throughout the eighteenth, nineteenth and early twentieth centuries, paper was the universal choice as a support for American architectural drawings, but the nature, manufacture and variety of papers changed radically. This study of papers used by architects traces these changes and the reasons for them, as architects made the transition from general purpose, handmade writing and drawing papers to purpose-designed, machine-made drawing papers, tracing papers and other specialized supports. Part of this story lies in the technological changes that made these new papers possible, but part also lies in the history of the American architectural profession as it evolved from its roots in the building trades into a part of the fine arts fraternity with one foot firmly planted in the world of business. A survey of trade catalogues, architects' manuals, representative drawings and paper samples, as well as the papermaking literature, reveals the full range of options available and how these options changed over time.

Throughout the eighteenth, nineteenth and early twentieth centuries, paper was the universal choice as a support for American architectural drawings, but the style and function of these drawings and their paper supports changed radically. Architectural drawings became increasingly important, moving from simple, utilitarian documents, often worn out or discarded at the completion of a project, to finished renderings hung in public exhibitions and considered necessary to the successful completion of any major building project. The materials and techniques used to create an architectural drawing can tell us much about the role that a drawing was expected to play: a functional image required to execute construction of a building; a seductive rendering designed to woo a client; or a work of art created to enhance an architect's professional position. The purpose of this study is to document the papers available to architects, explore the way they used them and postulate the reasons for their choices.

The English and American architects' and builders' manuals published from the late seventeenth century onwards are key documents in understanding the fabrication of architectural drawings. American trade catalogues, which began to appear in the 1840s, also proved to be key documents. Early manuals and trade catalogues produced during the period of established apprenticeships provide only scattered details about specific materials and techniques, while later manuals and trade catalogues, written after the mid-nineteenth century, provide increasingly detailed information about papers and draughting techniques. When these sources are used in conjunction with the examination of existing drawings and a general knowledge of artists' materials, we can glean a reasonably clear picture of draughting practice and the role of various papers.

In choosing their papers, architects had many of the same concerns as artists, such as the suitability of the paper surface for a given medium. In addition, however, architects highly valued durability in all grades of paper. A brief exploration of their working methods reveals why. Drawings were laid out in pencil, using compasses as necessary. The paper had to secure the point to achieve a smooth curve. Inked lines were then added with a ruling pen, whose nibs were kept sharp to ensure a clean line — sometimes too sharp, resulting in scoring and weakening of the paper. Corrections were made with a scraper or penknife. After corrections, the paper was expected to take inked lines and watercolour without a flaw, even in the corrected areas. Presentation renderings often involved applying multiple layers of ink and watercolour washes, interspersed with rinsing and scrubbing the surface to achieve the most translucent and luminous effects.

Often the finished drawing was duplicated by pricking it through to another sheet, by sharply tracing the lines with an agate stylus and transfer paper, or by exposing it to bright sunlight or arc lamps in a blueprinting process. Following possible exposure at the construction site, if the drawing survived that long, it was rolled in a bundle or folded sharply for storage. In addition to durability, cost was a factor, because architects, particularly after 1860, used paper in quantities that had a financial impact on their practice. Therefore papers were carefully chosen to balance the function, cost and durability required for each phase of the draughting process. Papermakers and designers competed to meet these needs.

In eighteenth-century America, unlike England, the architectural profession did not exist. Drawings were executed, when they were executed at all, by master builders. These drawings, typically composed of thin, uniformly inked ruled lines and simple watercolour washes, were generally done to a small scale and included very little design detail. During the first decades of the nineteenth century, beginning with the arrival of Benjamin Henry Latrobe in 1796, the professional architect began to replace the carpenter-builder. Latrobe was a fully trained English architect who brought with him sophisticated draughting techniques and professional attitudes unfamiliar to American builders. As Latrobe and his students and followers struggled to establish themselves as professionals essential to the design process, drawings became the major expression of their superior knowledge and aesthetic judgement. These attributes and their use of the materials and techniques of artists established them as part of the fine arts rather than the craft community. [1]

Papers of this early period fell into three major categories — writing, printing and wrapping. Writing papers

were strong and well-sized to allow the quill of a pen to glide smoothly over the surface and absorb the ink without spreading or blotting. Since both artists' and builders' drawings were relatively simple exercises in pen and ink, with the occasional ink or watercolour wash, any paper considered appropriate for writing was also used for drawing. Wrapping papers also appear with some frequency, usually in construction drawings of framing plans or roof trusses.

The abbreviated design process evident in builders' drawings was possible because of the nature of eighteenth- and early-nineteenth-century aesthetic assumptions and building practices. A plan, roughly drawn to scale, written specifications and an optional front elevation were often all that were necessary. Construction technology and vernacular design were based on well-understood craft traditions, while the design principles that guided more formal Georgian, Federal and Greek Revival architecture were readily available in published design books and familiar to both client and master builder.

In contrast to these small, modest drawings, trained English architects occasionally appeared in the colonies, where they executed the type of drawings common among their peers. Where the American drawings were executed on writing paper in iron-gall ink with the occasional flat, bright, watercolour wash, the English architects, such as Joseph Horatio Anderson in his designs for Whitehall, used large sheets of drawing paper watermarked *J Whatman*, carbon-based India ink lines and graduated ink washes.[2] The difference that the choice of both ink and paper made in the drawings is clearly evident. Generally, India ink lines and washes are crisp and clear while washes laid in over iron gall ink lines on the more absorbent and uneven writing paper cause feathering and uneven washes.

Drawing papers

The indifferent American attitude toward drawing papers changed in the late eighteenth century when the British began to develop and popularize the watercolour techniques and materials that revolutionized the medium and ultimately elevated watercolours to the status of oil paintings. The technical demands of the new watercolour methods resulted in papers designed specifically for watercolour work.

The need for specialized drawing papers was most successfully addressed by Whatman papers, which soon became the standard among watercolourists and British architects. They quickly discovered that wove papers, originally developed by Whatman, allowed them to lay down uninterrupted washes across a sheet without the pooling and irregular colour deposition that occurred along the laid lines of traditional writing paper. While other mills soon began producing wove papers, Whatman papers retained their pre-eminence because of their exceptional quality and Whatman's development of paper surface texture and sizing techniques that produced papers uniquely suited to watercolour work. The papers could be dampened and stretched on a drawing board, then dampened and dried through repeated campaigns of applying, softening and lifting watercolour washes without damage to the size or paper surface.

By the 1840s, American suppliers of artists' materials had begun to publish catalogues of their wares, providing further insight into the materials available to American architects. In the catalogue of N.D. Cotton of Boston in the 1840s, the paper stock included:

> Whatman drawing paper in sizes demy through antiquarian, including imperial in double thickness and double thickness rough.
>
> American drawing paper — demy, royal, double elephant and imperial.
>
> Also — a large cheap paper, for common outline sketches, 60 inches by 42, and 42 by 30, suitable for machinists, cabinetmakers and other working plans.
>
> London and bristol board, cap through imperial and 2–8 sheets thick.[3]

The American drawing paper is probably a machine-made, cartridge-type paper cut into standard size sheets. This assumption is based on the wholesale conversion of American hand paper mills to machine-made papers during this period and the lack of watermarked American paper among the many architectural drawings examined for this study. The term *cartridge* originally referred to a strong, tough paper used to wrap gunpowder or cartridges. By the early nineteenth century, however, cartridge referred to a type of drawing paper that was strong, with a relatively rough surface, and available in either white or a buff colour. It was clearly considered a drawing paper of lesser quality that architects used for developmental sketches and working drawings.[4]

The 'large cheap paper' probably refers to a lower-quality detail paper of a buff colour that was strong and suitable for working drawings and large-scale details executed in pencil or ink. Unlike the wrapping papers that had once served this function, the surface was better adapted for drawing but not formed or sized to take washes or precise inked lines.

Bristol is a smooth glazed board made by pasting together several layers of fine wove drawing paper, which made it suitable for detailed renderings. It was fabricated by a stationer or paper merchant and embossed with a circular stamp.

In addition to the papers Cotton provided in the 1840s, the catalogue issued by Goupil & Co. of New York in 1857 lists sheets of Whatman's cartridge paper, including imperial size for engineers, and 'Engineers and Architects' Paper,' available in rolls up to 54 inches wide.[5] Both are machine-made papers clearly designed for draughting. This is the first evidence that the market for draughting papers had reached the point that specifically designed special-purpose papers were available. The Whatman paper was probably made at one of the Hollingsworth mills that could legally use the J. Whatman name for either hand- or machine-made papers until 1859.

As the trade catalogues note, less expensive drawing

papers were available, but an examination of the drawings indicates that architects consistently chose expensive handmade drawing papers for much of their surviving work. Of the hundreds of architectural drawings examined during this study, almost all watermarked papers, particularly after 1840, were Whatman papers. This includes even the office copies of architects such as George M. Dexter of Boston (practised 1835 to 1852), who left 11 volumes of approximately 12,000 drawings, almost all on Whatman papers.[6]

This reliance on Whatman papers among American architects is consistent with their vision of themselves as artists. In their struggle to differentiate themselves from builders and establish their professional credentials as the essential element in the design process, the ability to draw and through drawing express their superior aesthetic judgement and knowledge of architectural history and forms was critical. The use of the best-quality artists' materials for these drawings was therefore an expression of their status as artists as well as a means of achieving the best possible results.

Not unexpectedly, architects who wrote for builders and house carpenters pointedly did not recommend the materials of the artist. In *The American House Carpenter*, published in 1844, R.G. Hatfield recommended that for line drawings 'drawing-paper' was not necessary and rather costly. He recommended cartridge paper as almost as good quality as drawing paper. 'If the drawing is to be much used, as working drawings generally are, cartridge paper is much better than the other kind [drawing paper].'[7]

The advice published for builders and architects in *Appleton's Cyclopedia of Drawing* in 1857 probably best represents the choices most commonly made in the decade before the Civil War:

> Whatman's white paper is the quality most usually employed for finished drawings; it will bear wetting and stretching without injury, and when so treated, receives colour readily. For working drawings that are not damp stretched, cartridge paper, of a coarser, harder, and tougher quality, is preferable. It bears the use of india rubber better, receives ink on the original undampened surface more freely, shows a fully better line, and as it does not absorb very rapidly, tinting lies better and more evenly upon it. For delicate small-scale line-drawing, the thick blue paper, such as is used for ledgers, &c., imperial size, answers exceedingly well; but it does not bear damp-stretching without injury, and should be merely pinned or waxed down to the board.[8]

The decades after 1860 saw an extraordinary increase in the types of papers used by architects. Machine-made drawing papers in a variety of weights, textures, colours and costs became widely available; tracing papers and cloths were manufactured in a bewildering array of surface quality, durability, colour and transparency; and inexpensive machine-made detail and manila papers were sold in wide widths by the roll. Before 1860, the function of each of the three major types of paper used by architects — drawing, cartridge and detail — had been clearly defined, and choices had been limited. In the decades after 1860, these functions became blurred as lower-quality drawing papers and better-quality cartridge or detail papers began to be used interchangeably.

While handmade Whatman drawing paper, the workhorse of the pre–Civil War period, continued to be listed in trade catalogues, machine-made papers predominated by 1880. By 1900, Whatman was sometimes the only handmade paper listed in pages of machine-made papers.

In spite of its much higher cost, however, Whatman handmade papers remained the support of choice for full watercolour renderings by leading architects, particularly those executed for design competitions and important presentation drawings. In a letter of 1863 to the firm that supplied his papers, Thomas U. Walter, architect of the Capitol, wrote 'I don't want any paper but *Whatman's*; I have some larger paper of French manufacture, but it is not fit for fine drawings. By fine drawings I mean highly finished drawings — it is the roughness of Whatman's paper that makes it so famous for producing fine architectural effects.'[9]

H. VanBuren Magonigle, an architect known for his renderings, expressed the same opinion in 1922. 'Of all the papers in the world the best for rendering is Whatman's cold-pressed.' According to Magonigle, age would even improve the subtle qualities of a sheet of Whatman paper. 'The older the paper the better dried out and seasoned it is. Some thoughtful persons lay down a few sheets a year as our forebears laid down wine to ripen and mellow.'[10]

The choice for pen-and-ink drawings, common in the later decades of the nineteenth century, was somewhat different. Benjamin Linfoot, in his 1884 publication, *Architectural Picture Making with Pen and Ink*, advises draughters to use cold-pressed Whatman; he then adds, in a rather contradictory manner, that it is a little more laborious and does not provide as much freedom as a smoother surface. He also notes that other draughters used cardboard and very smooth paper for their pen-and-ink work. In this instance, he is referring to hot-pressed papers and Bristol-type boards. [11]

Even Magonigle, however, had to turn to machine-made papers on occasion:

> For very large drawings it is sometimes necessary to use roll papers. Most of them are to be avoided. Whatman makes a good roll paper which lacks the quality of the hand-made sheet paper but has a fairly good surface. Eggshell paper was the best roll paper; it had texture, would stand hard usage and come up smiling to take a wash beautifully. [Most machine made papers are] so non-absorbent that the washes won't dry and you get run-backs and fans . . . the surface is too hard.[12]

Magonigle was probably unaware that Whatman's handmade papers and Whatman's machine-made papers came from two different mills owned and run by differ-

ent individuals. The Springfield Mill, under the management of the Balstons, continued to produce handmade paper with the J Whatman watermark until 1955. The Hollingsworth mills, which discontinued the production of handmade paper sometime between 1848 and 1859, retained the right to use the Turkey Mill mark on all their papers, although they could not include the J Whatman name after 1860.[13] They made a variety of machine-made papers, including Whatman's cartridge paper and Whatman's Imperial Machine Paper, described as 'a cheap and excellent substitute for the Handmade Paper where not so much colouring is required.'[14] Many architects continued to associate the Turkey Mill mark with the Whatman name and hand papermaking, and none of the trade catalogues make any distinction. It is possible that their machine-made paper, which was also available by the sheet, may have been sold and/or purchased as handmade paper.

The other machine-made drawing paper that Magonigle mentions was frequently listed in the trade catalogues. Eggshell refers to a paper with a pebbly surface resembling a coarse eggshell. It is produced by omitting the calendering of the damp paper after the sheet is formed and/or by the use of special felts or embossing rollers in the paper machine. Papers referred to as *antique finish* are very similar, but more finely grained.

By 1880, suppliers of draughting materials marketed papers designed for different draughting functions. They sought to provide a range of different papers that would be identified with their particular brand names, probably in an attempt to create product loyalty in an increasingly competitive market. In 1892, F. Weber & Co. introduced Columbia drawing paper, which it marketed as the successful rival of Whatman papers. It was listed immediately after Whatman papers as available by the sheet, without any indication that it was machine-made. That became evident only when Columbia was also listed among the roll papers as the finest roll paper made.[15] As machine-made rivals of Whatman's, always advertised as 'just as good,' Columbia was joined by Paragon, Peerless, Acme and Jupiter.

Cartridge and German drawing papers occupied a middle ground between first-quality hand- and machine-made drawing papers and detail papers. They continued to be listed in trade catalogues throughout the late nineteenth century and were available in different grades from *superfine*, which could be used as a drawing paper, to *good*, which was more appropriately used as a detail paper. Many of the papers were available in tints, such as buff and grey, for use with pencil or pen-and-ink renderings. By 1900, these medium-grade papers, like the top quality papers, were offered by brand names such as Sovereign, Empire, Janus and Superior. A typical description would read 'A good moderate priced paper for general work. Takes ink and colours well. Has a slightly grained surface.'[16]

Laminated Bristol-type boards became increasingly popular after 1880. Bristol had become a generic term for a board composed of laminated layers of paper; *abraded board* meant that the smooth surface had been adjusted to provide a slight grain. By 1895, laminated illustration boards with a paper face and core of inferior board were available. Weber & Co. listed architects' watercolour and mat boards in three weights and rough or eggshell surface.

Aside from the use of laminated boards, another common and very popular means of providing additional support for all kinds of papers, from Whatman to detail, was to use paper mounted on muslin. Artists' and draughting suppliers routinely offered most of their papers mounted and available in sheets or rolls.

Detail papers

Detail, the least expensive and lowest-quality papers, were used for developmental sketches and working drawings of construction details that were often full-scale and therefore quite large. These drawings were considered temporary, so, while short-term strength was important, long-term durability was not an issue. Most detail papers could not be dampened and stretched, so washes were used sparingly if at all. For large detail drawings, smooth brown manila paper, composed partially of jute, was recommended. It was tough and strong and did not show the dirt, ideal qualities for paper used on construction sites or in the shops of metal workers and other subcontractors. Tinted detail papers in shades of buff, green and pink were designed to reduce eye strain.

As with other types of paper, the 1880s saw the introduction of special-purpose, brand-name detail papers. In 1885, Wadsworth and Howland listed Duplex, a watermarked, better-quality detail paper, hard-sized, 100% rag and tinted so it would not show the dirt. It was soon joined by Simplex, Ajax and many other brand-name detail papers.

Graph, cross-section and profile papers

Although its presence is not noted by the early-nineteenth-century trade catalogues, graph or co-ordinate papers were occasionally used by architects during this period. Thomas Jefferson's drawings provide the first documented use of this paper in the United States, when he used it for drawings of the Virginia Capitol in 1786. He imported his paper from France, where it was produced to assist in draughting tapestries.[17] Architects such as A.J. Davis of New York used graph paper occasionally in the 1850s, but there is little evidence of its widespread use until the last decades of the nineteenth century.

Cross-section paper, composed of a grid of printed squares, was used by architects and engineers to draw buildings and machinery to scale. It was particularly useful for measured drawings and rough sketches.

While profile papers vary, most are composed of a grid of rectangles; they were used to draw a vertical section of the ground along a surveyed line or graded work. Profile papers were used primarily by civil engineers and landscape architects.

Tracing papers

Until the demand for tracing papers increased after 1860, there were limited choices available. As demand

increased, particularly after the introduction of blueprinting in the 1880s, the papermaking industry began to develop new papers that fulfilled the need of architects and engineers for a variety of transparent papers that met different drawing and photo-reproduction requirements.

Early recipes for the manufacture of tracing paper call for the use of oil of turpentine alone or mixed in varying proportions with a drying vegetable oil such as boiled or raw linseed or walnut oil. Banknote and bond papers, the most common supports, are thin, strong papers of well-beaten, compacted fibres that naturally have a moderate degree of transparency. They were used for tracing both plain and prepared with oil.

N.D. Cotton's trade catalogues of the 1840s and 1855 provide information about tracing paper in the first half of the nineteenth century. They listed two types of tracing papers. Finest French Vegetable Tracing paper, available in sizes up to 27 by 41 inches, was used with either ink or pencil. Prepared Tracing paper, available in various unspecified sizes, was suitable only for pencil.

The appearance of tracing papers in American trade catalogues corresponds to their appearance among architects' drawings. Drawings on prepared tracing paper appear in the work of Capt Alexander Hood, a civil engineer and architect who graduated from West Point in 1827, and in the 1849 drawings by Augustus Plintoe for the Washington Monument in Capitol Square in Richmond.[18] Although tracing papers were not heavily used in the decades before 1860, they were probably more prevalent than their occasional presence in scattered collections might suggest. Those that have survived are generally very brittle and discoloured, suggesting that many others may simply have been too fragile to last.

In the decades following the Civil War, the role and use of tracing paper changed and expanded. It began as a utilitarian support onto which drawings could be traced to provide the graphic information necessary for the construction of increasingly complex buildings employing numerous contractors. The 1880s saw the introduction of blueprinting, which was widely adopted by the architectural profession as a substitute for the labour-intensive process of tracing multiple copies of drawings onto tracing paper or cloth. The process required a drawing executed in dense black ink on a translucent support to serve as a master in making the blueprint. To provide this drawing, the image was first laid out on a sheet of medium-quality drawing, cartridge or detail paper whose thickness and density allowed the use of drawing instruments and permitted any necessary erasures. This drawing was then traced in ink onto tracing paper or cloth. The original drawing was often discarded and the inked tracing became the drawing of record for the project.

By the opening decades of the twentieth century, architects turned increasingly to dry media in the execution of both working and presentation drawings, a practice that greatly reduced the time required when compared with the use of ink and watercolour. Tracing papers, as manufacturers developed and refined their properties, offered an ideal surface for dry-media techniques. The diazo photo-reproduction process, introduced in the late 1920s, would reproduce pencil lines on a translucent support and further encouraged the use of dry media on tracing paper.

By this time, tracing papers, available in many grades and types for every purpose, had become the workhorses of most architects' offices. It was not unusual, by 1930, for the preliminary and developmental sketches, the presentation drawings and the working drawings all to be done on different varieties of tracing paper. Typical catalogues listed 15 to 20 varieties in a range of costs, weights, surfaces and degrees of transparency and durability.

Tracing papers used by architects can be divided into three sometimes overlapping categories based on their manufacturing process and properties. By combining various production techniques, manufacturers sought to balance the often conflicting properties of transparency, durability, erasability, dimensional stability, media receptivity and cost.

Papers produced by impregnation are commonly described as oiled, prepared or vellum papers. The basic concept is to fill the voids in a sheet of paper with an oil and/or resin with a refractive index similar to that of cellulose, which will allow more light to pass through the sheet. Until the introduction of acrylic resins in the 1950s, durability remained a problem for prepared papers. As the drying oil oxidized, it formed an increasingly inflexible and discoloured matrix within the paper fibres. Experimentation with various oils reduced these problems, but did not solve them until the use of acrylic resins. This resulted in the paper that architects now call vellum.

Natural, or unprepared, tracing paper was made by beating the pulp for a prolonged period of time. The highly hydrated fibres bonded closely, and the damp sheet was compacted further by the calender rollers at the far end of the papermaking machine. The filling of the pores and elimination of light-reflecting surfaces produced a translucent paper. Many of these papers have survived in good condition.

Aside from their superior transparency, prepared tracing papers usually have fewer visible fibres and exhibit a distinct opacity wherever they have been creased or damaged. Natural tracing papers are less transparent and the fibres and sheet formation are far more evident.

Vegetable parchment or parchment papers were produced by briefly exposing the paper to a strong acid bath, which leached out, swelled and partially dissolved the shorter-chain cellulose molecules. These were deposited in the voids between the fibres when the paper was washed and neutralized, rendering the paper translucent. Parchment paper first appeared in an American trade catalogue in 1879, when its remarkable toughness and transparency were noted.

From the antique laid writing papers of the eighteenth century to the specialized tracing papers of the twentieth, this study records the development and increasing sophistication of both the architectural profession and the paper industry that supplied its needs. The variety of papers used by architects was remarkably broad, although the reasons for their choices remained consis-

tent — a drawing surface appropriate for the media, durability and cost consistent with the function of the drawing in the design and construction process, and a due regard for the architect's professional stature and place in the fine arts community.

Notes

1. Most of the drawings used in this study are from the collections of the Athenaeum of Philadelphia; the Winterthur Library, Winterthur, DE; the architectural archives of the University of Pennsylvania; Girard College, Philadelphia; and the Boston Athenaeum. Many were examined and treated at the Conservation Center for Art and Historic Artifacts, Philadelphia, PA.
2. Collection of the Winterthur Library, Winterthur, DE.
3. Cotton, N.D. [184_]. *N.D. Cotton's Catalogue*. Boston. 7.
4. Krill, J. 1987. *English Artists Paper, Renaissance to Regency*. London: Victoria and Albert Museum.
5. Goupil & Co. 1857. *Catalogue & Price List of Artist Materials*. New York. 58
6. Collection of the Boston Athenaeum.
7. Hatfield, R.G. 1844. *The American House Carpenter*. New York: John Wiley. 2.
8. Worthen, W.E., ed. 1857. *Appleton's Cyclopedia of Drawing*. New York: D. Appleton & Co. 36.
9. Walter, T.U. Dec. 31, 1863. Letter to J.S. Earle. Athenaeum of Philadelphia.
10. Magonigle, H.V. 1922. *Architectural Rendering in Wash*. New York: Charles Scribner's Sons. 4–5.
11. Linfoot, B. 1884. *Architectural Picture Making with Pen and Ink*. Philadelphia: B. Linfoot. 18–19.
12. See Note 10 above.
13. Baker, C.A. 1985. *Audubon's 'Birds of America': A Technical examination and condition survey of the four volume folio set belonging to Syracuse University*. M.A. thesis, University of Syracuse. 32.
14. Goupil & Co. 1857. 58.
    Wipple, M.J. [*c.* 1860]. *Illustrated Catalogue of Artists' Materials*. Boston. 22.
15. F. Weber & Co. 1892. *Illustrated Price List of Artists' Materials and Draughtsmen's Supplies*. Philadelphia. 126.
16. Winsor and Newton. 1871. *Winsor and Newton's List of Watercolours*. London. 24.
    F. Weber & Co. 1895. 7.
    Soltmann, E.G. 1900. *Mammoth Catalogue of Drawing Materials, Architects' and Engineers' Supplies*. New York. 8.
    New York Blue Print Paper Co. 1921. Catalog of the New York Blue Print Paper Co. New York. 34.
17. Collins, P. 1962. The origin of graph paper as an influence on architectural designs. *Journal of the Society of Architectural Historians* 21: 159–62.
18. Collections Winterthur Library, Winterthur, DE (Hood) and Virginia State Library (Plintoe).

Paper Evidence and the Interpretation of the Creative Process in Modern Literary Manuscripts

CLAIRE BUSTARRET

Abstract

How does the material description of modern manuscripts provide evidence for the interpretation of the creative process? Handwritten or typed drafts by modern writers are composed of various kinds of paper supports. Different kinds of paper may be used at various periods and for various purposes by a writer who tends to develop meaningful habits, not only in using the writing surface of paper, but also in folding, cutting or gluing it.

Therefore a codicological description must follow specific guidelines for gathering all the details needed for identification, classification or dating purposes, and beyond that, to permit an interpretation of how an individual writer makes use of paper. A methodology based on the limited observation that can be carried out by a researcher in a library reading room has been tested over the last twenty years in the Institut des textes et manuscrits modernes. Databases of modern watermarked and unmarked papers have been developed and are still being improved to answer the needs of research in genetic criticism. Important results have been obtained from the systematic study of papers in the manuscripts of writers such as Diderot, Stendhal, Heine, Hugo and Roussel, and of artists such as Marcel Duchamp.

The outcome of such case studies is promising inasmuch as codicology and paper history are able to share their results on a wider scale. As the specialist is confronted with the lack of resources available concerning physical descriptions of industrially produced writing papers, research tools such as databases tend to become reference tools, although they are still to be considered as works in progress.

Handwritten or typed drafts by modern writers are composed of various kinds of paper, ranging from large double sheets of watermarked laid paper to small fragments from pocket notepads, standard wove Extra Strong A4 typewriter paper, low-quality cross-ruled school notebooks and so on. Since genetic criticism developed in France as an approach to the study of handwritten drafts in order to explore writers' process of composition, literary scholars have turned to the material analysis of modern manuscripts (from the eighteenth century to the present) with renewed interest.[1] Among other tools enabling us to grasp the complex interaction between the various phases of writing and editing, paper analysis has in fact played a significant role, but one often performed backstage. It is carried out, with minimal means, in a codicological perspective, which means that information obtained from the paper cannot be interpreted separately from other aspects, such as the handwriting, the visual layout or a linguistic analysis of the manuscript.

The common category of writing paper has developed into a wider and wider range of products, undergoing a spectacular growth in the mid-nineteenth century as literacy and education improved. Parallel to the markets of printing and newspapers, stationers invented all kinds of specific types of paper to answer the needs of schools and administrations, as well as private consumers.[2] On the other hand, mechanization itself, followed by the industrial standardization of size and quality, tended to reduce the individual aspects not only of each sheet of paper, but of each kind of paper as well. It seems obvious that such an evolution in papermaking renders the task of identifying papers in recent documents all the more difficult. To the naked eye, handmade, watermarked laid papers used by Diderot are much easier to identify than standard, anonymous A4 sheets found, for instance, in Sartre's archive.

Searching for evidence

Modern codicology must come to terms with both handmade and industrial papers, the latter bearing fewer visible clues of its origin. Unfortunately, little help is to be found in the available sources on the history of recent papermaking, since most of them concentrate on machine improvements and economics rather than describing the products. Considering the variety of material available to a modern writer, and the complexity of the working process — that takes shape on the surface of paper and leaves material evidence in the mass of several hundreds of leaves — what does *looking at paper* mean? One may even wonder whether the information provided by analysis of paper is still useful in dealing with the problems raised by the reconstruction of the writing process in modern literary works, as it has proven to be for the study of historic drawings, engravings, musical drafts and books.

Providing a technical context for the literary artefact

As an object made of paper used for writing, a manuscript bears witness to a hidden part of the poetic accomplishment: It shows the hard work in a material way. When they decide to keep their drafts, writers are aware of their ambiguous testimonial value. Some of them even make a point of enhancing their active and intimate involvement with the material aspect of the creative activity, especially as concerns paper.[3] André Gide writes in his diary on 4 June 1949, 'There are days when it seems that if I only had a good pen, good ink and good paper, I could easily write a masterpiece.' Stendhal simply notes down as a landmark, in a margin of folio 272 in the *Vie de Henry Brulard*, 'March 6, 1836. New paper, bought in Civita Vecchia,' while Hugo turns a similar note into a monument: 'April 29, 1865, I write the last

page of this book on the last leaf of the "Charles 1846" paper. This paper will have started and ended with this book.' Marcel Proust provocatively claimed to be a 'manual worker,' and the amazing aspect of his notebooks, where most pages grow out into as many as four additional scrolls folded on the sides, gives us an idea of what he meant. Another advocate of the pleasure of the craftsmanship of writing, Roland Barthes, also frequently indulged in collage, long before the notion of 'cut and paste' was promoted by electronic text processing. In order to describe such drastic material transformations, it is necessary to look at the object without any prejudice about the process of textual elaboration.

The very notion of a manuscript as a single object — a result of its preservation in a library or museum — often belies the scattered and mobile state of the written material on the writer's desk. Nevertheless, some unexpected characteristics of a specific process may come to light as one takes into account the technical context (including writing material and tools) in which singular gestures of the writer have taken place.

As professional consumers of paper, writers also respond to the growing offerings of the market. In the nineteenth century, for instance, they tended to behave according to two major trends, the first being a consistent, stable consumption, such as that of Flaubert or Zola, who were attached to one or two major kinds of paper and faithful to a small number of well-known papermakers (for example, Blanchet Frères & Kleber, and Lacroix Frères) throughout their lifetimes. Conversely, we also find a more varied consumption, such as is shown by the heterogeneous manuscripts of Balzac or Hugo. All kinds of paper qualities and sizes are tested, adopted for a while, used simultaneously or successively out of some material constraint (for instance, visits abroad or exile), as one indulges in a whim of fashion or casually picks up an envelope lying on a desk to scribble a note.

Different kinds of paper may be used by a writer at various periods or for specific purposes, as the manuscripts of Stendhal illustrate quite clearly. They combine stable options of good-quality paper used in full *in folio* format for his major works (mainly when in Italy on diplomatic service, but also when working with a secretary in Paris) and haphazard sets of laid or wove paper folded or cut into smaller dimensions for short notes and undeveloped drafts. But even such broad categories of behaviour are not so easily outlined, as we shall see in developing some of the cases previously mentioned. A writer is liable to develop meaningful habits as well as to react to incidental events (which may remain for the most part unknown to us), not only in choosing the paper, but in using the writing surface, as well as in folding, cutting or gluing it.

Another element should be taken into account before interpreting any information based on the material aspect of manuscripts: However well ordered, neatly bound and fully documented they may be, the documents we encounter today in library or museum collections are but a partial amount of the total mass of papers actually used by a writer to compose his works. Moreover, their present state may possibly reflect a selective disposition adopted by the author in consideration of the posterity of his or her work, or even a posthumous arrangement resulting from someone else's appreciation of the archive. Such limitations should not halt our investigation, but should remind us that all the clues do not lie in paper analysis alone.

Collecting data on modern manuscripts

Some remarkable research has been undertaken and published in recent years on the use of paper by artists. The material objects first underwent close scrutiny, which led to identifying or dating drawings, watercolours and prints.[4] Now the results of such detailed and systematic analysis have led to further conclusions concerning the choice of paper by artists such as Turner and Rembrandt, and their experimenting on it with various technical devices.[5] In other words, paper can no longer be considered solely as a passive surface receiving the creative work, but as a tool in the creative process. As P. Bower writes about Turner's work, 'The paper is always an integral part of the work ... . It is never merely a ground to carry an image.' Concurrently, in the field of textual studies, material descriptions of manuscripts have been published either as a part of the most thorough scholarly editions of complete works, such as Heine's *Säkularausgabe* (Akademie Verlag, Centre national de la recherche scientifique), or as a separate codicological catalogue of the manuscripts, such as *Der Handschriftliche Nachlass G.W.F. Hegels* from the Staatsbibliothek zu Berlin, presented by E. Ziesche (Harrassowitz Verlag, 1995). In both cases, the search for evidence appears to have been fruitful, yet it remains uncertain how much of such minute and precise data will actually be put to use in the interpretation of the work, especially when the codicologist's propositions happen to question some well-established scholarly interpretations.

As a first step, the limited observation that can be carried out by a researcher in a library reading room may provide enough data to identify the various kinds of paper and list their appearances. As long as we limit ourselves to data accessible to the naked eye, the specific guidelines a codicological description should follow in order to gather all the details needed for identification, classification or dating purposes are quite simple.[6] If the paper was not bought and used as single loose sheets, the kind of object the sheet belonged to originally (such as a notebook or notepad) should be mentioned before describing its physical aspects, and it may be useful to determine whether it was separated from the binding before or after writing.

Besides the description (and reproduction) of watermarks, as well as their position in the sheet, some physical characteristics allowing us to sort out different types of paper should be registered, for example, dimensions (fragment or full sheet, when available, with trimmed or original edges), manufacturing technique (hand or machine) and type of paper (laid or wove), colour, smoothness, rigidity and thickness. For laid paper, the average interval of chain and laid lines should be noted, and when it is printed, the colour and rhythm of ruling

or cross-ruling lines, and the letterhead, if present. Alterations such as folding, cutting, tearing or creasing should also qualify each leaf or fragment individually.

Because of such alterations, modern manuscripts present a number of obstacles to identification and dating. Full sheets are seldom encountered. When cut and folded, wove paper provides less information about the initial format than does laid paper. Often partially hidden by heavy ink erasures, watermarks are not easily accessible on *in quarto* or smaller folios (especially when they are bound). Fragments torn on more than two sides or in irregular shapes do not allow us to determine the original size easily. Yet the cross-checking of the various criteria mentioned above, when entered in a database, allows us to reduce the amount of unidentified paper, and may even suggest hypotheses to gather together some isolated pieces.

Theoretically, on a higher level of investigation, measuring exact thickness, degree of smoothness or colour with more sophisticated instruments or comparing the orientation of fibres by means of optic and laser analysis would facilitate comparison and checking. It would also enable further identification of unmarked wove sheets or smaller fragments, which are very common, for instance, in the manuscripts of Balzac or Stendhal. Practically, such an examination must be undertaken under the responsibility of conservation departments, which are not always open to research projects aimed at literary analysis rather than preservation.[7]

However precise the level of description, the next stage of research consists of comparing the papers found in a single work to other papers used by the same writer or some of his or her contemporaries, with a preference for complete sheets and dated documents. Identifying the papers in the author's letters may prove very useful for dating purposes, in that the same types might appear in some of the undated manuscripts. When Diderot, Montesquieu or Stendhal worked with several secretaries in various places or at different periods, distinction of the paper types gives solid ground upon which to confirm the identification of handwriting. The large number of characteristics and criteria thus used for comparison requires a heavily structured database system. Furthermore, cross-checking results from querying the codicological database with the results of linguistic and stylistic analysis, as well as with available biographical or autobiographical data, often sheds new light on the perception of the creative process.

In order to interpret properly some of the information which comes out of the codicological description, another stage of the work involves research in historical sources. Concerning recent history, it is not always easy to find information about the papermakers whose names are found in the watermarks or to trace back some technical characteristics in the hope that this might help localize or date a type of paper. Since existing watermark databases must improve before they become available on the Internet, we must still rely, most of the time, on indirect sources such as commercial or industrial exhibition catalogues.[8] Gathering scattered and often partial data in such a context is time-consuming and often disappointing. Nevertheless, some significant results have been reached through a systematic study of papers in the manuscripts of writers such as Stendhal, Hugo and Roussel, with a relatively low input from the bibliography on paper history. More discoveries are to be expected when consistent documentation on nineteenth- and twentieth-century papers becomes available.

Of course, paper by itself does not hold all of the clues, but looking at it closely may reveal unexpected twists and turns of the creative process, and thus provide decisive milestones to find one's way in the written labyrinth of the drafts. The fact that a piece of paper may have been used by the writer on more than one occasion, as shown by differences in inks and writing tools, or by the shape of the handwriting itself, makes it, in most cases, irrelevant to attempt a linear, sequential ordering of the sheets. Scholars in genetic criticism establish virtual sequences based on the results of the codicological analysis correlating the various stages of the work in progress. They are often more attached to the relative chronology than to dating, strictly speaking. Needless to say, in order to visualize such a multifarious and dynamic process, that takes into account several hundred pages (in the case of Flaubert, Joyce or Celine, for instance), scholars find tremendous help in the non-linear and multi-dimensional links offered by hypertext tools.[9]

Bearing in mind the limits of such an investigation, the question one pursues in systematic research on the paper found in literary manuscripts should not be merely *which* kind of paper was used — which leads to an identification process based mainly on data related to the history of paper production — or even *when* was it used — a question which requires cross-checking historical data about production and biographical data concerning the writer, and a comparison of as many autograph documents as possible — but also *how* was it used — a question which opens up a wider perspective on the history of writing in its material and cultural dimensions, even if it means an even more cautious or skeptical approach to what historians would call material evidence.

Case studies

Dating and chronology based on paper evidence

Following in Briquet's footsteps, art historians, bibliographers and philologists have often focussed their interest in paper on watermarks. Yet, as Jean Irigoin underscored,[10] dating a single item or a group of works with the help of watermarked papers implies a much wider knowledge of the history of paper than is provided by a glance at the major watermark catalogues available. His point is even more convincing when applied to modern documents, considering the small proportion of nineteenth- and twentieth-century watermarks in the published catalogues. Moreover, as suggested earlier, the lack of documentation is not the only obstacle; the supposedly unique shape of the handmade watermark on the mould used to produce paper sheet by sheet has little to do with the stereotyped metal cast fixed on the dandy-roll, whose imprint is repeated at regular intervals on the surface of the endless

reel of machine-made paper.[11] The latter is not always strictly connected to a single type of paper or even to a particular papermaker. Hence the difficulty in getting any useful information from such standard watermarks as the famous *J Whatman* found in a great number of wove sheets under the quill of Balzac in the 1830s, for instance. To what degree is variation in dimensions or position of the mark significant?

Nevertheless, in cases where the mark does bear either the name of a mill or several names (or initials) of associated partners, referring to a papermaking company whose official existence can be precisely determined, identifying the paper's watermark can still provide at least a *terminus a quo* by which to date a work. Among the ink drawings of Victor Hugo, some happen to be completely abstract, depriving art historians of any thematic or stylistic landmark. This fact entails two opposite interpretations. Some experts date them as part of the earliest graphic experiments carried out by the poet, others, on the contrary, as a freehand caprice by a mature artist. Fortunately, one of the wash drawings bears the watermark *DAMBRICOURT FRERES/Hallines*. After exploring a large sample of early and late Hugo manuscripts, we found that it appeared only in later works, such as *La Légende des siècles* (1875–78). This did not come as a surprise, considering the style of the watermark as well as other technical aspects of the paper. Further enquiry gave us the exact location and dates of activity of the mill, confirming the hypothesis of a late date, after 1875.[12]

When a watermark includes a date of manufacture, the problem of dating seems quite easily solved. Paper historians have even determined an average delay between date of manufacture and date of use, although such a delay is bound to undergo important variations according to historical and geographical circumstances.[13] One must also take into account a greater degree of freedom among private users compared to the normal professional (publishers, secretaries) and administrative consumption of paper, which is bound to lead to a quick turnover of stock. Furthermore, a number of examples bring to our attention the deliberate choice of writers or painters to buy old paper or to keep it in a drawer for a long period of time. A note in Victor Hugo's diary gives us some details about the paper he calls 'Charles 1846' (whereas the watermark actually reads *C. Harris/1846*), which he bought in January 1864 during his exile in Guernsey.[14] This information is valuable, considering his note at the opening of the manuscript of *Les Travailleurs de la mer*: 'June 4, 1864. I start using today this Charles 1846 paper which Bichard sold me as unalterable,' as well as the final remark quoted earlier. In this case, it would obviously be a mistake to question the autograph date of the manuscript (although they are often misleading in Hugo's manuscripts) in favour of the watermark evidence.

In most cases literary scholars are not so much confronted with a problem of dating as they are concerned with establishing a relative chronology, enabling them to situate one folio before or after another. For this purpose the connection between the paper used for drafts and for letters may provide a precise chronological reference. Such a connection is most effective with writers of the eighteenth century, who did not have at their disposal a specific kind of paper for letters, as would be the case in the next century. In a thorough study of Diderot's papers, M. Bockelkamp was able to assign to each kind of paper found in the manuscripts a limited span of time, according to the kinds identified in the philosopher's almost lifelong daily correspondence with Sophie Volland.[15] Some undated autograph pages among the late copies of his manuscripts ordered by Catherine II, and now in the Russian National Archives, could be approximately dated thanks to this chronological classification of paper.

Similar research has been undertaken recently on the notes, for the most part undated, of Marcel Duchamp. This corpus combines half French and half American papers now in major museums and collections on both sides of the Atlantic. Here the question of dating each fragment becomes crucial, since the artist kept coming back to some specific projects periodically after as many as 10 or 20 years. Yet the methodology adopted for Diderot's papers proves to be less effective for several reasons depending on both the history of papermaking and the individual means of use by the artist. On the one hand, industrially produced paper does not bear as many clues about its origins as does handmade paper. In particular, watermarks in the twentieth century are less frequent and less informative, and many types of paper have become standard products, available in a great number of slightly different versions, such as the famous American yellow legal-pad paper.[16]

The systematic comparison of Duchamp's notes with his letters, although it does allow much valuable cross-checking, is less useful in view of the fact that numerous letters are not dated, and many of his notes are scribbled on second-hand materials which are seldom used for letter-writing, such as the margins of a page torn from a telephone book, and the back of a label from a Camembert box.[17] On the other hand, some of these printed papers provide useful clues for dating or localizing the original document, which might give us a *terminus a quo*. This is the case with dated electricity bills, invitations to weddings or exhibit openings and telegram forms printed in Spanish (issued by a Buenos Aires company), as well as with printed letterhead from a hotel in Copenhagen or a transatlantic travel company. Some envelopes of letters addressed to the artist also have dated postal stamps, in instances when they have not been torn into smaller fragments.

As a matter of fact, Duchamp's habit of dividing the page into smaller pieces appears as one of the major obstacles to our investigation. The most frequent treatment of a large sheet of paper would be for him to fold it in two, write on the first, fourth (exterior) and then second and third (interior) pages, and eventually separate the two halves. When the two halves have both been preserved, and if we find them among hundreds of fragments, the irregularly torn side allows us to put them back together as two matching pieces of a jigsaw puzzle. Another frequent manipulation consists in tearing a

single corner out of a fully written page, the smaller piece usually being preserved, whereas the bigger one has been either lost or destroyed, thus depriving the remnant piece of its original (genetic) context.

In other words, it is not by chance that this large collection of scattered fragments continues to resist all attempts at ordering, numbering or classifying. Our hope is that the material analysis may reveal some of the deliberately hidden relationships linking the wandering pictorial or verbal messages, which Duchamp himself published in facsimile in *The Green Box* as loose unbound fragments, so that the reader would make up random combinations as she or he went along. For this reason his notes never became a text *per se*, but remained as a living, unfinished form, perpetually showing its own genesis *in statu nascendi*.

Paper against textual evidence: Deconstructing the manuscript as an object

Taking the object for granted as it is preserved today in a library binding has, in the past, led some philologists astray. A more precise codicological analysis of the material leads to criticism of previous interpretations. This remark does not mean that the classification adopted by the librarian is pointless. As a matter of fact, the purpose of giving access to a 'readable' manuscript often entails a material paradox when the draft has several parallel layers and conflicting versions intertwined on the same sheet of paper. They are materially inseparable although they belong to different phases of the genesis. Yet some early parts of a work, erased and deleted or scattered by later interventions of the author, may well pass unnoticed in the process of ordering a manuscript according to the final and best-known (in most cases, published) version. Even before this ultimate step, we are aware of the risks undergone by the mass of papers as they are handled by family, friends, heirs or collectors before they find material stability. Moreover, working on drafts teaches us how mobile a work in progress can be throughout its career in the writer's hands! Thus there are many reasons to question the object in its present state and to search for safer grounds for interpretation.

Among the recently discovered drafts of Raymond Roussel (1877–1933), the Bibliothèque nationale de France has bound in three volumes some 915 autograph leaves related to the novel *Impressions d'Afrique*.[18] Two volumes gather the chapters of the first and second parts respectively, whereas all the fragments which did not appear in the published version — either because they represent early summary versions of some episodes, or because they had been rejected at some point from later stages of the work — are found in the third volume. At first sight, describing the papers seemed an easy task, since everything was written on the same kind of material; the 915 leaves came from standard school notebooks (approximately 222 × 172 mm) composed of low-quality ruled paper that Roussel apparently used as loose sheets. Closer examination revealed the presence of seven different kinds of laid paper, of which four happened to bear a watermark, and two kinds of wove paper, without watermarks but bearing different ruling, one of them significantly smaller in size than all the others (209 × 166 mm).

Thanks to the earliest numbering of the pages by the writer himself, we have been able to reconstruct several long sequences developing a coherent narrative. Written initially on either one of the two kinds of wove paper, this early version is now scattered throughout the three volumes, since some of the leaves were corrected and kept in a different order in the late version, while others were abandoned and put aside. A number of pages have been cut and glued onto a different kind of paper bearing new developments, yet many of these fragments can be matched, thanks to the irregularly cut edges, allowing the reconstitution of their original state. Unlike the continuity found in the use of the wove papers, the different kinds of laid paper are generally used in short sets of less than 10 leaves, which means they had been inserted later in the genetic process. In most cases, though, the early strata plainly disappeared underneath heavy erasures and additions superimposed on the same page. Starting with 89 disconnected leaves, we ended up restoring five early narrative sequences (comprising 232 written pages in total) whose existence was not previously suspected.

Such a spectacular result is all the more striking since the apparent homogeneity of the material components of the manuscript sustained very low initial expectations. Without the guiding thread of paper analysis, the likelihood of a philological study finding coherence among so many scattered fragments was rather limited. In fact, the cohesion of the last version, set forth by the final organization of the volumes, hid its own genetic background from the eye of the reader. To discover it, one had to give up reading entirely in order to just *look* at the paper. A similar method was applied to the manuscripts of Stendhal's last novel, *Lamiel*, which was left unfinished at his death. In this case, a long series of posthumous publications has attempted to organize the various components of the archive as a whole to make it accessible to reading. But the editors found themselves compelled to argue that only the author's deteriorating health could explain the great number of mistakes, gaps and discrepancies in the narrative, such as constant alterations of the main characters' names.

In his genetic approach to the problem, Serge Linkès followed the methodology which proved successful with Roussel's drafts, and started with the description of the paper.[19] Using a database to cross-check the codicological data with the information about the handwriting, the places of work and the dates of Stendhal's travels between Italy and France at the end of his life, he discovered that the chronology generally accepted was not compatible with the material composition of the manuscript, especially concerning the genesis of the very first period of the work.

To make a complex story short, after jotting down a sketchy program of action and characters in Paris in May 1839, the writer is supposed to have developed a first draft of 71 pages while he was back in Civita Vecchia at the

beginning of October, followed by 87 more pages at the end of November. He would have resumed work on *Lamiel*'s first chapter during his stay in Rome at the beginning of January 1840, completing the October version up to some 112 pages as he dictated it to a secretary. He would have started correcting this new version in early February and then continued working sporadically on the second chapter for two years, until a few days before his death, in Paris. From several remarks in his letters, we learn that he praised highly the capacity of his secretary in Paris, named Bonavie, and was not so satisfied with the one he found in Rome (apparently no one was available to work in French in Civita Vecchia). Although this second secretary remains anonymous, Stendhal refers to him in the marginalia of *Lamiel* by means of an ugly crow's head, probably a pun on the man's name.

The correlation between the types of paper and the identification of the handwriting gives a quite different picture of the beginning of the work. According to Linkès, the 80 pages which were obviously dictated to the French secretary, Bonavie, on French paper (a wove paper marked by an embossed stamp with the name *Chambellan, Paris,* probably provided by Bonavie's agency) must date from Stendhal's stay in Paris (May 1839), shortly following the autograph sketch. In October, back in his office in Civita Vecchia, the consul starts rewriting the first pages of the novel on a different wove paper, then gives up on the autograph copy to work directly on Bonavie's copy. Once the correction is finished, since he does not have a secretary in Civita Vecchia, Stendhal goes on, writing a few pages in his own hand, apparently without much conviction. It is only when he goes to Rome in January that he is able to develop a new version, amplifying the first Parisian version he reviewed during the fall as he dictates to the Roman secretary. This amplified second version (112 pages) is written in 'the Crow's' hand on Italian wove paper bearing the watermark *Feliciano Innamorati.*

The most important point in this new perception of the chronology is that the short, autograph version of the beginning of the novel is *not a first draft* but an aborted new version written in Italy. Thus the earliest narrative development is done orally, dictating to Bonavie, and precedes the writer's autograph tentative revision. This working scheme apparently contradicts most critics' preconceptions, since none of them tried to question the model of the autograph first draft followed by a neat copy in a secretary's hand. This new chronology, established on codicological grounds, solves most of the incongruencies and inner contradictions between the successive versions. It also shows that Stendhal obviously lacks energy to write in his own hand, but that his sickness does not prevent him from mentally composing some 80 pages in a few days, and that he actually keeps control over the narrative transformations of his novel through a year of interrupted work in various locations. Linkès' approach also demonstrates that a long-lasting biographical legend may obscure material evidence for several generations before a newcomer simply endeavours to *look at the paper.*

The Use of paper in the writing process: Beyond evidence?

Although describing the physical characteristics of modern literary manuscripts and searching through the recent history of papermaking to document one's findings offer the codicologist a lifetime pursuit, there is a second motivation for our enquiry which eventually takes us beyond the aims of discovering and gathering evidence. Our purpose in examining manuscripts is not only to help define and understand the writing process by providing factual elements, but also to open up a different approach to the creative phenomenon. The question is not only *which* paper has been used *when* and *by whom* (the major topics for the art historian), or *by whom* and *how* this paper was produced and sold (the main focus for the paper historian), but ultimately, *how* it was used by the artist or writer.

The results of such an investigation give a revealing picture of some material aspects of the work that are seldom commented upon by writers themselves. While they may be tempted to modify their manuscripts' dates or tell tales about the genesis of their works, it would be surprising to see authors intentionally alter physical details of their drafts *a posteriori*, unless they decide to destroy them. It is precisely because they are performed, in most cases, unconsciously that the gestures performed on paper to shape the work materially out of poetic necessity are so unique, and so meaningful. Looking at paper to uncover the meaning of its transformations is a way to approach the creative phenomenon qualitatively, in its dynamic singularity.[20]

The never-ending outgrowth of Proust's collage for *A la recherche du temps perdu* and, in a less spectacular way, the unexpected treasures hidden in Roussel's drafts show that a material as common and basic as a school notebook may be used, under the urge of creation, in so many completely original ways. As revealed in the radical change of perspective on Stendhal's working habits, a minute detail such as an embossed stamp barely showing at the corner of a folio may lead one to reconsider a whole conception of the genetic process. It is true that the scarce available resources in recent paper history do not always provide sufficiently solid ground for new interpretations; yet, many of these could not be reached without the contribution of paper analysis. Through their common search for evidence, codicologists and literary scholars are beginning to learn to what extent the paper plays an active part in the genetic process. Looking at paper as it is, without yielding to well-established preconceptions about what the writing means, brings to light some of the writer's most personal and compulsive gestures, previously unnoticed. It seems that paper still has a lot to teach us about how we write. When Yves Bonnefoy argues that 'writers' manuscripts raise more problems than they can solve,'[21] Duchamp's stimulating answer would be, 'There is no solution, because there is no problem.'

Notes

1. Grésillon, A. 1994. *Eléments de critique génétique: Lire les manuscrits modernes.* Paris: Presses universitaires de France

and L. Hay, ed. 1993. *Les Manuscrits des écrivains*. Paris: CNRS Editions, Hachette.

Genetic criticism, initiated in France by the members of the Institut des textes et manuscrits modernes (Centre national de la recherche scientifique), endeavours to restore and interpret the process of creative writing by means of a systematic analysis of writers' drafts.

2. Lacroix, A. 1863. *Historique de la papeterie d'Angoulême*. Paris: Laîné et Havard.
3. Bustarret, C. 1997. L'énigme de l'extra-strong. *Cahiers de médiologie* 4: 85–97.
4. Spector, S., ed. 1987. *Essays in Paper Analysis*. Cranbury, London, Mississauga: Associated University Presses.
5. Bower, P. 1990, 1999. *Turner's Papers: A Study of the Manufacture, Selection and Use of his Drawing Papers, 1787–1820* (Vol.1) and *1820–1852* (Vol. 2). London: Tate Gallery.
6. Our own descriptive grid almost matches the data mentioned as indispensable (marked with an *) in the *International Standard for the Registration of Watermarks*, published by the International Association of Paper Historians, 1996.
7. Our institute has recently undertaken a project, in collaboration with the Bibliothèque municipale, the Équipe des manuscrits de Stendhal and the École nationale de papeterie in Grenoble, aimed at a systematic description of papers in the manuscripts of Stendhal.
8. Bower, P. 1996. Who made this rubbish? — The historical investigation of particular twentieth-century papers. *IPH* 1: 12–20.
9. A genetic classification of manuscripts is necessarily virtual, either through verbal reconstruction or by means of electronic devices such as hypertext (Several links attached by the critic to words or portions of text allow a predetermined circulation of the reader between fragments which do not appear as a sequence in the original document. The manuscript itself may be visually accessible in facsimile reproduction and/or transcribed). See J.-L. Lebrave, 1994. Hypertextes—Mémoires—Ecriture. *Genesis* 5: 9–24; and N. Ferrand, ed. 1997. Hypertexte et édition génétique: L'Exemple d'*Hérodias* de Flaubert. In *Banques de données et hypertextes pour l'étude du roman*. Paris: Presses universitaires de France, 137–54.
10. Irigoin, J. 1980. La datation par les filigranes du papier. *Codicologica* 5: 9–36.
11. Bockelkamp, M. 1996. Wasserzeichenmotive im Maschinenpapier aus literarischen Handschriften. In *Papiergeschichte(n): Papierhistorische Beiträge W. Schlieder zum 70.Geburtstag*, ed. F. Schmidt. Wiesbaden: Harassowitz.
12. Bibliothèque nationale. 1985. *Soleil d'encre: Manuscrits et dessins de Victor Hugo*. Ville de Paris: Bibliothèque nationale. 283. Catalogue nos. 424, 425.
13. Jones, R. 1988. From papermill to scribe: The Lapse of time. *Papers from the III European Colloquium on Malay and Indonesian Studies*. Napoli: Istituto Universitario Orientale, 153–69.
14. Prévôt, M.-L. 1997. Écrit sur une page blanche: Les Écrivains et leurs papiers. *Cahiers de médiologie* 4: 171–78.
15. Bockelkamp, M. 1988. L'analyse bétaradiographique du papier appliquée aux manuscrits de Diderot. In *Studies on Voltaire and the Eighteenth Century*. Oxford: Voltaire Foundation. 254.
16. As the descriptive part of this project is coming to an end, I would sincerely appreciate any help in locating bibliographical or commercial sources which might enable me to identify or date some of the American papers he used between 1915 and the 1960s.
17. At the back of a letter to Katherine Dreier, written on a rough paper torn from an accounting notebook printed with red and blue columns, Duchamp hastily wrote in big capital letters 'EXCUSE PAPER !!!'
18. We are here leaving aside the typed versions as well as the sets of proofs which belong to the final phase of the genetic process. See C. Bustarret and A.-M. Basset. 1994. Les cahiers d'*Impressions d'Afrique*: L'Apport de la codicologie à l'étude génétique. *Genesis* 5: 153–65; and A.-M. Basset. 1996. *La genèse d'*Impressions d'Afrique *de Raymond Roussel ou le mythe de la création*. Doctoral dissertation, Université Paris III.
19. Linkès, S. Des clés pour les manuscrits de Stendhal: Le Cas *Lamiel*. *Genèses, Proceedings of the 2nd International Congress of Genetic Criticism*, Paris, September 1998 (to be published shortly by ITEM, CNRS).
20. Ginzburg, C. 1989. *Mythes, emblèmes, traces*. Paris: Flammarion.
21. Bonnefoy, Y. 1992. Enchevêtrements d'écriture: Entretien avec M. Collot. *Genesis* 2: 123–30.

Board Making in Lalande's *Art du cartonnier*

JANE EAGAN

Abstract

In 1762, the celebrated French astronomer Joseph Jérôme Lefrançais de Lalande saw published his treatise on board making, *Art du cartonnier*. Lalande's *mémoire* was part of an ambitious project, initiated almost 70 years earlier by the Académie royale des sciences, to record all of the industrial processes of France. A scaled-down version of the project, which would have been the earliest such survey in any country had it been carried out as planned, was revived and the resulting *Descriptions des arts et métiers* was published in parts from 1761 to 1788. The publication of the *Descriptions* was partly in reaction to Diderot and d'Alembert's *Encyclopédie*, a work which in the opinion of some members of the Académie had, in trying to cater to the specialist and the uninitiated at the same time, succeeded in satisfying neither.

In his account, Lalande, author of *Art de faire le papier*, outlines the eight steps of pulp- and pasteboard manufacture and lists types, qualities and usage of boards. The engraved illustration by Ludovic Simonneau, which gives a naturalistic depiction of stages of the work, an exploded view of machinery and a primer of tools, dates to 1697, when the project was first begun and abandoned.

This paper gives an overview of Lalande's treatise based on the author's annotated translation, which draws from descriptions of boards and board making found in contemporary French and English sources.

In 1762, Joseph Jérôme Lefrançais de Lalande saw published his work on board making, *Art du cartonnier*.[1] One volume, or *cahier*, of the series, *Descriptions des arts et métiers*, was published in parts from 1761 to 1788 by the French Académie royale des sciences.[2] *Art du cartonnier* furnishes a detailed record of the method of production, types and use of board in eighteenth-century France. Lalande (1732–1807) is best known to paper conservators and historians for his peerless work on papermaking published in 1762 and entitled *Art de faire le papier*.[3] He was best known in his own time as France's most celebrated astronomer, called by one eulogist the 'embodiment of astronomy in the French mind.' Admitted to the Académie des sciences in 1753, Lalande was a complicated figure, tireless in his pursuit of knowledge, yet relentlessly self-publicizing, contentious and impetuous. Controversial statements, particularly regarding his atheism in his later years, made him an increasing number of enemies in high places, culminating in his official silencing by Bonaparte in 1805. The order preventing him from publishing was eventually relaxed on condition that he show his writings to other academicians.

Lalande contributed nine *mémoires* on aspects of the paper and leather trades to the *Descriptions des arts et métiers*, a series comprising from 73 to 81 separate accounts of the arts and handicrafts.[4] The Académie's project was an ambitious one, its aim to document in an objective and scientific way all the industrial processes of France. This goal seems to have been present in some form or other from the earliest days of the Académie, which was originally an informal group of scholars (including Descartes and Blaise and Étienne Pascal) organized by the statesman Jean-Baptiste Colbert in 1666. In 1675, Louis XIV requested that the group begin work on a treatise on the theoretical and practical arts; this was to prove the beginning of an almost century-long preoccupation for the body, undertaken after some delay in 1693 and culminating in the *Descriptions des arts et métiers*. During the long period of work on the project, the fortunes of the Académie were not without reversals, and towards the end of the seventeenth century it fell into a state of decline. On its revival in 1699 and with the approval and support of Louis XIV, it once again resumed its project, preparing and reading *mémoires* under the direction of René Antoine Ferchault de Réaumur (1683–1757). The manuscripts were held in the stores of the Académie until they could be gathered into a collection with a coherent arrangement. With Réaumur acting as editor from 1711, volumes of varying length were completed on a wide range of subjects, such as mirror and pin making, copper-plate engraving, type founding, sugar refining, gold beating and harpsichord making. On his death in 1757, and possibly in response to publication of the first volumes of the *Encyclopédie*,[5] Réaumur's papers were distributed among 20 members of the Académie charged with bringing the project to completion, examining and publishing manuscripts if possible, completing unfinished accounts and determining what remained to be covered. Among Réaumur's papers were 38 portfolios of plates.[6] It is probable that the driving force behind the project from this point was Henri Duhamel Dumonceau (1700–82), author of the first published volume, *Art du charbonnier*, in 1761 and of the 'Avertissement général' announcing the project. A new sense of urgency resulted in a shift in approach from the 'detailed monument to posterity,' to a more utilitarian collection of practical accounts investigating working methods and trade secrets with a view to improving production and maximizing profit.[7]

The *Descriptions des arts et métiers* was the earliest practical, descriptive survey of the handicrafts conceived in any country. In England, the Royal Society of London, established in 1660, had conceived of a similar study and, as early as 1667, had prepared descriptions or 'histories' of certain industrial processes. Their practical approach, however, was abandoned in favour of a more theoretical one, and the technical arts fell into neglect in England until the foundation of the Society of Arts in

1753. Certainly no publishing initiative to equal the French project was ever attempted in England. The *Descriptions des arts et métiers*, then, stands alone by virtue of the scope and depth of its programme of providing objective and descriptive accounts drawn from the experience of practitioners and aided by the powers of scientific observation and knowledge, for the benefit of the country.

The accounts were published as separate *cahiers* in folio, available at low cost to widen their availability. By 1788, the Académie des sciences had almost 13,500 pages of text and over 1,800 plates. Accounts were published at a rate of four to six per year for nearly 20 years, but the project lost impetus in the 1770s and from 1780 to 1788 only five new titles appeared. No official statement was made as to why work ceased. Lack of money due to poor sales may have contributed; the price was reduced in 1783, presumably to try to reverse this trend.[8]

The series was quickly taken up in translation, beginning with a 20-volume German publication in quarto entitled *Schauplatz der Künste* (1762 to 1795),[9] and individual accounts were translated into Polish, Dutch, English, Spanish, Arabic and Portuguese. Excerpts of Lalande's *Art de faire le papier* were translated almost immediately into English and appeared in the *Universal Magazine*.[10] *Art du cartonnier*, however, has not yet benefited from a proper translation into English. It exists in an incomplete and inadequate translation dating from 1950, which took as its source text the rather verbose eighteenth-century German translation.[11]

Lalande's account of board making, comprising 30 pages of text and one copper engraving,[12] begins with a reference to his description of papermaking (fig. 1). Although the two arts are similar, at least superficially, we are told that a separate account of board making was felt necessary in view of the great number of distinct details presented by the materials and machinery used in its manufacture, as well as the use made of it. Lalande points out that, while bookbinders made the most interesting use of board, it was frequently used in other arts, such as in the production of boxes and cases for haberdashers, hatters and shoemakers and in architectural papier mâché.

The 'matter,' or raw materials, mentioned by Lalande included all types of paper, but principally that which could not be used for anything else, such as trimmings produced by binders, playing-card makers, papermakers, print sellers and fan makers and printed and written waste paper. White and coloured paper, old torn board, wrappings, old boxes and even notices stripped from billboards were also used. Lalande bemoans the fact that a more than ample supply of material would have been available to board makers, had unsold books in sheets not been sold for wrapping at a rather prohibitively high price. He also signals a change in the disposal of dangerous and prohibited books and indicates that this was the only material from which a profit could be made. While it had been customary to burn banned books, instead these works were taken directly to a board maker's workshop and pulped immediately, at the same cost to

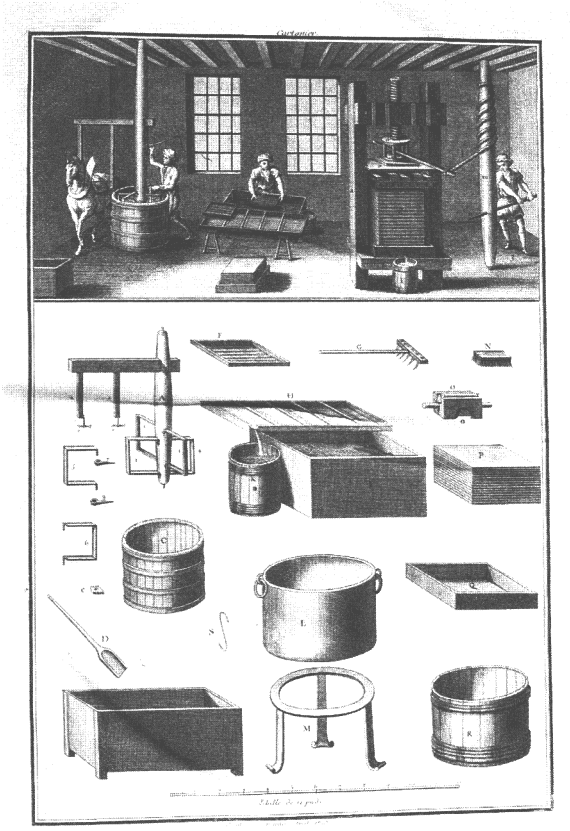


Fig. 1 *Art du cartonnier*, **1762, Bodleian Library, University of Oxford, plate facing page 30 from 1733 b.7.**

the board maker as trimmings. According to Lalande, the profits from this were distributed to the poor. To give an idea of prices and profits of the time, 1 quintal (the equivalent of 100 lb.) of paper trimmings cost 6 livres and 1 quintal of finished board fetched 12 livres; raw materials therefore cost the board maker about half the takings of the finished product.[13]

Trimmings were sometimes sorted by quality and colour: binders' and playing-card makers' trimmings were reserved for a better-quality board called *carton blanc* (white board), while the coloured papers, including blue wrappings and recycled board, were used for the lower-quality *carton bis* (brown board). The material was soaked either in a heap on the pavement of the workshop or in troughs, in the manner of rags for papermaking. The trimmings were then piled in a heap eight feet long by six and one-half feet wide which required seven to eight days to ferment, depending on weather conditions. The fermented trimmings were then taken to a trough where they were cut and roughly sorted by hand to remove foreign objects, beaten with a wooden shovel or iron scraper until reduced to small bits and put in a wooden mortar. The waste paper was then worked in a horse mill, which consisted of the wooden mortar with a vertical wooden shaft inside, turning in a metal thrust bearing at the bottom and pivoting on the ceiling beam. To this shaft were attached rough bands of metal, either fixed or removable, which acted as knives, cutting the material in water and reducing it to a pulp. The harnessing of the horse to the horizontal turn-tree attached to the

main shaft is also described by Lalande, who mentions that the horse was walked in one direction for three-quarters of an hour, then was turned and made to walk in the other direction for the same length of time, a routine which apparently eased the animal's labour. We are told that one horse made to complete the pulping three times per day could supply two vats, and thereby six men, two at the vat and four at other tasks.

When ready, the pulp was taken from the mill to the vat or put aside in the equivalent of a stuff chest: a trough, a vat or some barrels. The moulds used for forming the board were made of a frame of four pieces of oak joined together along the long side by anywhere from just one batten to ten or twelve. On the surface of the mould was a facing of brass wires, the edges of which were covered with sheet brass nailed with wire nails to the frame. The wires were laid about one-twelfth of an inch apart and were attached to other wires at two- to three-inch intervals, which held them in place. The deckle was made of four sides with a central bar and was eight- to nine-twelfths of an inch high. Lalande mentions that in Paris pin makers made these rather rough single-faced moulds, which cost about 40 livres.[14]

The work at the vat was essentially the same as in papermaking. Boards were couched onto felts of soft, loosely woven, woollen cloth; the cheapest cloth was usually sought. The felts were often too narrow to cover the newly made boards, and gaps had to be made up with odd pieces of other woollens, including old tapestries, which led to inconsistencies in texture and thickness in the finished product. The felts required washing every three to four weeks and lasted only one year or so.

The boards, between felts, were placed on a platform which was dragged under the press; it was designed with a hole to let excess water drain into a bucket, to be reused or merely routed away. Board of different qualities and consistencies could be made using the same pulp. Approximately 112 to 115 boards were made in about three to four hours, and up to 200 thinner boards could be formed in that time.

The first pressing in felts was done in a large wooden capstan press. Four men were needed to turn a lever five feet in length that was placed between the staves of the lantern wheel of the press. After the first pressing, women carried out such unskilled tasks as picking out foreign material, taking the boards from the felts, piling them and mending any faults. The second pressing was done without felts. The board post, three and one-half feet high, was put back in the press and the boards were evened up and squared by scraping any excess material from the sides with an iron scraper; the excess was returned to the vat.

After pressing the boards were hung on S-shaped hooks of wire, two or three at a time, from the laths in the drying loft. Heavier boards were hung singly because of their weight. When space ran out, the boards were put on end on the floor, in the manner of a house of cards.

Polishing or glazing with an iron roller and spring pole was done to compact and consolidate the board.[15] As it did not require a high polish, this step was done quickly, according to Lalande, although polishing eight to ten sheets on both sides seems to have taken an hour. Water was often required to dampen the boards, which had been hanging and were very dry. After polishing, some were passed to the paster, who laminated them one to another or lined them with paper. An adhesive of four parts animal glue to one part flour paste was used. The paster had six to seven packs of board to laminate and press in a day. Too heavy to hang, the laminated boards were put on end.

Lalande identifies two categories of board based on means of production, made either on the mould or by pasting. The first he calls *carton de moulage* (mouldmade board), which includes single plies or *feuilles* made of one layer of pulp on the mould; *cartons redoublés*, where a second layer was couched onto a newly couched board (couched laminates, or multi-couched boards); and *cartons collés* (adhesive laminates) which could comprise seven to eight sheets in the case of boards used for binding large and heavy books such as bibles. The *carton redoublé* made quite a soft board, and was not often made of more than two plies; this quality was recognized by the book trade and binders often chose the more expensive but stronger *carton collé,* despite its higher cost. Another, more exotic type of board, made by splitting a single sheet while damp and inserting a second *feuille* before pressing, was called *carton enté* (grafted board).

The most common mouldmade boards by size were *Petit Ais* at 13 × 19–20 in., used on text blocks of folio or duodecimo small paper; *Catholicon* at 14 × 20–21 in., used on duodecimo usual-sized paper, folios of *papier de Hollande* and octavo small paper; *Bible* at 16–17 in., used for folio, quarto and octavo; and *Saint-Augustin* at 18–19 in., used on folio, quarto and octavo large paper.

This first category of board can be divided further according to composition, whether *carton bis* (brown board), made of coloured paper, wrappings, old board and other waste — an economical material for cases, comb stands, backs of frames for little prints, et cetera; or *carton blanc* (white board), made of cleaner and finer material.

Lalande's second category is *carton de pur collage* (true pasteboard), made by pasting sheets of paper together (usually from five to twenty) with flour paste. The most common type of pasteboard was made in exactly the same way as playing cards, with a middle of either two layers of a grey paper called *main-brune* or of *carton bis,* with pastings of *Cartier* and *Pot* on the sides. This board was called *Carte de Rouen* in Paris, as much of it was made in Rouen. Included in this group was *carton couvert*, or lined board, a single ply of board to which a sheet of white paper was pasted on one side for drawing or writing.

These pasteboards were improved by pressing, and Lalande indicates they were pressed several times during drying and at each lamination. They were also polished with a stone rather than the metal roller, using soap, as for playing cards, for they were less supple than mould-made board. In view of their formation, the size of pasteboards was predetermined by the size of the sheets of paper from which they were made, although larger boards could be made by overlapping sheets. In view of

the multiplication of operations, increase in labour required and more costly materials used, it seems that these pasteboards were of higher quality and more costly to manufacture than the simple mouldmade boards.

Lalande's *Art du cartonnier* offers a wealth of detail based on eighteenth-century objective scientific observation and practice and is a valuable source of information about historical techniques of production. This wealth of detail speaks of the wide range of materials available to craftsmen and artists and of the differing qualities of a material, which were understood and chosen. Each seemingly small choice of material or technique builds on others, modifying and determining the nature of the object produced. It may be that a fuller understanding of these choices and their significance will be useful in the interpretation of objects of cultural production.

Art du cartonnier, just one of the *Descriptions des arts et métiers*, seems to fulfil the hopes of its creators, that discoveries in the arts, as in the sciences, should be as a common treasure to all peoples, as well as confirming their suspicion that the project could be even more useful in the centuries that followed than it was in its own.[16]

Notes

1. No printer or place of publication of the treatise is given. The first *mémoire* of the series, Duhamel Dumonceau's *Art du charbonnier*, is preceded by a general title page for the series which gives the following information: Paris: Desaint & Saillant, Librairies, rue Saint Jean de Beauvais. 1761. *Art du cartonnier* was reprinted in *Les arts du papier*. Geneva: Slatkine. 1984.
2. The story of the *Descriptions des arts et métiers* is given in Lalande's preface to *Art du tanneur*, published in 1764. It is reported in English by A. Cole and G. Watts. *The Handicrafts of France as recorded in the* Descriptions des Arts et Métiers *1761–1788*. Boston: Baker Library. 1952; and described in relation to the *Encyclopédie* by J. Proust. *Diderot et l'Encyclopédie*. Paris: Armand Collin. 1962. A plan of the entire project is outlined in the 'Avertissement général' by Duhamel Dumonceau in *Art du charbonnier*, published in 1761. A recent addition to bibliography on the *Descriptions des arts et métiers* is the new edition by J. Mosely of H. Carter's translation into English [London: Soncino Press. 1930] of Pierre-Simon Fournier's *Manuel typographique*. Darmstadt: Technische Hochschule. 1995.
3. An account originally entitled 'L'art de la papeterie,' prepared and read to the Académie in 1706 by des Billettes and later reworked by Lalande.
4. The nine *mémoires* by Lalande are *L'art de faire le maroquin*. n.d.; *Art de faire le papier*. n.d.; *Art de faire le parchemin*. [Paris]: H. L. Guérin and L. F. Delatour. 1762; *L'art de l'hongroyeur*. n.d.; *Art du cartonnier*. 1762; *Art du chamoiseur*. 1763; *Art du corroyeur*. [Paris]: L. F. Delatour. 1767; *Art du mégissier*. [Paris]: L. F. Delatour. 1765; *Art du tanneur*. [Paris]: H. L. Guérin and L. F. Delatour. 1764. The number of separate items which constitutes a complete series varies; if one includes supplements and corrections, it is 81, if not, it is 73. A complete list of individual *cahiers* and supplements can be found in Cole and Watts. Appendix A, 25–36; and of contributors, in Appendix C, 37–43.
5. A publication which overshadows the *Descriptions des arts et métiers* today, but which was heavily influenced by the latter, particularly in the design of the plates, which feature a vignette above with a primer of tools and machinery below. Of the *Encyclopédie*, Réaumur said that it 'm'a paru ou trop long ou de beaucoup trop court,' reported in J. Torlais. *Réaumur*. Paris: Desclée De Brouwer. 1936. 249. Influences on the *Encyclopédie* are described by J. Proust. 'La documentation technique de Diderot dans l'<Encyclopédie>'. *Revue d'histoire littéraire de la France* 57 (1957): 335–52.
6. A full discussion of the question of plagiarism of these plates by 'gents [sic] peu délicats' in the preparation of the *Encyclopédie* is beyond the scope of this paper; this subject is treated by J. Proust. *Diderot*. 1962, and in M. Pinault. 'A propos des planches de l'Encyclopédie.' *Studies on Voltaire and the Eighteenth Century* 254 (1988): 351–62.
7. Proust. 1962. *Diderot*. 183, 187.
8. In 1773 the first 86 *cahiers* were sold as a set for 640 livres (£28) and the individual *cahiers* for 2 livres, 10 sous (2*s*. 2*d*.). In 1783 the price of individual *cahiers* was reduced by two-fifths (1 livre, 12 sous) and the whole series by half. Cole and Watts. 1952. 22. Exchange is based on rates given by G. Barber, ed. *Anecdotes typographiques*, by Nicolas Contat dit Le Brun. Oxford: Oxford Bibliographical Society. 1980. 22–23.
9. Published from 1762 to 1795. See Kayser's *Vollständiges Bucher-Lexicon* for editors and places of publication.
10. March 1762, 113–17; May 1762, 260–61; June 1762, 281–82.
11. The author has been preparing an annotated translation from French to English of *Art du cartonnier*, which is forthcoming. The translation referred to above may be found in H. Bockwitz and H. Kotte. *Cardboard in the Course of Time*. 1950, a publication celebrating the fiftieth anniversary of the company Feldmuhle Works, of Arnsberg, Westphalia, Germany.
12. The engraving by Simonneau is dated 1697, placing it within the earliest period of work on the project, prior to the revival of the Académie in 1699. The plate mark measures 330 × 220 mm and the border 325 × 217 mm.
13. Twelve livres would have been roughly equivalent to 10*s*.6*d*. and 6 livres to 5*s*.3*d*.
14. These board moulds were often made of oak throughout, and were much stronger than ordinary paper moulds, resembling more closely moulds for wrappings.
15. The spring mechanism consisted of a plank fixed to the ceiling, pressing down onto the upper end of a pole, which fitted onto the wooden box in which the iron roller was mounted and on the sides of which two handles were fitted.
16. In Lalande's words, 'tout ce qui se découvre dans les Arts comme dans les Sciences doit être un trésor commun à tous les peuples du monde.' Preface, *Art du tanneur*. 1764. iv; and in Dumonceau's, 'l'on ne peut employer à la fois trop de mains habiles pour accélérer l'exécution d'une entreprise qui peut être utile à notre siècle, & plus encore à ceux qui le suivront.' Avertissement général. *Art du charbonnier*. 1761. iii.

Design for Water-Powered Stampers: Early Italian Papermaking Technology Illustrated in a Drawing in the Canadian Centre for Architecture, Montreal

THEA BURNS AND MYRA NAN ROSENFELD

Abstract

This paper describes and considers the evidence afforded by an Italian sixteenth-century technical drawing of papermaking stampers. The drawing, a highly detailed image of a stamping mill powered by a water-wheel, has been attributed to Alberto Alberti (1526–98). It may be the earliest illustration in the West of this hydraulically powered machinery. An accompanying inscription documents the adoption of fulling-mill technology to the preparation of rags for papermaking. The attribution of this drawing to Alberti will be discussed and the drawing will be situated in the broader context of the Tuscan and Florentine tradition of technical illustrations of machines.

Description of the CCA drawing

The sixteenth-century Italian drawing *Design for Water-Powered Stampers* is preserved today in the collection of the Canadian Centre for Architecture in Montreal (fig.1). It measures 227 × 379 mm and is executed in pen and brown ink on an antique laid paper substrate. Besides the manuscript inscriptions within the body of the drawing referred to above, which will be discussed later, there are two additional inscriptions on the recto: one, the name 'alberti' written in pen and brown ink at the lower left, and the other, the number 42 in graphite at the lower right. The side designated recto features a series of drawings of water-powered stampers executed from a variety of different viewpoints. There is an underdrawing in black chalk beneath the finished image, which has been executed in pen and brown ink. The freedom, variety, tentative placement and repetition of the lines indicate clearly that this drawing is an original, not a copy. The CCA drawing is double-sided. The verso features drawings of water-powered and geared mechanical saws and an edge-runner mill; there is no exploratory underdrawing beneath the machinery illustrated on the verso (fig. 2).

The main furnish for papermaking in the early modern period was linen rags or hemp ropes. Preparation of this source material into a consistency satisfactory for sheet forming involved several steps; one of these was beating and bruising to clean the raw material, to separate the rags or ropes into their constituent fibres and to fibrillate the fibres. This could be done in various ways;[1] one, shown in the CCA drawing, was to pound the rags with hammers in a stamping mill.

A small sketch in the lower right corner of the CCA drawing identifies the various parts of the central image with manuscript inscriptions. In the upper left corner of the full paper sheet the artist has placed a view of an artificial or natural reservoir of water (inscribed '*gorgone d'aqua*,' translated as whirlpool). From the pool a chute or jet of water is directed onto an undershot wheel (inscribed '*rota*'), which is placed partly within and partly

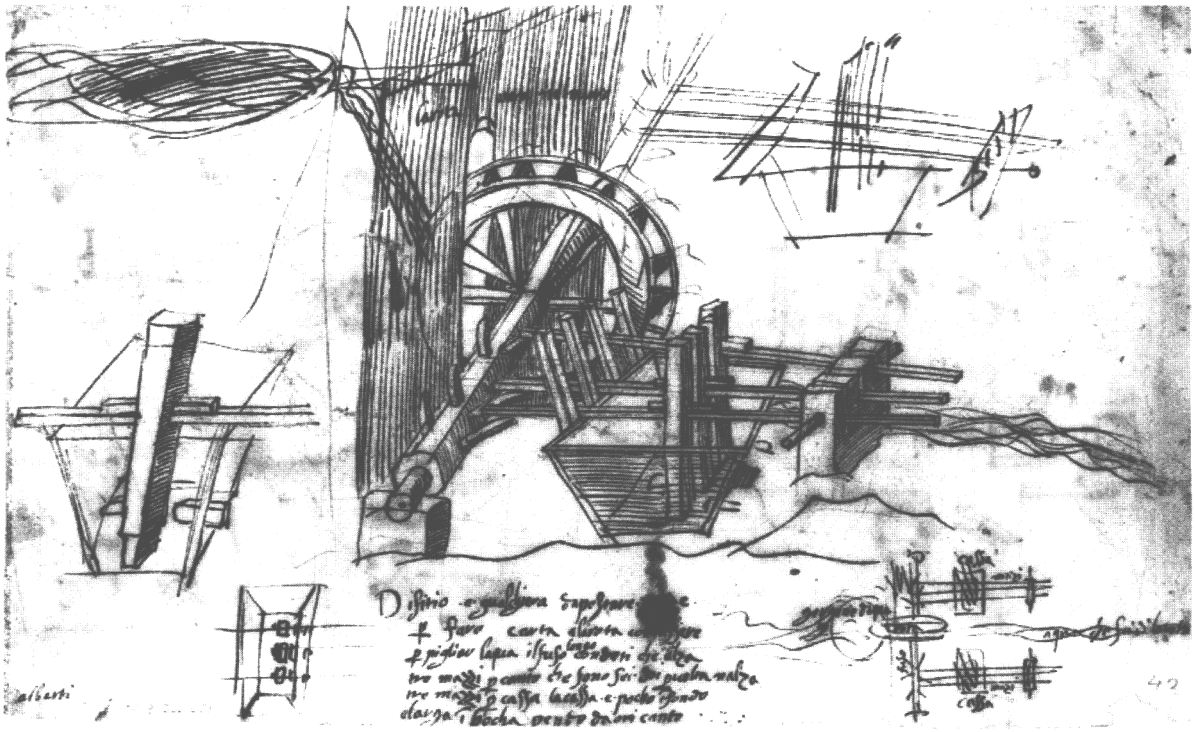


Fig. 1 Alberto Alberti (1526–98), *Paper Making Machine*, pen, brown ink and black chalk underdrawing, about 1558–65, 22.7 x 37.9 cm, Centre d'Architecture/Canadian Centre for Architecture, Montreal, Prints and Drawings Collection, DR 1979:0020, recto.

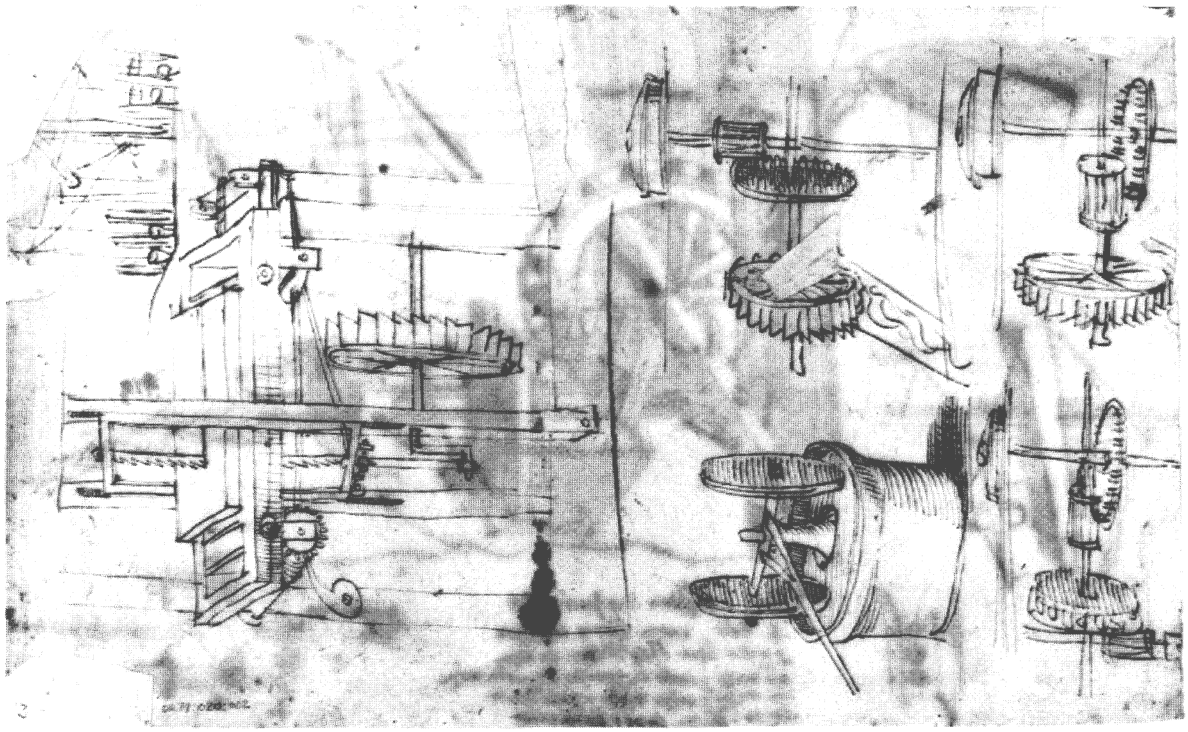


Fig. 2 Alberto Alberti (1526–98), *Edge Runner Mill, Three Sets of Gears and a Saw Driven by Gears*, pen, brown ink and black chalk underdrawing, about 1558–65, 22.7 x 37.9 cm, Centre d'Architecture/Canadian Centre for Architecture, Montreal, Prints and Drawings Collection, DR 1979:0020, verso.

outside wooden walls — the parallel vertical lines suggest wood construction (inscribed '*la rota entra . . . muro*'). The water discharged from the wheel exits to the right (inscribed '*aqua che fuis . . . la terra*').

The water-wheel drives a long round shaft with cams (inscribed '*fuso*,' meaning shaft) which lift three other square-cut shafts or beams attached to hammers (inscribed '*mazi*'); these are grouped on either side of the wheel. Such cams were typically off-set from each other so that the stamper feet could be raised in sequence, not all at the same time; this feature is precisely recorded in the CCA drawing. The machinery in the foreground is drawn in some detail; that on the far side is merely suggested. As the wheel and camshaft turn, driven by the falling water, cams lift the hammers and then release them so that they fall back into the trough or vat. The rags are not shown in this drawing but we may presume that they have been or will soon be placed in the water-filled boxes or vats (inscribed '*cassa*'). The vats are constructed of smaller pieces of wood and feature widely flaring sides. This special shape assisted the circulation of the pulp under the hammers and prevented it from splashing out.[2]

The precision of the draughtsman's observation is evident in the way he has made the beams supporting the hammers for each vat splay out from their supporting pivots, rather than placing them parallel. Richard Hills noted this feature in an early paper mill at Pescia in Italy.[3] Precise observation is also evident in the way in which the angle of the main shaft slopes up from the back pivots through the hammers to the camshaft. Hills has described this as a characteristic feature of Italian stampers found, for example, at Fabriano. It shortened the bearing block for the pivots and may have increased the steadiness of the stamper feet.[4] In the earliest preserved layouts for stamping mills described by Hills, at Capellades and La Riba in Spain and at Ambert in France, the rags being pulped were to be passed from one vat or trough to another.[5]

A small plan placed at the lower left of the CCA drawing shows the hammers and the vat. A larger view farther to the left shows a single hammer in greater detail. The stamper foot and shaft were not set vertically in the vat but were angled. Thus, in action, the head moved slightly sideways as well as moving vertically; this orientation assisted in circulating the pulp.

The rags were customarily moved from vat to vat during the beating process so that they would be beaten in turn by stampers with different types of feet, usually of three designs. It is thought that it was in Italy that stamper feet were first fitted with spikes to shred and pound the rags.[6] Hills has described this arrangement at Capellades and La Riba. This ensured that the fibres in the pulp would be appropriately dispersed and bruised before sheet forming took place.[7] Plain wooden feet were used for blending the fibres at the end of the beating process or for repulping them if they had previously been dried and stored. There is, however, no indication in the CCA drawing of a metal bedplate fitted into the bottom of the wood vat; feet shod with metal spikes would require one.[8] Nor is it clear how the feet were shod. The draughtsman does not show the rags being beaten, the entry point into the vat of the clean water required in the beating process (though possibly the rags were to be washed in a separate operation), the covering of the bottom of the vats or the cladding of the stamper feet. This may indicate that he is more conversant with and/or interested in the water-driven mechanism than the papermaking process. We see only two troughs in the

drawing, not the customary grouping of three thought to have been found at Amalfi, from the thirteenth century in Spain and elsewhere.[9] Hills has suggested, however, that the number of troughs undoubtedly varied with the power available, which would determine the length of the camshaft to be driven and number of cams on it.[10]

The main inscription, in the lower centre of the drawing, is in archaic Italian; translated into English it reads:

> Structure of a fulling mill used for shredding rags and making paper. The wheel, with hollowed-out pockets to catch the water. The long shaft with pegs which lifts three hammers on each side for a total of six. Turning, [it] lifts three hammers [per] box. The box is shallow and widely flared on each side.[11]

The text of this inscription makes it clear that these are stampers for papermaking. The inscription also relates the technology of the stamping mill, for pulping rags to make paper, to the fulling mill (*gualcheria*). Fulling mills were used for washing or scouring and felting woollen cloth. Hills has suggested that the similarity of primitive fulling stocks, preserved today in Romania, to early papermaking stampers is significant and could help to account for the design of stamping mills in early modern Europe.[12] Water-powered fulling stocks, normally featuring a pair of straight hammers with pegs sticking out at the back, were lifted by cams on the water-wheel axle. Cloth was placed in the basin or trough to soak in the fulling liquor. The cloth was moved around in the trough by the action of the hammers. The link made between papermaking and fulling technology is not arbitrary; Italian and Spanish wool merchants and manufacturers were heavily involved in the early paper industry.[13]

Several further observations may be made about the machinery illustrated on the recto of the CCA drawing. Water-powered stamping mills preserved today at Amalfi and Pescia are considered to be surviving examples of an early form of this technology. Typically there, as in the CCA drawing, the water-wheel was built directly around the camshaft which lifted the stamper heads. This eliminated the need for gearing. Such an arrangement is also typical of many drawings of other machines from early modern Italy. Likewise, the use of a directed impulse of water is common to other early water-wheels, both under- and overshot; sometimes water falls on the wheel from a great height. The method shown in the CCA drawing is similar to that described for the paper mills at Amalfi and Pescia; the water is delivered in a concentrated jet from a vertical tapered cutting in the rock or wood chute. A jet hits the circumference of the wheel at the level of the camshaft.[14] The draughtsman of the CCA drawing has merely suggested this arrangement; undoubtedly it was such a well-known feature of contemporary technology that he felt no need to render it in detail.

The Attribution

Alberto Alberti, to whom this drawing is attributed, was born in 1526 in Borgo San Sepolcro (now called Sansepolcro), a town on one of the crossroads between Tuscany, Umbria, and the Marches. He died there in 1598. Alberto Alberti is less well known than his three sons, the painters Alessandro (1551–96), Cherubino (1553–1615) and Giovanni (1558–1601), who were responsible for important fresco cycles executed in Rome at the end of the sixteenth century: the vault decorations of the Chapel of San Silvestro and of the Sala Clementina (1596) in the Vatican, the *Scenes of the Life of St. Clement* (1602–5) in the Canon's sacristy at San Giovanni in Laterano, and those in the Aldobrandini Chapel in Santa Maria sopra Minerva (1604).[15]

Alberto, who was the son of the metal founder Giovanni di Berto Alberti, was active as an architect, military engineer, sculptor and engraver. According to his diaries and those of his sons, which are dated between 1543 and 1593 and are deposited in the Uffizi Library, Florence, he was involved in construction of the fortifications of Livorno in 1558 and those of Borgo San Sepolcro between 1561 and 1565. He had been called to that task by Giorgio Vasari (1511–74), artistic and architectural advisor to Duke Cosimo I de Medici of Florence (1519–74). We also know from these diaries that Alberto first went to Rome in 1547 to study ancient architecture. He settled there in 1566 and on February 8 of that year he opened a workshop. On 5 July 1568 he was inscribed in the guild of wood sculptors and engravers in Rome, which may explain his interest in the papermaking stampers illustrated on the recto of this drawing. According to his son Cherubino, Alberto was elected to the council of the guild on 17 March 1576. Although he lived in Rome, Alberto Alberti continued to work in Tuscany. His building commissions are mainly found in his native town of Borgo San Sepolcro. The most important are the monasteries of Santa Chiara (1587) and San Bartolomeo (1589). Alberto acted as an intermediary for Giorgio Vasari on Vasari's commissions of the chapel of Pius V in the Vatican in Rome (1571) and the choir of the Cathedral of Arezzo (1554).[16]

Alberto Alberti's securely attributed drawings are divided between the Gabinetto Nazionale delle Stampe, Rome, where there are three albums of drawings of Roman buildings by Alberto and one album with figurative drawings by his sons and drawings of machines by Alberto himself, and the Gabinetto Disegni e Stampe, Uffizi, Florence, where there are several figurative and architectural drawings by different members of the Alberti family, in four different albums.[17] It is difficult to identify Alberto's autograph drawings. He collected drawings; consequently not all of the drawings in the albums in Rome and Florence are by himself or his sons. Since very few of his drawings are dated and since there has been no study of the development of his graphic style, it is not possible to securely date the drawing in the Canadian Centre for Architecture. Lamberini has dated the drawings of machines in the albums in Rome, between 1558 and 1565, when Alberto was designing fortifications for Duke Cosimo I de Medici.[18] The CCA's drawing, executed in pen and brown ink with black chalk underdrawing, is extremely similar in style and technique to a drawing of a frieze with putti in the Uffizi, as well as

to a drawing from one of the albums in the Gabinetto Nazionale della Stampe, which shows the remains of a Roman monument in the vicinity of the Church of Santi Quattro Coronati in Rome. This drawing has been dated by Forni to the latter part of Alberto's career, between 1570 and 1598.[19] We find the same vigorous, bold pen strokes, parallel and cross-hatching to indicate shadows, chalk underdrawing (red) and handwriting with the same characteristic *s*, *f* and *d* as in the drawing at the CCA.[20] There is no watermark on the CCA's drawing.[21] There is a modern paper hinge along the left side and the number 42 inscribed in the lower right corner, which indicate that the CCA's drawing was originally part of an album composed in the nineteenth or twentieth century. The inscription 'alberti' in the lower left corner is not autograph, but may have been added in the seventeenth century.

The Broader context

In contrast to the drawings on the recto (fig. 1), those on the verso (fig. 2), according to examination with an infrared Vidicon, have no pentimenti and thus must have been copied from other drawings. The drawings on the verso of the CCA sheet, showing an edge-runner mill, three sets of gears and a saw driven by gears, reveal that Alberto Alberti knew the drawings of the fifteenth-century Sienese painter, sculptor, architect and military engineer Francesco di Giorgio (1439–1502). Although, according to Scaglia, none of the machines in the CCA's drawing were copied directly from known drawings by Francesco, they do show similar gears, machines and mills. Francesco di Giorgio is not known to have drawn papermaking stampers like those depicted on the recto of this drawing.[22] It is possible, however, that Alberto Alberti's drawings were copied from lost drawings by Francesco. There are similar drawings of mills with gears run by water in a vellum manuscript, Codex Ashburnham 361, Biblioteca Medicea Laurenziana, Florence, which was executed in the scriptorium of the monastery of Monte Oliveto Maggiore, near Siena, by an anonymous Sienese artist between 1480 and 1503, after a lost copy of Francesco di Giorgio's first treatise on architecture, *Trattato I*. The original, lost version of this treatise has been dated by Scaglia to between 1475 and 1480.[23] Francesco's interest in hydraulic engineering is further shown in a drawing on folio 2 recto of a fragment of a recently discovered manuscript in the Biblioteca Municipale A. Panizzi, Reggio Emilia, which was drawn, like that in the Biblioteca Medicea Laurenziana, after the original, lost version of *Trattato I*. The sheets in Reggio Emilia may have originally been part of the Codex Ashburnham 361. The drawing there shows various machines which could be used to attack a castle located on a body of water.[24] Francesco di Giorgio worked as a hydraulic engineer, as did his compatriot Mariano Taccola (1382–1453) before him. During the fifteenth century Siena had the largest water supply system in Italy. Taccola, who was responsible for improving that system, made the greatest innovations in hydraulic engineering in fifteenth-century Italy. He had illustrated several pumps and mills run by water in his first treatise on engineering, *De Ingeneis*, written between 1427 and 1433.[25] We know that Francesco di Giorgio had access to Taccola's manuscript of the first part of *De Ingeneis* in the Studio, a school and scriptorium in Siena, since he placed notes on several folios of one of the autograph manuscripts now in the Bayerische Staatsbibliothek, Munich.[26]

Alberto Alberti's drawings are witness to the circulation of manuscript copies of drawings by Mariano Taccola and Francesco di Giorgio to the end of the sixteenth century. Francesco di Giorgio's drawings of machines were copied by Leonardo da Vinci; a drawing of gears and a crankshaft originally designed by Filippo Brunelleschi (1377–1446) is found in the Codex Atlanticus, today in the Biblioteca Ambrosiana, Milan. Leonardo executed this drawing in France before 1519, the year of his death.[27] The two artist-architects had met in Pavia in 1490. Leonardo had gone to the monastery of Monte Oliveto Maggiore near Siena in 1503 while he was designing the fortifications at Piombino, and he made notes in the copy of Francesco di Giorgio's first treatise, which has survived in Codex Ashburnham 361.[28] In addition, Leonardo, like Alberto Alberti, was interested in the making of paper and printing. Leonardo had drawn a printing press between 1480 and 1482, which is depicted elsewhere in the Codex Atlanticus.[29]

Copies of Francesco di Giorgio's drawings of machines circulated not only in Tuscany but also in the Veneto. Daniele Barbaro had illustrated five pumps, a mill and several wooden beam supports by Francesco di Giorgio in his Italian translation of Vitruvius, which was published in Venice in 1556.[30] He had access, like Vittorio Zonca (1580–1602), the author of the *Nuovo teatro di macchine,* published in Padua in 1607, to a copy of a manuscript showing machines by Francesco di Giorgio, perhaps the *Opusculum*, composed, according to Scaglia, between 1470 and 1475.[31] We have already seen that Zonca's illustration of papermaking stampers depicts technology similar to that shown on the recto of the CCA's drawing (fig.1). Zonca, who was the architect for the city of Padua, worked briefly as a hydraulic engineer in 1599 for the magistrates and deputies in charge of the water system for the city of Venice.[32] Zonca's book was preceded by another important book on machines, *Le diverse e artificiose machine*, published by Agostino Ramelli (1531–1600) in Italian and French in Paris in 1588; it contained illustrations of machines after Francesco di Giorgio's designs.

Sometime between the late 1550s and the 1570s, about the time that Alberto Alberti executed the drawing now in the Canadian Centre for Architecture, there was an attempt in Florence to publish a printed book with illustrations of machines, similar to that published in 1607 by Zonca in Padua. A manuscript with ink drawings on vellum and text on paper and vellum folios, now in the Biblioteca Nazionale Centrale, Florence (Ms. Palatino 1077), is the preparatory manuscript for this unpublished book. It has been dated by Scaglia to sometime before 1556 and by Lamberini to between 1572 and 1575. Scaglia's dating is more plausible since the manuscript

was copied by Daniele Barbaro in his 1556 edition of Vitruvius. Many of the drawings, like the one of a perpetual motion machine on folio 75 recto, are derived from Francesco di Giorgio's earlier designs.[33] Lamberini has attributed the text of this manuscript to the Florentine mathematician Bernardo Pucci (1521–75), who was a member of the court of Grand Duke Francesco I of Tuscany (1541–87). She has related Pucci's presence at the Medici court to the introduction of mathematics as a subject of instruction in the Accademia del Disegno in Florence in the late 1570s, by the painter Federico Zuccaro (*ca.* 1540–1609) at the instigation of Grand Duke Francesco I, who was himself interested in mechanics and alchemy. It is possible that the duke also encouraged the publication of the book on machines which was to have been published after Ms. Palatino 1077.[34]

Thus Alberto Alberti's drawings of machines in the Canadian Centre for Architecture are the product of the great interest in mechanics in Italy at the end of the sixteenth century. The image of papermaking stampers attributed to him is the earliest known technical drawing of papermaking stampers that has been preserved.

Appendix

Other early illustrations of papermaking technology:

1. Jost Amman (illustrator of) Hartmann Schopper, *Panoplia omnium . . . artium . . .*, Frankfurt a/M: Feyerabend (1568) (155 × 95 mm).

This famous woodblock print of 1568 has been described as 'the earliest surviving illustration of a papermaker in the West.'[35] It appears in the *Panoplia*, a book of trades which describes 139 different trades and professions. The *Panoplia* was written by the German Hartmann Schopper and illustrated by the Swiss artist Jost Amman. A wheel with typical shrouds or flat board sides attached to its outer rim is visible outside the window. The stamping mill with its axle, attached cams and stampers is visible in the background; the stamper feet are suggested but not precisely delineated.

2. Jacques Besson, *Theatre des instruments mathematiques & mechaniques*, Lyons (1579), engraving, pl. 25.

This engraving illustrates a simple, hand-operated mortar-and-pestle arrangement for beating pulp for papermaking. Sometimes, as here, the heavy pestles were suspended above their mortars to relieve the operator of their weight.[36]

3. Vittorio Zonca, *Novo teatro di machine et edificii*, Padua: Pietro Bertelli (1607), engraving (281 × 197 mm).

This engraving shows an undershot water-wheel placed inside the stamping mill, driving the camshaft. The cams or lugs on the camshaft raise the individual hammers and let them fall. This illustration has been called 'the first technical illustration of a stamping mill.'[37] Because it was vital for the stuff to circulate under the stamper feet if it was to be evenly beaten, water is shown running from a raised channel into one corner of the trough.

Acknowledgements

We would like to thank Gustina Scaglia, Professor Emeritus, Queens College, New York; Giovanni Agosti, Curator, Gabinetto Disegni e Stampe, Uffizi, Florence; Professor John Muendel, University of Wisconsin; Dr. Kristina Herrmann-Fiore, Curator, Galeria Villa Borghese, Rome; and Jeremy Powell, Canadian Conservation Institute, Ottawa, for their help in preparing this article. The drawing was acquired by Phyllis Lambert from Regina Slatkin, New York, in 1979 and donated to the Canadian Centre for Architecture, Montreal (DR 1979:0020 R/V).

Notes

1. Hills, R. 1984. Papermaking stampers: a study in technological diffusion. In *IPH Yearbook of Paper History 5*: 67–76. Hills summarizes the various methods used in the traditional preparation of paper by hand. On page 70 he suggests that when papermaking was introduced into Spain, the rags might have been crushed into pulp using the heavy edge-runner, a type of mill associated particularly with the oil mills in southern Spain. Interestingly, on the verso of the CCA drawing an edge-runner is illustrated among the mechanical saws. See also Hills, Richard. 1988. *Papermaking in Britain 1488–1988*. London: Athlone Press. 15–18.
2. Hills. 1984. 73.
3. Hills. 1984. 73 and fig. 6. At Ambert (fig. 9) the beams are placed parallel.
4. Hills. 1984. 75.
5. Hills, R. 1992. Early Italian papermaking: a crucial technical revolution. In *IPH Yearbook of Paper History 9*: 40.
6. Blum, A. 1934. *On the Origin of Paper*, trans. H.M. Lyndenberg. New York. 34–35.
7. Hills. 1984. 73; Hills. 1988. 21.
8. Hills. 1984. 73.
9. Gasparinetti, A.F. 1953. Paper, papermakers and paper-mills of Fabriano. In *Zonghi's Watermarks*, ed. A. and A. Zonghi. Hilversum: Paper Publications Society.
10. Hills. 1984. 73.
11. Transcribed and translated by Nicola Sivilotti. The archaic Italian reads:

    Difitio e gualchiera da pestare pezze
    per fare carta alarota concassette
    per pigliar laqua il fuso longo con deti che alza
    tre mazzi per canto che sono sei Poi (?) per volta n alza
    tre mazzi per cassi la cassa e pocho fondo
    e larga con bocha a vento da ogni canto
12. Hills. 1984. 71. Hills also outlines the further development of Romanian fulling stocks.
13. Dini, F. 1902. *Le Cartiere in Colle di Valdelsa*. Castelfiorentino: Giovanelli e Carpitelli. 7–10.
    Valls i Subirà, O. 1978. *The History of Paper in Spain*. Madrid: Empresa Nacional de Celulosas. Vol. I, 2–4, 8. Hills. 1988. 18.
14. Hills. 1984. 71; Hills. 1988. 17–18; Hills. 1992. 38, 40; Gasparinetti. 1953. 69–70.
15. The best summaries of the activities of the Alberti family are Bell, J.C. 1996. Alberti: Italian family of artists. In *The Dictionary of Art*, ed. J. Turner. London. 550–53, and Herrmann-Fiore, K. 1984. *Disegni degli Alberti*. Il volume 2503 del Gabinetto Nazionale delle Stampe. Rome: Gabinetto Nazionale delle Stampe (Villa Farnesina alla

Lungara). Ex. cat. 25 November 1983–2 January 1984. 25–34. See also Abromson, M. 1978. Clement VIII's patronage of the brothers Alberti. *Art Bulletin* 60: 531–47.

16. Forni, G.M. 1991. Monumenti antichi di Roma nei disegni d'Alberto Alberti. In *Atti della Accademia Nazionale dei Lincei.* Anno CCCLXXXVI, 1989. *Memorie, classe di scienze morali, storiche e filologiche.* Serie VIII, XXXIII. Rome. Vol. I, 15–18. The diaries in the library of the Uffizi are in volumes 267, 275, and 342. See also Conforti, C. 1993. *Giorgio Vasari architetto.* Milan. 78, 113, 74, 210.
17. Herrmann-Fiore. 1984. 8–13. Nos. 178–83 and 254–68 for the drawings of machines by Alberto, and 13 for three volumes, 93695–97 in Florence: Uffizi, Gabinetto Disegni e Stampe.
    Scaglia, G. 1992. *Francesco di Giorgio, Checklist and History of Manuscripts and Drawings in Autographs and Copies.* Bethlehem. No. 33, 96–98, figs. 39–40, 98, does not accept the attribution of vol. 2503 to Alberto Alberti.
    Forni. 1991. I, 7–12, for volumes 2501A, 2501B, 2502, 2504, in Rome: Gabinetto Nazionale delle Stampe.
    In 1987, the Gabinetto Disegni e Stampe, Uffizi, Florence, acquired a fourth volume with drawings of the Alberti family. See Cecchi, Alessandro. 1995. *Dieci anni di acquisizione 1984–1994, Uffizi, Gabinetto Disegni e Stampe.* Florence. No. 42, 29–30, album 114781.
18. Lamberini, D. 1991. La fortuna delle machine senesi nel cinquecento. In *Prima di Leonardo, Cultura della machine a Siena nel rinascimento*, ed. P. Galluzzi. Siena. Magazzine del Sale, Siena. Ex. cat. 9 June–30 September 1991. 143 and no. I.q.1, 252.
19. The drawing in the Uffizi is in Album 93697, folio 4 verso/5 recto, 35.5 × 106.4 cm. For the drawing of the Roman monument see Codex C, album 2502, folio 48v, 53.2 × 35.5 cm, Rome, Gabinetto Nazionale delle Stampe, in Forni. 1991. I, 135, ill.; II, no. CCXLII.
20. Alberto used both black and red chalk underdrawing. The drawing in the Uffizi mentioned above has red chalk underdrawing.
21. For the watermarks of paper used by the Alberti family, see Herrmann-Fiore. 1984. 289–98 and Forni. 1991. I, 193–204.
22. Scaglia, G. 1999. Personal communication. The closest drawing Scaglia has found to the one in the CCA is by an unknown Sienese artist, *ca.* 1520, Florence: Uffizi, Gabinetto Disegni e Stampe, 204 F verso, in Scaglia. 1992. No. 47, 126–27; fig. 63, 127.
23. Lamberini. 1991. Fig. 7, 139 and No. I.g.4.
    Florence: Biblioteca Medicea Laurenziana. Codex Ashburnham 361. Folio 37 verso, 216–17, ill.
    Scaglia. 1992. 16, 25, no. 62, 154–61. This codex has been published in facsimile. See Martini, F. di Giorgio. 1979. *Trattato d'architettura di Francesco di Giorgio Martini.* Florence.
24. Massimi, M. 1991. Un frammento del trattato di Francesco di Giorgio Martini nel Archivio di G. Venturi alla Biblioteca Municipale di Reggio Emilia. In *Prima di Leonardo, Cultura della machine a Siena nel rinascimento*, ed. P. Galluzzi. Siena: Magazzine del Sale, Siena. Ex. cat. 9 June–30 September 1991. 82–87, fig. 4, 83, no. I.e.4, Mss. Regg. A 46.9 bis, folio 2 recto, 206, ill. This fragment of a manuscript has been published in facsimile. See Massimi, M. 1991. *Il Trattato di Francesco di Giorgio e Leonardo: Il Codice Estense restituto.* Parma.
25. Taccola worked for the city of Siena as a hydraulic engineer and Francesco di Giorgio for Duke Alfonso of Calabria in Naples and Puglia between 1483 and 1484. Prager, F. D. and G. Scaglia. 1972. *Mariano Taccola and his Book* De Ingeneis. Cambridge: MIT Press. 3, 10–17.
    Galluzzi, P. 1991. Le macchine senese, ricerca antiquaria, spirito di innovazione e cultura del territorio. In 26–28, 36–37, a water pump by Taccola illustrated in *De Ingeneis.* Florence: Biblioteca Nazionale Centrale. Ms. Palatino 766, folio 18 verso/19 recto, no. I.c.3, 193, ill. The other autograph manuscript of *De Ingeneis* is in Munich, Bayerische Staatsbibliothek, Codex C M L 197 II, which has been published in facsimile. Taccola, M. 1984. *De Ingeneis*, ed. G. Scaglia and F. D. Prager. Wiesbaden: Ulrich Montag. 2 vols.
26. Galluzzi. 1991. 28, fig. 41; 34.
    Notes of Francesco di Giorgio in *De Ingeneis*, Munich: Bayerische Staatsbibliothek. Codex Latinus C L M 197 II, folio 130 verso. Scaglia. 1992. 15.
27. Galluzzi. 1991. 39–40. Milan: Biblioteca Ambrosiana. Codex Atlanticus, folio 1083 verso, no. I.b.3, 186, ill.
28. Galluzzi. 1991. 39.
    Scaglia. 1992. Florence: Biblioteca Medicea Laurenziana. Codex Ashburnham, 361. No. 62, 155.
    Marani, P.C. 1991. Francesco di Giorgio e Leonardo a Milano e a Pavia, consequenze e ipotesi. In *Prima di Leonardo, Cultura della machine a Siena nel rinascimento*, ed. P. Galluzzi. Siena: Magazzine del Sale, Siena. Ex. cat. 9 June–30 September 1991. 93–105.
29. Marani, P., M. Rosci and A. Rovetta. 1999. *L'Ambrosiano e Leonardo.* Milan: Biblioteca Pinacoteca Ambrosiana. Ex. cat. Intr. by G. Ravasi. 1 December 1998–30 April 1999. Codex Atlanticus, folio 995, no.1, 24–25, ill. 25.
30. Lamberini. 1991. 135.
    Scaglia. 1992. 75.
    Vitruvius. *I Dieci Libri di Architettura*, trans. D. Barbaro. No. 42, 117–18; fig. 55, 117; 261–62.
31. Lamberini. 1991. 135.
    Scaglia. 1992. 75.
    Zonca, V. 1607. *Novo teatro di macchine et edificii.* No. 77, 185–86; fig. 109, 186.
    For the *Opusculum*, British Museum, Codex 197 B 21, no. 1, 43–49; figs. 1–2, 49.
32. Zonca, V. [1607] 1985. *Novo teatro di machine et edificii.* Facsimile ed. with an introduction by C. Pini. Milan: Il Polifilo. ix–x.
33. Lamberini. 1991. 142–44.
    Florence: Biblioteca Nazionale Centrale. Ms. Palatino 1077, folio 75 recto, fig. 8, 140, no. I.k.6, 1–2, 234–35, ill.
    Scaglia. 1992. 75.
34. Lamberini. 1991. 143–44. See also Wine, H. 1996. Academy. In *The Dictionary of Art*, ed. J. Turner. London. Vol. I, 102.
35. Hills. 1992. 40.
36. Schlosser, L.B. 1979. A history of paper. In *Papermaking – Art and Technology.* San Francisco: World Print Council. 5. Hills. 1984. 67 (1).
37. Schlosser. 1979. 94.

A Technical Revolution in Papermaking, 1250–1350

RICHARD L. HILLS

Abstract

Around 1200, the paper produced in Spain, based on Arab techniques, is thick, poorly beaten, sized with starch and has no watermark. Although its appearance seems fine, it is liable to disintegrate around the edges when handled. By looking at sheets of paper made in Italy between 1250 and 1350, we can see that the character of paper changed completely. The technological advances that brought this about can be deduced by comparing earlier technology, that has survived in countries such as China and India, with that of ancient European handmade paper mills. We can identify improvements in pulping techniques, changes to paper moulds and the introduction of new drying techniques.

Long before 1400, Italians were producing a much thinner sheet of paper, better beaten, with watermarks and a gelatin size that was very strong so it withstood the use of quill pens and, later, printing presses. New papermaking techniques enabled paper to supplant parchment as a writing material, and the art of papermaking soon spread from Italy into the rest of Europe. Few changes were made to the equipment or techniques used in the mills for the next 400 years.

I received a telephone call last summer asking if I could identify the oldest sheet of paper discovered in the archives of the Hereford Cathedral library.[1] Someone in the papacy, while it was at Avignon, had used this sheet to write a letter to the ecclesiastical authorities in Hereford around 1308. The paper itself was quite different in character from later sheets and is further evidence of a technical revolution in papermaking occurring roughly between 1250 and 1350. If my thesis is correct, for 400 years, during a migration westward from China to southern Europe, papermaking underwent little technical development. Then a sudden and dramatic improvement occurred in Italy that set the style of papermaking for the next 400 years, until the advent of the machine.

While the background to this research has been carried out over many years in many different countries, I will base my contribution to this symposium on this sheet and three later ones, also in the Hereford Cathedral archives, to see how we can reconstruct what happened to change the style of papermaking. We will use evidence from the historical background, evidence from examining the artefacts themselves, evidence from primitive techniques which survive today or have survived until recently, and archival or pictorial evidence. In addition there could have been chemical tests, microscopic examination or modern reconstructions of ancient techniques, but none of these methods were available in this case.

Historical evidence

The letter written on our oldest sheet of paper gave us a place and a date. It is from Avignon in the south of France. The earliest traditionally accepted date for the start of papermaking in that country is 1326, although evidence for this is slim; better-authenticated dates are 1338 or even 1348.[2] Whichever you choose, this shows that this sheet of paper could not have been made in Avignon or in France. Where else was paper being made at that time? The Arabs had started to make paper in the south of Spain around the middle of the tenth century. However, it is probably of great significance that there was always hostility between the Muslim Arabs in the south of Spain and the Christian Europeans in the north during this time. This almost certainly prevented the transfer of papermaking through Spain and into the rest of Europe by this route.

The art of papermaking spread through Sicily into Italy itself by another traditionally accepted date of 1269, but in fact it must have been much earlier, around 1210. There is now considerable evidence to show that the region around Genoa was a very important area for early papermaking, and probably preceded Fabriano.[3] We must also note another traditional date, 1282, for the introduction of the first watermarked paper at Fabriano in central Italy.[4] In this period Italian paper was already showing signs of a technical revolution in manufacturing while that produced in Spain was not. So this may give us a clue to the origin of our sheet of paper, because the papacy had fled from Rome to Avignon, and might therefore have preferred establishing trading links with Muslims in Spain rather than hostile Christians in Italy.

Visible evidence

Now let us turn to the primary evidence we can gain from this sheet of paper itself (fig.1). Discolouration over a large part of its surface indicates it must have become damp at some time in its life, but in those areas unaffected, the surface is fairly shiny and a bit whiter than later papers. Handling the paper shows that, while it is thicker than later sheets, it is much more flexible and softer. But what is noticed immediately by a quick glance is the roughness of the surface. Lumps of fibres can be seen and there are even short lengths of twisted thread or yarn. At the edges of the sheet or where the surface sizing has been destroyed, the paper is fuzzy or furry, showing quite long whitish fibres rather like cotton wool, suggesting that the coating has not penetrated far. It is obvious that this paper would quickly disintegrate if handled extensively. When the sheet is held up to the light, the clumps of long fibres can be seen clearly in large blotchy patches. However, the thickness of the sheet and the long-fibred pulp obscure detail of the construction of the mould on which the paper has been made. It is possible to make out chain lines at a spacing of 55 to 56 mm, although the laid lines are not visible enough to measure

them.[5] All of this is typical of early Arab paper made in Spain, and therefore all the evidence we have seen so far confirms that this sheet could have been made just before 1308 in that country.

Pulp preparation

The next stage is to see if we can determine how this sheet of paper might have been made and why it is so different in many ways from later ones. The short pieces of twisted yarn show that it has been derived from some textile fibre. The appearance and fineness indicate a cellulose origin rather than wool. This points towards the traditional papermaking sources of rags made from linen cloth, or hemp ropes — probably the former in this instance. These remained the usual fibre sources for better-quality paper in Europe until the middle of the nineteenth century. While the raw material used to make our sheet of paper is similar to that used later, there is a great difference in the way this material was prepared. There must have been some form of beating process to break up and disintegrate this basic material. While crushing it under the stones of an edge-runner or *kollergang*[6] has been suggested, there is no evidence for the use of such a machine in places where handmade paper continues to be made (China, Nepal, India and Kashmir). Nor do surviving handmade mills in Europe, such as those in Italy, Spain and France, have such equipment.

On the other hand, we can trace the development of the hand-held stick beater used to prepare tapa cloth in the Pacific islands, through the hand-held mallet or hammer used in China and Japan, then finally into the foot-operated tail stamper. The foot-operated stamper was also used for hulling rice in China and was easily adapted for papermaking. It is almost certain that this was the device taken by papermakers as they migrated slowly westwards, so it could have eventually been introduced by Arabs into Spain. The Arab Emir Mu'izz ibn Badis, who lived between 1007 and 1061, instructed that after the fibres had been cut with scissors into short lengths and bleached, 'beat the fibres in a stone mortar, making sure they remain fresh and moist.'[7] This certainly sounds like pounding with a pestle or hammer rather than crushing under a heavy stone, and points to something else: that the rags were not being pulped while immersed in water.

The foot-operated stamper may still be used in India at the present time, since it was certainly in use up to the Second World War.[8] It was operated by one or two men who pressed down one end of a long, pivoted beam to raise the heavy hammer head at the other end. They let it fall onto a slab of stone, where another man pushed small pieces of rags soaked in water under the head for pounding. This sounds rather similar to the method of Emir Mu'izz ibn Badis. We can imagine how labour-intensive and therefore expensive this process must have been, and how the person shoving the raw material under the hammer head would have been tempted to skimp on his job. It would be necessary to add water during the beating process so that the pulp remained 'fresh and moist.' A better-quality pulp resulted from the material being returned to the same stamper two or three times, but obviously this took longer. This poorly-beaten pulp would consist mostly of long fibres and would drain quickly on the mould.

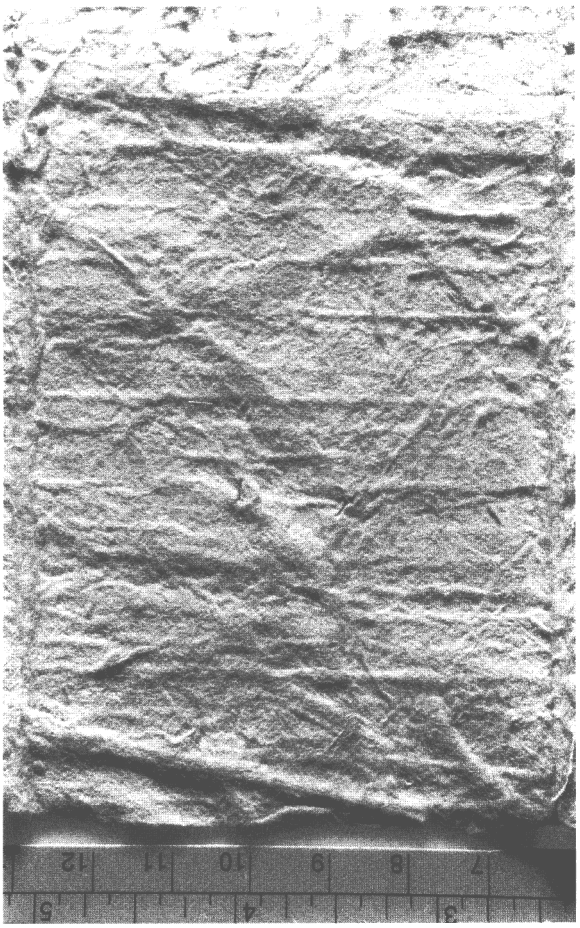


Fig. 1 Probably a Spanish/Arab paper used for a letter written around 1308 from Avignon to the ecclesiastical authorities in Hereford, Hereford Cathedral archives, no. 1443, by permission of the Dean and Chapter of Hereford Cathedral.

It was probably in Europe that the person or people who raised the stamper head were replaced by a water-wheel. Here again we have an accepted date for this, in Xativa, Spain, in 1151, but it did not lead to the technical revolution occurring there.[9] This would have reduced cost and would have been easier to operate for longer periods to beat the pulp better. A primitive form of water-wheel-operated stamper, with a single head where a man shoves the rags underneath, survived in Kashmir as late as the 1930s.[10] On this machine the cams on the drive shaft pushed down the tail of the shaft, but on surviving western models the cams lifted the end at the hammer head, like the arrangement in fulling stocks. Fulling stocks were probably the crucial element in our technical revolution (fig. 2). First, they had a pair of hammer heads. Second, they did not hammer the cloth with a vertical blow but pummelled it so the cloth rotated as it lay in the trough. In this way it was treated evenly. Third, the trough could contain water and fuller's earth for washing the cloth. Finally, the layout of the stocks with the camshaft close to the heads meant that access to the troughs was restricted.

We must now turn to our second sheet of paper from Hereford Cathedral (fig. 3). This has been dated to 1322–23 and is most likely Italian; it has an indis-

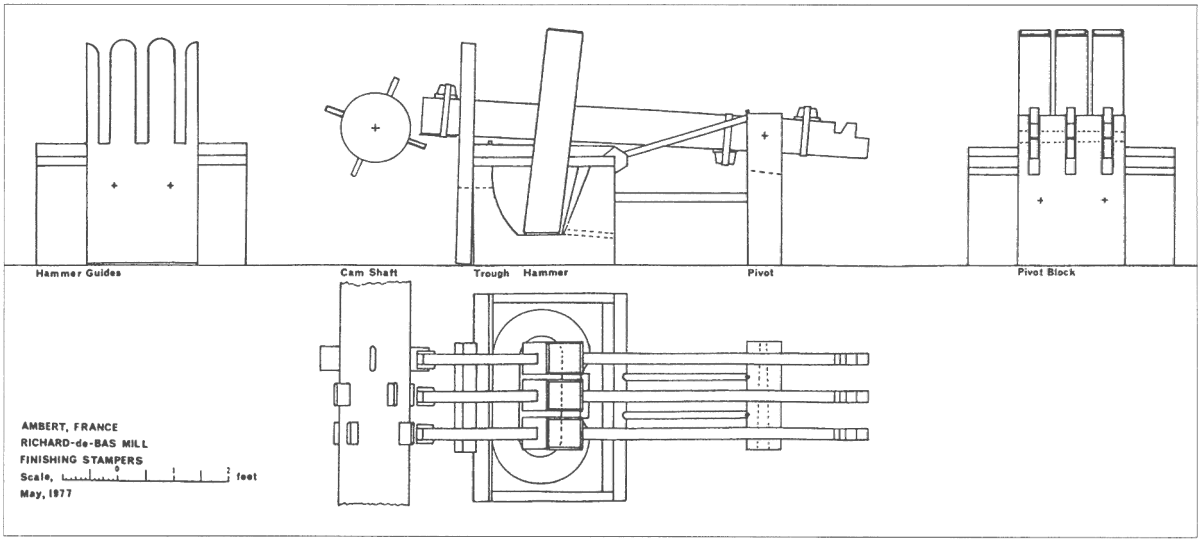


Fig. 2 Finishing stampers in the Richard-de-Bas mill, Ambert, France.

tinct watermark, so it cannot be Spanish.[11] The first improvement by the Italians was in beating the pulp. Even a quick glance shows that the surface of this sheet is much smoother. Holding it up to the light reveals that the lengths of twisted yarn and clumps of fibre are missing, even though the furnish is still thick and heavy. How was this improvement in beating achieved? We must jump to surviving artefacts in remaining water-powered mills in Italy and Spain, where we discover three probable developments. The first is that the man pushing the rags under the hammer head has been replaced by a trough filled with water in which the rags can circulate, giving much more even pulping. The second is that, instead of a single stamper head, there are now usually three or more, which provide a more thorough beating. These two changes alone would result in an improvement in the pulp as well as a reduction in costs. We can see the influence of the design of the fulling stocks, but no doubt the development was slow as angles of shafts and heads were altered to achieve the optimum performance. This could have been an intermediate stage in the development of stamper units, which is reflected in these early sheets of Italian paper. Typically they have a long-fibre pulp which makes it difficult to distinguish the watermark, and so it is also difficult to make out the construction of the mould with its chain and laid lines. Such is the case with this second sheet of paper from Hereford Cathedral, another indication that its date is early.

The third sheet from Hereford Cathedral is much later, dated 1375–1400.[12] It shows a marked improvement in pulp preparation, with shorter fibres so that the mould construction can be seen much more clearly (fig. 4). This is where our third improvement must have been introduced. If we look again at European mills where stampers have survived, we will see that there are sets of three or more troughs in which the material was passed in succession from one to the next. An examination of the bottoms of the stamper heads will show the reason why. In the first trough the bottom end of the head had special nails driven into it, each of which ended in a single sharp rib so that they would cut the rags against a metal bedplate. In the next the heads of the nails have three blunter ribs, to pound as well as cut the rags and fibres. In the third set the stamper heads had no nails and pounded the pulp to fibrillate it. Here we have a process with the potential for preparing an even pulp with short fibres to produce smoother paper.[13] Such well-beaten pulp would have greater bonding strength

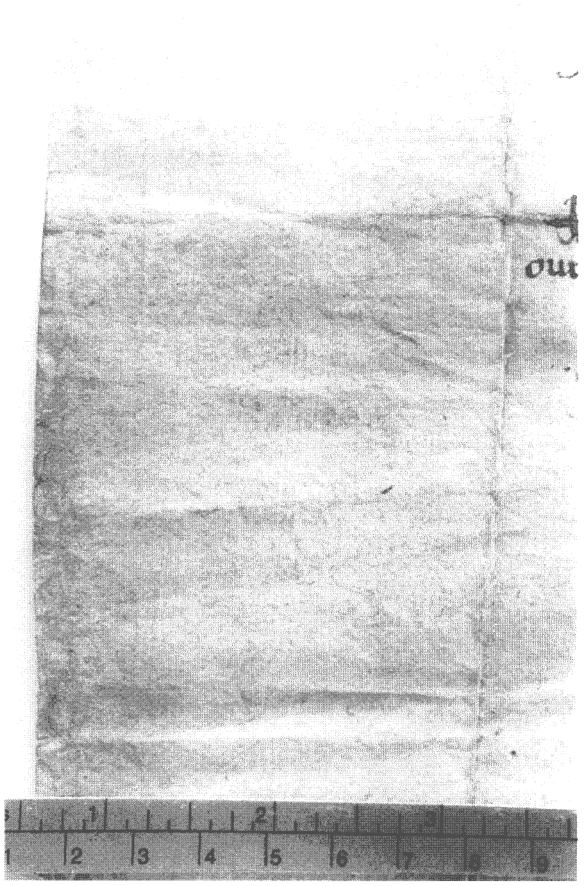


Fig. 3 A letter dated to 1322–23 which is most likely on Italian paper. The lines across the surface of the paper are probably caused by the sizing technique. Hereford Cathedral archives, no. 3004, by permission of the Dean and Chapter of Hereford Cathedral.

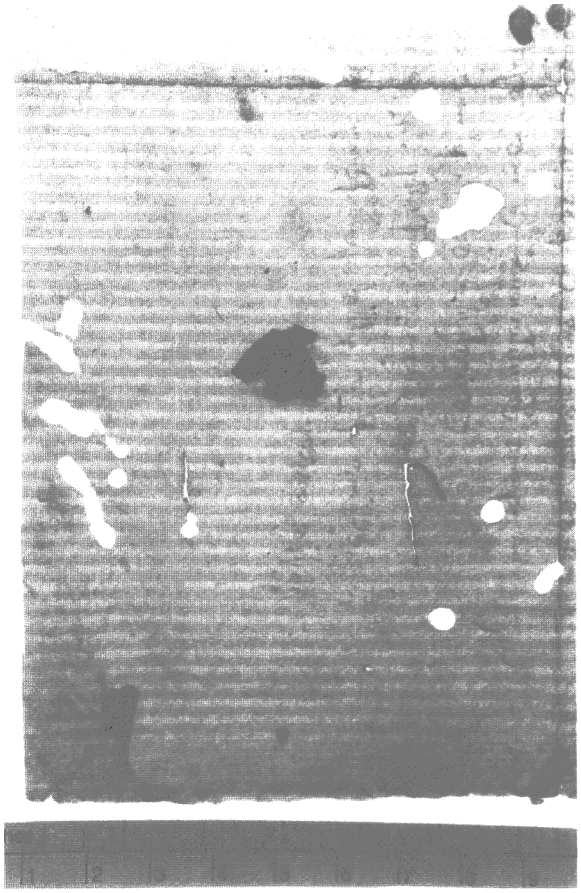


Fig. 4 The mould construction can be seen more clearly in this sheet dated around 1375. The very thick laid lines should be noted. Hereford Cathedral archives, no. 3188, by permission of the Dean and Chapter of Hereford Cathedral.

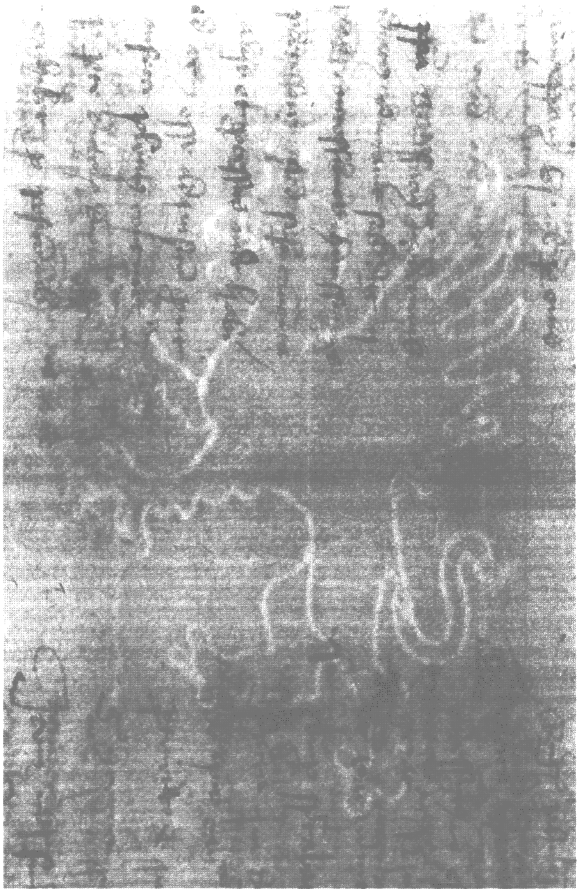


Fig. 5 The griffin watermark along with the narrow laid lines and fine chain lines reveal the transformation which had occurred in paper production by the date of this sheet, *c.* 1343. Hereford Cathedral archives, no. 3205, by permission of the Dean and Chapter of Hereford Cathedral.

and drain more slowly. These qualities would enable the papermaker to produce thinner, stronger sheets with clearer watermarks. We can see this in another sheet of paper from Hereford Cathedral (fig. 5), dated to 1393–96, with a griffin as a watermark.[14]

An Italian drawing from the middle of the sixteenth century which was discussed at this symposium shows three heads per trough but only two troughs, one on either side of the water-wheel.[15] The set of stamper troughs in the paper museum at Capellades in Spain has three troughs, each with these different types of stamper heads. Remains in other mills in that region confirm that this was the usual layout there. Italian mills such as Pescia and the Richard de Bas mill at Ambert in France have more troughs but still have only the three different types of stamper heads. The reason for more troughs is that two or three are used for the cutting stage, two for the second stage but only one for the last, all tending to produce better pulp. The oldest printed picture of papermaking stampers, that by Zonca of Italy in 1607, shows eight heads and multiple troughs, but the precise number of these cannot be determined.[16] In Zonca's picture and in French and Spanish mills, the water-wheel was placed at one end of the camshaft lifting the stamper heads. Therefore the final system and layout must have been improved over a number of years but its origins must have been in Italy towards the end of the thirteenth century.

The Mould

Improvement in Italian pulp preparation seems to predate developments in mould construction and sheet formation. It could well be that the slower drainage of better-beaten pulp necessitated changes in couching off the sheet of newly formed paper from the mould. The mould has a special sieve or cover through which the water in the pulp can drain, leaving the fibres behind on the surface to make the sheet. Right up until the middle of the eighteenth century this cover was nearly always made with the same basic structure, which dates back almost to the first days of papermaking. It consisted of thin parallel strips of grass, reed, bamboo or, later, bronze wire (the laid lines) running from side to side and bound together by chain lines made from thread, horsehair or thinner wire which ran from top to bottom. The water ran out through spaces left between the laid lines, leaving the fibres on top. This cover was supported by the wooden framing of the mould, which normally had ribs in the middle, also running from top to bottom, under the positions of the chain lines to keep the cover flat.

The earlier eastern tradition has been, and still is, to have a loose cover which can be taken off when the sheet of paper has been formed.[17] After it has drained, the sheet is removed from this cover by turning both upside down, placing the wet sheet on top of the previous one and peeling the cover off the top. This is possible through

the flexibility of the chain lines. We have no evidence of this type of mould being used by Arab papermakers in Spain. Emir Mu'izz ibn Badis does not describe how the paper was couched off the cover or mould. One translation of his account reads,

> You put the mould in it [a large vat] and shake it from right to left and from front to back, and with your hand you even out the pulp left on the mould so that it does not come out thinner on one side and thicker on the other. When the pulp is well spread out, you leave it on the mould until it has the desired consistency. Then you transfer the sheet from the mould to a flat plate.[18]

I have no idea whether this confused account originated with Emir Mu'izz ibn Badis or with the translator, but one possibly significant point that is missing here is the mention of felts, a feature particularly associated with Italian papermakers and wool merchants. Therefore I ascribe to the view that the Arabs in Spain were still practising the earlier eastern methods of papermaking, using a mould with a removable cover, and that this was probably how the oldest sheet of paper in the Hereford Cathedral archives was made.

Of what material might the cover for this Spanish mould have been made? The Arabs were, of course, skilled workers in metal and so could have used metal strips for their laid lines. The binding chain lines would almost certainly have been sewn up either with thread or horsehair. This was probably continued on early Italian moulds, where we can see that the chain lines are very narrow. Flexing a removable cover would have work-hardened copper or bronze wire, so fine chain lines made of these substances would have broken quickly. It is unfortunate that the long-fibre pulp on our earliest western Italian papers makes it very difficult to distinguish the laid lines and so determine their size accurately. Where they can be seen, they appear to be quite thick. If the Arabs used strips of reed and the first Italian mould makers followed their example, there is no reason why a watermark profile made from wire could not have been sewn on top of such a cover, provided it were fixed to the mould. So this could have been an intermediate stage. There survives in Italy an ancient wire profile made from silver, so perhaps that is how the first watermarked covers were made, with a silver-wire profile sewn onto a reed or cane cover which in turn would be sewn onto the mould framing. Perhaps the Italian papermakers had difficulty in couching off their better-beaten, wetter sheets of paper and needed a more rigid type of mould. The western mould has the cover attached to its upper surface. When the new sheet of paper has drained on the mould sufficiently, both are turned upside down and the paper couched off onto a felted blanket. When the mould has been lifted off, another felt is placed on top so the sheets of paper are separated by layers of papermaker's felts.

Are we able to determine the steps in which changes from the eastern to western mould may have occurred — through our Hereford sheets of paper? At least we have evidence for a change in the construction of the mould. I mentioned that on our earliest sheet of paper we could see chain lines spaced at 55 to 56 mm apart. Those on the last must average something like 38 mm. This is consistent with the development of narrower chain-line spacing over the years, covering the transition from Spanish-Arab moulds to the traditional western type of mould.

There is also evidence in the watermarks. A more appropriate name for a watermark would be a wire mark or wire profile, because these watermarks, which show up in the paper as a lighter part of the sheet, are made from lengths of wire bent to the appropriate shape and stitched onto the surface of the cover. Therefore they protrude into the pulp on the mould, causing thinner and hence lighter places. Because these wire outlines are stiff, if they were sewn onto the flexible cover of the eastern mould they would soon come off as the sheet was being couched. Therefore a watermarked sheet of paper must have been couched on a rigid mould where the cover is firmly attached to it. Hence watermarked papers, such as those originating from Fabriano around 1282, must have been produced with some embryonic form of western mould.

From the two earlier sheets of paper at Hereford Cathedral we can distinguish little of the mould structure except that the chain lines are at 55 mm and 50 mm respectively — again indicating early paper. But on the third sheet, dated to the last quarter of the fourteenth century, we can see heavy laid lines 1.2 mm apart covering most of the sheet, but some very fine ones at top and bottom for about 15 mm. By this date we must surely be looking at metal wires. It has been suggested that the earliest metal wires were cut from a sheet and then hammered round. This could mean that they were fairly thick and heavy, so it is possible that this is what we are seeing here. This does not account for the narrower laid lines at the edges, which remain a mystery.

Wire-drawing in Europe dates from about 1100.[19] The art was known in Italy before Germany. Evidence for the spread of this art, so essential for the western papermaking mould, is still lacking.[20] Drawing wire would have been a cheaper method than hammering and, as the art was improved, would have produced thinner wire. We can see this in our fourth sheet of paper.[21] The diameter of the wires forming these laid lines must be 1 mm or slightly less. We can also observe that the chain lines are thicker than on the earlier sheet. What must have happened here is that the fine horse hair or thread has been replaced by wire, even though the wire-drawer did not yet have the skill to make it quite as thin as the thread. From this date onwards the construction of traditional western hand-moulds would alter very little.

Pressing the paper

A further difference between eastern and western papermaking is that in the West, newly formed sheets had as much water as possible removed by subjecting them to pressure in some form of press. This may have been necessary because the better-beaten pulp would have retained water longer. Some water is necessary to help

remove the sheet from the surface of the cover when couching with the western mould, but I have no experience of eastern types. In surviving mills we can still see the heavy wooden framing supporting press heads that are driven down by a screw. This was a type of press used in the woollen industry for pressing cloth and later would be developed into the printing press. The lever press, found in vineyards, does not seem to have been used for paper in the West, although it has been in the East.

The Drying loft

Ibn Badis said, 'You transfer the sheet from the mould to a flat plate, and with the help of this, you place it on a clean, smooth wall where you leave it stuck until, once dry, it comes loose.'[22] His account of drying paper follows eastern practice as found in Kashmir and India. The wet sheets were couched off on top of one another, with a board or flat plate placed underneath to support the pile. Then they could be carried to a place where they could be spread across a plastered wall and left to dry. There are accounts of people chasing down the street after sheets which the wind had blown off. In the Italian town of Amalfi, a couple of old papermills have never had drying lofts above them where paper could be hung up on ropes and left to dry. Might drying lofts be another Italian development? Lofts would be essential when papermaking spread to the wetter, colder regions in Europe north of the Alps.

Sizing

We are on firmer ground when we examine the sizing of these sheets of paper from Hereford Cathedral. The size traditionally used in the East and by the Arabs was a flour or starch paste. In India, until recently, this would be applied and smoothed across the surface with a gloved hand. When dry it would be polished with a smooth stone. Presumably this was the way the Arabs sized and polished their papers. Although chemical tests have not been carried out, I am certain that starch size is what would be found to have been applied on the earliest sheet of paper from Hereford Cathedral. The application of this size as a paste rather than a liquid supports my observation earlier that the size appears to have remained on the surface and not penetrated far into the fibres. This would account for the fuzzy, cotton wool-like appearance where the size has been worn away. It would mean that, once the sized surface was destroyed in some way or removed by handling, the fibres underneath would not have much cohesion.

The second Hereford sheet has quite a different surface. It is much harder, and is evidently a gelatin rather than a starch size. Gelatin size gives a much harder surface, which was better for writing on with a quill pen, as used in the West, than for painting with a brush in the Chinese manner, which is suited to softer, starch-sized papers. If this sheet is held so light shines across its surface and it is positioned almost horizontally just below eye level, the size does not appear to have been applied very evenly and there are lines or scratches across the surface. In some other sheets made about the same date, it looks as if the size has been applied with a brush, and this method (or the gloved hand) may have been the way the early Italian papers were sized, following the Arab example.

When the two more recent sheets from Hereford are examined in a similar raking light, the sizing on their surfaces appears much more even. Ways of sizing handmade paper that have survived until recently are either by dipping the sheets into a bath of size or pouring the size over the sheet. We can understand immediately why these methods would have placed a more even layer over the sheet. A liquid would penetrate further among the fibres, helping to adhere them all together and so make a tougher sheet.

Who made these changes?

Historical tradition links the spread of papermaking in Italy with wool merchants who already had their trading links well established. As well as wool, they would have been in a position to trade in the skins of sheep from which the earlier writing material, parchment, was made. However, this is my speculation, because I have never seen any discussion about trade in parchment. What is significant is that many of the western improvements in papermaking techniques can be seen to have links with the woollen industry. Western stampers have been based on the layout of fulling stocks used to clean and compact woven cloth. Fulling stocks by 1300 were driven by water-power, and such mills could have been converted easily into paper mills. While development of the mould has no traces of influence from the woollen industry, couching the newly formed sheet onto a felted blanket obviously does. The screw press again was almost certainly adapted from linen or other textile presses. Gelatin size would be made from boiling up parts of animals such as hooves, skins and bones, raw material to which wool merchants might have had access. Another indication of these links is found on an old paper mill in Capellades; the keystone of the arch over the main door is carved with emblems of finishing woollen cloth — teasels and hand shears. Incidentally, some form of hand shears could have been used initially to cut up the rags.

The trading connections of the wool merchants, across Italy and then into the rest of Europe, may have contributed to the spread of papermaking. I have suggested that improving the stampers reduced the cost of pulp preparation. Making the sheets by the western method was quicker than earlier ones, again tending to reduce the price. Therefore paper became more competitive against parchment, and I am sure it is significant that papermaking spread into northern Europe *after* the improvements in techniques outlined here had taken place. We find that mills were spreading across the northern parts of Italy during the middle years of the fourteenth century, for example, Padua in 1339, Urbino in 1375 and Turin in 1392. North of the Alps, we have the possibility for the first one appearing in France at Troyes in 1338 or 1348. In Germany there were mills in Nuremburg by 1390 and Switzerland as well — Freiburg in 1411 and Basel in 1434 — just to mention a few of

the earliest in each country.[23] Britain lagged behind with John Tate's mill being established around 1494. This new style of papermaking spread into northern Spain in the Catalonia district and ousted the earlier Arab methods. This shows how the Italian-style paper superseded not only the earlier Spanish paper, but also parchment. More importantly, it formed the basis for the printing presses of Gutenberg, which were so vital for the development of our civilization. Yet we still know very little about when and where these changes in manufacturing techniques were introduced. Our understanding of this will only be improved by studying more closely the surviving evidence — the paper itself.

Acknowledgements

I wish to thank the staff of the Cathedral Library at Hereford for their help in the preparation of this article. The archivist, Mrs R. Caird, identified these documents as examples of early paper and recognized their significance. The librarian, Miss J. Williams, was most helpful, especially with the production of the photographs.

Notes

1. Hereford Cathedral archives, no. 1443.
2. Gachet, H. 1976. Some remarks and reflections concerning the introduction of paper and its manufacture in the Mediterranean world. Paper presented to the International Association of Paper Historians Congress, Fabriano. 7.
3. Tschudin, P. 1998. Paper comes to Italy. In *International Paper History* No. 3. Paper given to the International Association of Paper Historians Congress, Portugal. 44. Cervini, P. 1995. *Edifici da Carta Genovesi, Secoli XVI–XIX*. Genova: SAGEP.
4. Hunter, D. 1947. *Papermaking, The History and technique of an ancient craft*. New York: Dover Publications. 260.
5. Loeber, E.G. 1982. *Paper Mould and Mouldmaker*. Appendix VI. Amsterdam: Paper Publications Society. 73.
6. The *kollergang* has a circular trough in which the material to be pulped is placed. A stone disc, set vertically, is pushed around in the trough and crushes the material.
7. Valls i Subirà, O. 1978. *The History of Paper in Spain, X–XIV Centuries*. Madrid: Empressa Nacional de Celulosas 1. 67.
8. Clapperton, R.H. 1934. *Paper, an Historical account of its making by hand from the earliest times down to the present day*. Oxford: Shakespeare Head Press. 54.
9. Valls i Subirà. 1978. 130 f.
10. Clapperton. 1934. 48–49.
11. Hereford Cathedral archives, no. 3004.
12. Hereford Cathedral archives, no. 3188.
13. Hills, R.H. 1984. Papermaking stampers: A Study in technological diffusion. In *International Association of Paper Historians Year Book 5*. 67–76.
14. Hereford Cathedral archives, no. 3205.
15. See Burns, T., and M. Rosenfeld. 2001. *Design for Water-Powered Stampers*: Early Italian papermaking technology illustrated in a drawing in the Canadian Centre for Architecture, Montreal. In *Looking at Paper*. Ottawa: Canadian Conservation Institute. 99, fig. 1; 100, fig. 2.
16. Zonca, V. 1656. *Novo teatro di machine et edificii*. Padoua: F. Bertelli. 95.
17. Hunter. 1947. 84.
18. Valls i Subirà. 1978. 71.
19. Clapperton. 1934. 79.
20. Balston, J.N. 1998. *Whatmans and Wove (Velin) Paper: Its invention and development in the West*. West Farleigh: J.N. Balston. xxiv.
21. Hereford Cathedral archives, no. 3205.
22. Valls i Subirà. 1978. 71.
23. These dates were taken from an exhibition held in 1990 at Nuremberg to mark the 600th anniversary of papermaking in Germany.

Quality *and* Quantity? Eighteenth-Century Acceleration of Hand Methods of Papermaking

PIERRE CLAUDE REYNARD

Abstract

The methods at work in European paper mills before the spread of the paper machine had matured in the Middle Ages, when oriental principles were adapted to European needs and resources. The longevity of these practices offers a good illustration of the stability of early modern technologies, a stability that should not, however, be confused with immobility. The manner and the environment in which papermakers operated never stopped changing. The following pages turn to one crucial dimension of change in the lives of papermakers, the increasing pace at which they worked. How did papermakers reconcile the imperatives of quality and quantity as the output of their mills grew?

A comparison of papermaking in the fifteenth and eighteenth centuries is hardly possible, because of the disparities of the sources. Consequently, much of what follows will be concerned with papermaking on the eve of mechanization, when the rate of change accelerated. The scale, pace and skill requirements of eighteenth-century papermaking will first be recalled. Then the quality of early modern paper will be assessed, with particular attention to the multitude of complaints faced by papermakers. Finally, the ways the papermakers addressed the quality challenges facing them will be described.

By the eighteenth century, the mills of France, Italy, England, the Low Countries and Spain dominated European markets. Some rare aggregate figures reveal an important industry, whose value of output ranked between that of the linen- and the soap-making sectors in France. In this kingdom alone, some 900 to 1,000 vats were at work on the eve of the Revolution. They produced between 11,500 metric tons (mt) and 20,000 mt of paper, two figures that remind us of the precariousness of quantitative data before the nineteenth century. Nonetheless, a rough comparison is possible with the output of English mills, which approached 5,000 mt at the end of the same century, and that of Dutch mills, which had likely reached 2,000 to 3,000 mt a few decades earlier. In the better documented English context, we are also told that per capita consumption of white and coarse paper had steadily grown from ¼ pound around 1600 to 1½ pounds in 1715 to 2½ pounds late in the same century.[1] It appears that between 1638 and 1800, British paper mills quadrupled their output, while their number only doubled. In the Auvergne, France's leading papermaking region, production increased fivefold from the early 1680s to the late 1770s.[2]

The growth of the papermaking industry was supported by broad commercial, administrative and literary expansion. Most important to remember is the surprising number of uses to which paper was put. Paper wrapped a wide range of goods, from delicate fruits to gunpowder to sugar to pins. It also served to make playing cards, pasteboards, fans and a multitude of decorative objects. It gave lustre to textiles through the hands of cloth pressers, decorated furniture and walls, offered cheap protection from the elements when oiled and assisted hair dressers in their art. Writing and printing reached well beyond the areas of intellectual inquiry or didactic and entertainment publishing. Commerce floated on a sea of paper and, notably, a rising tide of advertisement, while administrations cultivated their taste for paperwork. Reading touched an ever-wider public through cheap editions and the posting of news on the walls of expanding cities. Paper should also be seen as an experimental material. Some enterprising manufacturers envisioned the making of large sheets intended, once tarred, to protect the hulls of ships from the marine life that afflicted them in tropical waters. Another went as far as patenting a paperboard intended for house and ship building! Even if such projects proved less than successful, it is clear that, contrary to what a cursory reading of literacy statistics may suggest, few households would have lacked some paper goods.[3] By the end of the early modern period, paper was becoming an object of common usage, and papermakers obviously responded to this demand.

A further proof of the growing availability and popularity of paper is to be found in its dropping price. This demonstration is complicated by the very diversity of papers made and sold over several centuries, the fluctuations of the many currencies in which paper was traded and the absence of serial data. Yet, it is possible to assemble a composite series of the price of a mix of paper sold by three mills of the Auvergne for the last century of the *ancien régime*.[4] The price of paper from this leading region at the mill's door dropped below 10 *sous tournois* per pound early in the century, and remained below this threshold over the following six or seven decades, in spite of the inflationary trend affecting many other commodities during the same period. Papermakers often contrasted this stability with the substantial increase characteristic of the cost of rags, and worried about the diminishing profitability of their trade.[5] Consumers, however, would no doubt have come to appreciate the fact that, if paper remained far from cheap in the eighteenth century (since a pound of paper cost between a third and a half of the day wage of a labourer), it was nonetheless becoming increasingly affordable.

Like many other industries, papermaking shows signs of concentration in the eighteenth century, although a majority of mills still employed less than a dozen people around one vat. Some dynamic papermakers had gathered several mills in their hands as early as the seventeenth century, and some very large units opened in the middle of the following century. However, big or small, all mills

displayed the same substantial but limited degree of mechanization, the same advanced division of labour and yet the same need for qualified hands. Each vat required the services of four or five highly skilled workers, the beaterman, the vatman, the coucher, the layer and the sizeman (who, in small mills, could well be also the beaterman).

Those familiar with this trade, both in its historical dimension and in its present state, cannot fail to be impressed with the productivity of early modern teams. All accounts suggest that an average team produced between 5 to 12 reams a day (2,500 to 6,000 sheets), depending on the type of paper made. The records of the Montgolfier mills (Annonay, France) show all of their teams consistently producing over 5,000 sheets per day over many years late in the eighteenth century. Both government regulations and regional customs defined a proper daily workload just under such numbers, but all agreed that piece-rate supplements were fully appropriate. J. de Lalande remained vague when he suggested a maximum daily output ranging from one to nine reams for paper varying from 6 to 130 lbs per ream, but two rulings tell us more. In 1688, the administration ended a labour dispute in the Auvergne by posting the requirement of a daily output of between five and eight reams, according to their weight. A similar settlement in the Angoumois a few years later demanded the production of 4,977 sheets at 13 lbs per ream (130 lbs of *petit compte*) or 2,360 sheets at 35 lbs per ream (165 lbs of *royal*) or 1,320 sheets at 60 lbs per ream (158 lbs of *impérial*). It appears that workers were expected to produce their weight in paper before they could benefit from the piece-rate supplements they likely had come to expect in periods of high demand.[6]

These figures imply the formation of a sheet every 5 to 10 seconds. During that brief time, the vatman fitted the deckle on a mould, plunged it partly into the warm cellulose pulp, pulled it out, shut the fibres through the shaking of the dripping mould and slid it toward the coucher while retrieving the deckle. The coucher grabbed the newly loaded mould while handing back an empty one to the vatman and laid it to drain on the horn. He then laid a new felt on his post, on which he delicately overturned the fresh sheet of paper. He finally turned back to the vat to trade moulds again. This rapid exchange was repeated until a post was ready for pressing.

Other tasks demanded skill and experience, if less coordination of movements. Both the retting and pulping of rags required sharp visual and tactile monitoring. The handling of damp and still fragile sheets after the first pressing had to be attentive and light. Their sizing in a gelatin bath called for a rapid but even leafing movement, as well as a subtle awareness of atmospheric conditions and knowledge of the animal by-products used. The polishing of dry sheets may have been of little risk to their structure, but it conditioned their receptivity to ink. A final inspection entailed the rapid handling of each sheet before packaging. In the eighteenth century, Dutch papermakers introduced a practice known as *échange*, which called for a succession of light pressings between which individual sheets were rotated. Varying the areas of contact between adjacent sheets before the initial drying delivered a more uniform grain, yet such handling of fresh sheets at great speed could only be done by steady hands.

Without allowing for a measure of productivity gains in paper mills, data clearly reveal a pattern of incremental improvements characteristic of early modern technological complexes. Close examinations of early sheets have documented the refining of the mould's chain and laid wires to maximize support and draining, their eventual use in pairs and the appearance of a two-sheet mould for lesser formats late in the seventeenth century. A sparse iconography has recorded improvements to the bridge where the hands of vatman and coucher met, the heating of the pulp to ease its draining and the quest for ways to refill and stir the vat without disturbing work. In the seventeenth and eighteenth centuries, mechanical rag-cutting, trip hammers, glazing rolls and friction calenders accelerated the first and last stages of papermaking, while alum helped control sizing. The shape and number of stampers, their mallets and their metal-studded heads had been frequently amended before the eighteenth-century arrival of the hollander. This Dutch invention eliminated the retting stage and shortened pulping time, but rather enhanced the skills of the beaterman. The introduction of steam drying, hydraulic presses, iron water wheels, vat agitators and the bleaching of rags attests to the continuing pursuit of efficiency just before the paper machine recast the craft.[7] The productivity gains resulting from these improvements could only magnify tensions around the crucial tasks that remained entirely dependent on human skills. The resulting imperfections have left numerous traces.

A Less than perfect output

Once experience had alleviated initial fears about the fragility of paper, consumers learned to look for thinness, or a thickness appropriate to intended use, and opacity; strength with regard to tears, scratches and folding lines; whiteness or, later, a bluish or creamy tint; the absence of foreign particles, stains, discolouration, air bubbles, water drops, ripples, fingerprints, partial tears or even stretching; uniformity of grain (itself dependent on intended use); appropriateness of sizing; fullness of sheet (including clean edges); and uniformity of these characteristics within and between batches, particularly for paper destined to be bound in volumes.

It is generally agreed that the fourteenth and fifteenth centuries witnessed considerable amelioration to the quality of paper in all these areas, reflecting the spread of the methods pioneered in Italy which were well suited to European resources. The record of the following two centuries is, in contrast, most often seen as one of erosion of quality, linked to the multiplication of mills fostered by the rise of the printing industry. The wealth of evidence available for the eighteenth century reveals a more mixed picture.[8] Good paper and bad paper abound because of the diversity of national and regional contexts, but also because even the best producers could not help but make both. They were indeed quite aware of the unevenness of their production.

The correspondence of de Canson, a leading French manufacturer in the early nineteenth century, registered the incessant complaints of his customers. A generation earlier, his predecessors, the Montgolfiers, had tacitly acknowledged the validity of similar charges by readily granting disgruntled clients a rebate. An educated comparison was made in the second half of the nineteenth century by a manufacturer-turned-historian of the Angoulême (France) paper industry. A. Lacroix observed that early modern Angoulême paper — ranked among the best in France — was less pure, less white and of a rougher surface than even fairly common sheets of his own mills. A study of seventeenth-century sales in this same region confirms that parties to the trade anticipated unsatisfactory deliveries. Contracts included a sample sheet, the name of a third party to arbitrate disputes and a scale of the discounts to be granted. In spite of such precautions, merchants 'not infrequently' refused a delivery of paper because of its poor quality.[9]

The correspondence between a small Lyon (France) paper retailer and his suppliers offers a lively record of such disputes over the years 1726 to 1744.[10] While courteous, the exchanges between André Charmette and his suppliers leave no doubt as to the obstacles lying in their paths. Although such letters may overstate the difficulties arising between a supplier and a customer, the explanations offered by papermakers lend credibility to Charmette's accusations. Suppliers could rarely deliver the type and amount of paper ordered on time. Not infrequently, they substituted one type of paper for another. Yet, upon arrival, the reams were most often found wanting.[11] A similar, if shorter, record of dissatisfaction is found among the papers of M. Joannin, a Lyon paper merchant selling on commission for many papermakers. His customers often denounced obvious disparities between samples and deliveries. One client took advantage of a shipping mistake to unfavourably compare his purchase with that intended for a local rival. Barely a month later, however, the latter also rejected much of the very same redirected delivery![12]

Similar quarrels appear in the records of celebrated producers and some of their important clients. After sending samples to the offices of the Montpellier intendant (the king's representative in the Languedoc), the brother of Charmette's Annonay supplier, Jean Johannot, received an order for 26 reams of his best paper. Upon delivery, it was judged to be so much below expectations that the intendant himself penned his displeasure. A generation later, the same family anticipated similar disappointments. When Mathieu Johannot planned to have Arnoult, a Paris merchant, act as his main wholesaler in the capital, the contract obligated him to receive all paper rejected by the region's buyers. He was to try to sell it in the best possible fashion.[13] A final confirmation of dissatisfaction is found in R. Darnton's probe, *The Business of Enlightenment*. The publishers of the third edition of the *Encyclopédie* struggled to supply their presses from mills situated in a wide radius around Lyon. Panckoucke and his associates were only claiming a fraction of the industry's output during the years 1777 to 1781, but their ambitious project entailed strict quality and timetable standards. Delays multiplied and the printer, the Société typographique de Neuchâtel (STN), 'almost systematically' asked for a discount upon receipt of a shipment. The STN was justifiably worried, since its customers rarely found the volumes to match the samples advertising the subscription.[14]

Such disputes fostered the growth of an impressive and picturesque vocabulary common to French papermakers and their clients. Draining the mould too swiftly, allowing an uneven spreading of the stuff on the mould or working with too warm a solution marred the sheet with *andouilles* and *châtaignes*, or *enverge*. Old or dirty felts or an ill-fitting deckle delivered a paper *dentellé* or *rebordé*. Water drops or air bubbles dotted the sheet with *musettes*. A sheet stressed by an indelicate pull would be, according to the degree of injury, *lachée, coulée, écrasée, tirée de flautre, labourée* or *bourdonnée*. A *pied de chèvre* reveals an attempt to weld back together two halves of a ripped sheet, while the words *chaperons*, *marroquins* and *godées* refer to the unwanted results of improper hanging and drying. Paper could also be burnt by size (*brûlé de colle*), *rouillé* (stained by rust spots), *broqueteux*, *nuageux*, *picqué*, *reverché*, laden with unsightly *bouteilles* and so on! This vocabulary and its equivalents in other languages testify not only to the oft-noted liveliness of the culture of papermakers, but also to the repetitious nature of the principal mistakes these skilled artisans could not avoid making.[15] It informed the work of, among others, the women who sorted the sheets into several categories. They separated *bon* (full-size and free of defects), *retrié* (re-sorted and blemished in certain ways) and *chantonné* (burdened with some more serious defects) paper, while putting aside all *cassé* and short sheets. The woman doing this exacting work was not expected to sort more than the output of a day at the vat.[16] This means that she was granted as much time to examine each sheet as had been taken to form or couch it, a confirmation of the seriousness of this job.

A few papermakers also tried to quantify the uncertain results of their methods. At a time when they were embarking on the modernization of their enterprise that would bring them national attention, the Montgolfiers set aside one of their six vats to record its expenses and output. The 1779 and 1779–80 campaigns offer a measure of the irreducible proportion of paper deemed less than satisfactory, sorted into three categories.[17] Sheets that could not be sold and had to be re-beaten (*cassées*) were weighed and, for accounting purposes, attributed a price comparable to that of rags ready for the stampers. Sheets deemed *inférieures* were to be sold separately, and discounted some 30% of expected sale price. Finally, *moitiées* (when half of the sheet could be salvaged and sold) were discounted more heavily than inferior paper but less than *cassées*. The figures recorded for each of these three categories of unsatisfactory paper of every type vary between 5% and 25%. In their overall evaluation, the Montgolfiers concluded that an average daily production of eight reams, including two unsatisfactory reams, met the team's obligations.

Less than 100 miles from Annonay, another papermaker engaged in a related exercise. In 1784, Jacques Berger started to record his impressions of the paper sent to his warehouse by the tenants of his La Chatte mill in Thiers. Upon receiving these reams, Berger made a note of the possible need to discount some of them and penalize his tenant. Among the 16,310 reams delivered in six years, over 2,400 reams were deemed of questionable weight, while some 2,000 reams exhibited signs of poor sizing, poor beating, and so on. Over 20% of this production was earmarked for a potential discount because of one or both types of problems.[18] These figures offer an estimate of the proportion of a mill's shipment (after some post-production sorting) that could be deemed of questionable value by an admittedly inquisitive receiver. How did papermakers face this substantial challenge?

Coping with imperfections

Papermakers naturally strove to diminish the percentage of discounted and wasted sheets. To that end, they followed several strategies. They could first supply their teams with better working conditions and supplies. Papermakers appreciated the advantages of repairs and renovations to tools, machines and buildings, and acknowledged the importance of clean and well-sorted rags. Good working conditions also included proper lighting, a clean mill, draught control in the drying lofts, pure water for the vat, quality size, clean felts and even good food for their staff. Directly related to investment and operational costs, these elements were the object of frequent negotiations between workers, mill masters and, in the eighteenth century, the inspectors sent to the mills by the French state.[19] Papermakers could also select and train their workers carefully, monitor their work attentively and stimulate them with an appropriate compensation package. The state of the labour market in a given area fixed the cost and effectiveness of such efforts.[20] Papermakers operating more than one vat could create a hierarchy among them, gathering their most skilled workers around a leading vat to produce the better grades of paper with some consistency. Such a strategy is most evident among the vats of the Montgolfiers late in the eighteenth century, but is also seen among smaller enterprises.[21]

Finally, papermakers could monitor the evolution of their trade in the search for technological solutions to their quality worries. For instance, late in the eighteenth century, the bleaching of rags promised more uniform sheets, just as the hollander had slowly offered a finer pulp. However, no radical technological answer to the problem of quality emerged until the paper machine was fully operational, well into the nineteenth century. Naturally, the paper machine took a long time to become a reliable producer. Because its operating speed (and, ultimately, the cost of its paper) conflicted with the quality of its output, it conquered only gradually the more demanding markets. However, it opened the way to such a vast range of incremental improvements to both speed and quality of production that it changed the nature of the problem. In their quest for quality and speed, the owners of a paper machine focussed on design modifications or adjustments to its settings. Slowly the markets for newsprint, wrapping, quality printing, office writing and, eventually, drawing and engraving came within their reach.[22]

In contrast, pre-machine producers faced a more rigid limit set by the skills of their key workers. Although human talents are presumably infinitely improvable, within a given set of circumstances ranging from the level of their investment to the characteristics of their labour pool, a point came where papermakers could only quicken their production at the expense of its quality, and vice versa. And what papermakers decided to be an optimal combination of speed and care delivered a sizeable and irreducible burden of below-grade paper. The profitability of their enterprises depended on their ability to valorize this stack of imperfect paper. To that end, they multiplied the categories of paper they sold.

Most evident is the great range of formats produced in early modern paper mills. The 1739 to 1741 French attempt at standardizing output officially recognized 57 formats differing in weight and size. Exceptions to this standard were claimed and granted, while the dimensions of exported paper as well as most small and rough sheets remained undefined.[23] Papermakers could further segment their output by increasing the number of grades they offered. While many smaller mills only distinguished between fine, medium and wrapping grades of paper, the Montgolfiers made six different qualities (formats and grades combined in this case to offer some 90 distinct product lines). Arches (Vosges, France), chosen by Beaumarchais for his fine edition of Voltaire's work, distinguished only four categories of rags, but further ranked its fine papers according to the proportion of second-rate rags included (none, 1/6, 1/4, 1/3). The Auvergne and Dauphiné often divided their output into seven groups.[24] Further distinctions were based on the degree or absence of sizing, blueing, polishing, cutting and so on.

In itself, this diversity could not answer the quality concerns of papermakers, since each production run yielded its percentage of imperfect sheets. Nonetheless, short batches were less revealing of the unreliability of hand production methods than large lots, because they limited buyers' expectations of the number of similar items they could find. Moreover, the multiplicity of products invited a careful definition of users' needs and, if possible, the substitution of one type of paper for another. The Montgolfier records tell us, for instance, that a 20% variation in the weight of a ream of *bâtard moyen* changed its destination from music to plain writing.[25] In a mechanized environment, long production runs deliver a small number of distinct product lines. In each line, consumers expect large numbers of items to meet specifications and answer their needs. Early modern paper mills, however, delivered an immense array of papers of distinct formats, each in very limited quantities. In response, consumers defined their needs in a narrower fashion and searched for lesser quantities of the matching product among a greater diversity of offerings. The process is readily visible in the case of printers.

Whereas modern printers will print large numbers of many different books on paper produced to reliable standards in endless lots, their early modern counterparts printed each text on a short batch of paper (a practice naturally facilitated by the diminutive runs of pre-industrial publishing). In effect, the diversification of marketed products transferred some of the quality burden onto customers, who had to define their needs more precisely and shop more attentively than their modern successors.

Papermakers also had to choose the degree to which they would eliminate blemished sheets from their shipments. Mid-eighteenth-century French commercial standards considered marketable a ream that included eight quires of good paper, eight of sorted paper and four quires of even more seriously defective paper (it was put on the outside to protect the ream). Customers could expect only 40% of a shipment to be of first grade, although it is reasonable to assume that this sorting process varied according to the client. Many papermakers failed to match this goal, and even this rather lax standard imposed the rejection of many sheets, which would be cut and further sorted. If half a sheet could be salvaged, it was used for writing pads. Quarter sections became *papier à poulet*, little note-pads. Yet rougher sheets could go to grocers for wrapping small orders. Finally, after all efforts had been made to find a use for imperfect sheets, we are told that even the better mills still had to reject at least 10% of the production that reached the sorting tables. Part of this contingent found its way to the shops of the *cartonniers* who pasted remnants into various sorts of cardboard, but most of it awaited repulping.[26] The kind of precise post-production sorting described here is very visible in the particularly detailed shipping records of a medium-sized French mill.

The Layered output of the mill at Arcier (France)

The shipping records of a medium-sized French mill show that the manufacturing of a large batch of paper was accompanied by the production of several secondary lots of slightly different paper. In effect, the irreducible uncertainties of accelerated hand production added several smaller echoes to each principal call for production. In the middle of the eighteenth century, the paper mill at Arcier came to be owned by two paper sellers/printers from neighbouring Besançon. The estate was indivisible, and tensions between the two families led to the precise recording of the type and weight of papers manufactured and shipped directly to the owners' warehouses from 1743 to 1757, allowing for a detailed analysis of the structure of production and sorting.[27]

The first evidence of the packaging of imperfect sheets comes from entries of reams labelled *retrié*, *de rebut* and *de reste* (re-sorted, rejected and remnants). A lease signed in 1740 explicitly permitted such shipments of remnants. It also suggested a second way to dispose of flawed paper, through the bundling of some 'small reams' alongside shipments of 'large reams.' The latter contained sheets meeting the order's specifications and the former partially blemished sheets trimmed to yield smaller paper. Throughout the period, various types of paper left the mill in a large quantity of *rames grandes* and a smaller number of *rames petites*. For instance, on 1 April 1744, the owners received 499 lbs of *grand raisin* in 18 large reams and 2 small reams. A few months later, 240 lbs of *couronne fine lissé* arrived in 19 large reams and 1 small ream, and so on.

A third category of shipment testifies to the careful selection that followed production. Over time, a majority of the reams of a given type of paper was shipped at a consistent weight per ream equal or close to the official standard weight. Over the same period, the remaining paper of the same type was shipped in reams of various and distinct, although not unrelated, weight. Thus, while 29 deliveries of *couronne* were recorded at 12 lbs per ream (the prescribed weight), the owners also received, at intervals, 16 batches of the same paper weighing between 10 and 14 lbs per ream. The random assembling of several scores of reams for a shipment would have yielded an average weight close to 12 lbs per ream, and regulations did not call for such distinctions, since they tolerated deviations from the standard of 10% to 20%. Yet this mill chose to sort its production and ship lighter and heavier reams as separate lots for all its main products.

Overall, almost all (95%) of the paper manufactured at Arcier between 1743 and 1757 was shipped in a layered pattern that is best described as consisting of, for each type of paper, a core of numerous shipments made at the standard weight per ream, and a series of secondary shipments of reams of a weight slightly different from the standard weight or consisting of remnants or trimmed sheets. This pattern is illustrated here for two types of paper, *bâtard* and *croix de malte*:

Shipments of bâtard *paper from Arcier (1743–57):*

Core shipments:
33 lots (1,634 reams @ 17 lbs/ream, or 65% of all *bâtard* output)

Secondary shipments:
2 lots *en petit* (half-sheets?; 42 reams @ 8.5–8.6 lbs/ream)
1 lot remnants (6 reams @ 16.5 lbs/ream)
3 lots (134 reams @ 13.5–13.7 lbs/ream)
3 lots (180 reams @ 16 lbs/ream)
8 lots (223 reams @ 18–18.1 lbs/ream)
1 lot (70 reams @ 20.3 lbs/ream)
1 lot (10 reams @ 22.6 lbs/ream)
1 lot (5 reams @ 25 lbs/ream)
12 small reams (exact weight unknown)
1 lot (9 reams @ 14.8 lbs/ream)
3 lots (104 reams @ 16.5–16.7 lbs/ream)
2 lots (54 reams @ 20 lbs/ream)
1 lot (29 reams @ 21 lbs/ream)
1 lot (4 reams @ 24.8 lbs/ream)

Shipments of croix de malte *paper from Arcier (1743–57):*

Core shipments:
136 lots (4,734 reams @ 7 lbs/ream and 1,398 reams @ 14 lbs/ream, or 86% of *croix de malte* output)

Secondary shipments:
6 lots remnants (95 reams @ 14 lbs/ream)
1 lot (60 reams @ 5.3 lbs/ream)
1 lot (109 reams @ 6 lbs/ream)
3 lots (297 reams @ 6.5 lbs/ream)
4 lots (477 reams @ 6.7–6.8 lbs/ream)
1 lot (41 reams @ 8.2 lbs/ream)
1 lot (27 reams @ 9.4 lbs/ream)
1 lot (9 reams @ 12 lbs/ream)
1 lot (10 reams @ 12.8 lbs/ream)
2 lots (113 reams @ 13 lbs/ream)
1 lot (36 reams @ 13.4 lbs/ream)

This sketch of the structure underlying the production of a paper mill calls for some immediate remarks. Admittedly, we do not know that secondary batches were not made purposely to a format different from that of most reams of the same name, just as we have no evidence of the owners' intentions to sell them separately. However, several arguments may be advanced to support our interpretation. First, we know that the tenants were aware of standard weights for each category of paper, which were spelled out in their lease. Second, it appears that secondary lots were consistently smaller than their core counterparts, even when the paper did not fit official measurements and could thus have been manufactured according to demand (such as in the cases of *croix de malte* or *thèse*). Had these reams been the product of special orders, we could expect at least some of them to appear in substantial quantities. Third, it is also unlikely that these secondary batches could have been made expressly at a weight differing only by a small margin from the usual figure. Fourth, it appears that not all products were sorted to the same extent. The proportion of output shipped at the core weight varies from 65% to 99%. Since there is no reason to believe that papers such as *catéchisme* or *heures* could be manufactured in more uniform batches than a comparable *couronne*, we must assume that their intended uses did not demand as rigorous a sorting. Finally, it must be noted that the categories shown here are not consistently related to other distinguishing characteristics, such as polishing, sizing or pulp grade.

Overall, the structure of the output of Arcier suggests the following practice. Paper was manufactured according to prescribed or traditional measurements. The weight and the quality of the sheets were distributed around the target weight and quality in a pattern dependent on the skills of the team at work and the pace of work. A process of sorting assembled a large core of reams of acceptable quality close to the standard weight for the type of paper under consideration as well as a smaller number of reams of remnants, reams of trimmed sheets and reams of a weight slightly different from the expected standard. Concurrently with other types of sorting, this selection defined the homogeneity of the reams.

This analysis suggests that the output of an early modern paper mill was forcefully structured by the irreducible diversity of output characteristic of hand methods of production under a demanding schedule. To position themselves in the marketplace, papermakers could modulate their investments in mills, raw materials and labour force. Beyond that, they could vary the format and grade of their paper, as well as the degree of several secondary preparations. Finally, sorting eliminated the worst sheets and transformed the remaining diversity into a predictable order suited to a fragmented market. The technological and economic determinants of the quality of early modern paper were complemented by what was, in effect, a social process, an ordering process designed to meet customers' expectations. Sorting materialized a producer's understanding of his or her market, creating layers of forms and qualities intended to profitably reflect the many hierarchical and corporate divisions of early modern society.

Implications

Enhanced by watermarks, the heterogeneity of the paper leaving early modern mills was reflected in the large and carefully itemized stocks of paper sellers, who could not expect to easily re-order paper that would match a depleted line. The 1732 inventory of Antoine Flachon, a Lyon paper seller, counted 554 reams of paper, valued at over 3,600 *livres tournois* (lt) and composed of 49 types of paper. More than a generation later, 69 qualities of paper made up the 808 reams valued at over 5,200 lt found in the storerooms of Joannin, the Lyon paper merchant encountered earlier. His clients obviously appreciated the choice; between August 1778 and October 1779 Ducrest, a grocer for whom paper was a minor item, purchased 9 sorts of paper in 13 small orders amounting to only 197 lt. A nearby *confrère*, Genevet, deployed a similar strategy. Between June 1778 and January 1779 he ordered 200 reams of 36 distinct types of paper, for a total value of 1,421 lt. Not surprisingly, an advertisement for the store consisted, like many others, of a simple but impressively long list of types of paper and related objects offered 'at the right price.'[28] Clearly, consumers entering these shops expected a vast array of papers of differing quality rather than a limited range of perfect sheets. Printers similarly held large stocks of paper, although perhaps on a more restrained scale. J.-J. Vatard, for instance, had some 910 reams of 22 types at his disposal in 1777. Almost a century earlier, the Paris *Imprimerie royale* logged 457 reams in 10 qualities.[29]

The implications of this diversity are numerous. From the point of view of economic history, one may ponder the costs associated with the handling, storing and marketing of numerous batches of different reams or, conversely, the benefits of attracting a wider range of consumers in a still very fragmented marketplace. Historians of technology will wonder how these traditional patterns affected the decision to adopt the paper machine, which would slowly make possible a more targeted production but also called for new marketing strategies. Historians of consumption, for their part, will want to consider the links between the stratification of demand and the transformation of commodity supplies before and during the period of industrialization. Those concerned with entrepreneurial strategies will recognize

in the patterns outlined here a form of batch production shaped as much by necessity as by the conscious will to steer away from mass production. More generally, all those interested in the process of industrialization will read here the need to reflect on the particularities of what may be termed, in a precise if not elegant manner, large-scale, concentrated and rapid production of finished or semi-finished goods to fixed specifications. This rather heavy label applied, in fact, to a large segment of the manufacturing sector: a type of fabrication centrally located (both chronologically and methodologically) between the opposite poles of craft and mass production.

For their part, those interested in the history of papermaking and paper usages will note that the reputation of mill owners would have been closely linked to their willingness to finely segment their production and design their marketing strategies accordingly. Indeed, the reputation of any mill should not be seen as a simple, solid entity. A papermaking name would have meant different things to different users of paper. A papermaking reputation should be seen as a layered property, to be cultivated as much through marketing strategies as through attention to skills, supplies and techniques, as much through diversification as through specialization. No direct comment on the question has come to us, but inventories of ready-to-ship paper at various mills suggest a proportionality between the range of product lines and the size and renown of enterprises. Small or medium mills in Ambert (France) often had between 8 and 15 distinct product lines in stock at the time of inventories. The slightly more important mill of La Combe-basse, also in Ambert, was equipped with 26 sets of moulds, suggesting a more varied output. A similarly important mill in the Beaujolais (Les Ardillats) held upon the death of its owner 18 distinct types of paper and several piles of varied paper. The very large mill of Buges stocked 44 distinct product lines.[30] Production records speak to the same trend. From 1767 to 1782, J. Berger's tenants delivered 47 types of paper. A century earlier, the Colombier brothers of Ambert, owners of a much larger operation, shipped over 4,300 reams of 36 different types of paper in one season.[31]

This great diversity of offerings will explain the often-noted practice among artists and other discriminating users, of a careful and very personal choice of paper for their various projects.[32] For them, the distinctive characteristics of a sheet mattered as much as its more standard qualities, and the selection available for examination in the shops they frequented was no doubt as important as the international reputation of various papermakers. In turn, such an observation leads us to a fuller appreciation of the role played by those who retailed paper, who most likely further refined the selection process initiated at the mill. Similarly, we may better credit the selection process that took place in early modern print shops. The need for a homogeneous supply of paper would have limited the size of print runs and added to their cost, particularly for large formats. For their part, discriminating book buyers would have paid great attention to the homogeneity of the volumes they bought, an expectation especially difficult to meet in the case of multi-volume publications.

The importance of sorting may also lead us to reassess our understanding of regional and national reputations. If the quality of a papermaker's output was determined as much by his or her sorting practices as by the attention paid to the material used and the labour standards maintained, one may be led to conclude, with some prudence, that the reputation of a region rested to a great degree on the understanding its mill owners had of the nature of their markets and the extent to which they permitted a detailed sorting. Commercial factors — the size of the market in particular — must have played as great a role in establishing the hierarchy of European paper mills as more traditional determinants of quality such as labour skills and technological standards. Similarly, the much slower work pace of those who are today making paper by hand may in part be explained by the narrowness of the markets they expect to reach.

Not long ago, T. Barrett reflected on the quality of incunabula-era papers. His familiarity with such precious volumes and his experience of the trade led him to clearly see that the beauty of fifteenth-century papers lay in the 'tension between the natural irregularity of handwork and the excellence of skilled workmanship.' The mixing of skills and production demands resulted in 'a variety of slight imperfections amid a generally high level of quality.'[33] This insight is most important and may be extended well beyond 1500, if one takes the precaution to complement it by taking into account the selection processes that stand behind the corpus that was the object of his study. The rare fifteenth-century books that have reached us were no doubt deserving of the best paper originally, within the limits imposed by the commercial operations that conceived them. Their production entailed the rejection of many other sheets. Their paper is representative of a commercial selection process as much as of a refined level of skills.

The beauty of early modern paper connects us not only to the skills of the artisans that produced it and their very human inability to produce two exactly similar, blemish-free sheets. It also reminds us of the many other sheets that were selected for a myriad of more humble usages. Even those familiar with archives of private papers going well beyond printed material only see a fraction of the paper produced and used in early modern Europe. Each sheet of handmade paper that has reached us speaks of a workday when many others were made. The quality of the former directly depended on finding uses for the latter. Ironically perhaps, in this case as in no doubt many others, exceptional quality rests on common needs.

Notes

1. Arnould, A. M. [Year 3] 1983. *De la balance du commerce.* Reprint. Geneva. 221.
   Chevallier, A. 1984. *La matière première: le papier.* Vol. 2 of *Histoire de l'édition française*, under the direction of H.-J. Martin and R. Chartier. Paris. 34–41.
   Markovitch, T.J. 1966. L'industrie française de 1789 à 1964. Analyse des faits. *Cahiers de l'Institut de Science Economique Appliquée* Series AF 6(174): 21–72.

Coleman, D.C. 1958. *The British Paper Industry 1495–1960*. Oxford. 15, 105.
Duplessis, R.S. 1986. Capital and finance in the early modern Veluwe paper industry. *A.A.G. Bijdragen* 28: 185–97.

2. Hills, R.L. 1988. *Papermaking in Britain 1488–1988, A Short history*. London. 53.
Reynard, P.C. 1998. Manufacturing strategies in the eighteenth century: Subcontracting for growth among papermakers in the Auvergne. *Journal of Economic History* 58 (1): 155–82.

3. Diverse uses of paper mentioned in:
Krill J. 1987. *English Artists Paper, Renaissance to Regency*. London: Victoria and Albert Museum. passim, 101.
Doizy, M.-A. and Ipert, S. 1985. *Le papier marbré, son histoire et sa fabrication*. passim.
Feyel, F. 1995. Négoce et presse provinciale en France au 18e siècle : méthodes et perspectives de recherches. *Cultures et formations négociantes dans l'Europe moderne*, under the direction of F. Angiolini and D. Roche. Paris. 439–511.
Popkin, J.D. 1990. *Revolutionary News. The Press in France 1789–1799*. Durham, NC. passim.
Patrick, A. 1978–79. Paper, posters and people: official communication in France, 1789–94. *Historical Studies* 18 (70–73): 1–23.
Le Roy Ladurie, E. 1995. Une histoire sérielle du livre (XVe-XXe siècles). *Histoire, économie et société* 14(1): 1–24.
Vidalenc, J. 1946. *La petite métallurgie rurale en Haute-Normandie sous l'Ancien Régime*. Paris. 224 ff.
Reynaud, M.-H. 1981. *Les moulins à papier d'Annonay à l'ère pré-industrielle : Les Montgolfier et Vidalon*. Annonay. 90.

4. Reynard, P.C. 1994. La papeterie ambertoise au XVIIIe siècle : Une prospérité fragile et stérile. Doctoral thesis, York University. 98–104, 432–33.
Three price series of mixes of papers sold by the Grand-rive mills (Ambert, France, 1688–1720, 1738–80) and mill of J. Berger (Thiers, France, 1769–89) Sources: Archives départementales du Puy-de-Dôme (henceforth AD PD). 2 E 518, 519, 520, 521, and 3 J 42. Some prices are also available for the years 1720 to 1740 in the papers of Lyon paper merchant A. Charmette, Archives départementales du Rhône (henceforth AD R). Fonds de la Conservation des Foires de Lyon, Papiers Charmette. 1726–44. Série 8 B. Among other price references, one may note D. Hunter's suggestion that the price of 'royal' paper dropped by a third between 1352 and 1483 at Florence (1943. *Papermaking, The History and technique of an ancient craft*. New York: Alfred A. Knopf.).

5. Reynard (1994. 104–9) documents a 30% to 40% increase in the price of 'fine' rags from the second to the last quarter of the eighteenth century. For comments on the profitability of the trade, see for instance the 1748 (naturally slightly overstated) complaint by B. Vimal, papermaker at La Boissonie (Ambert, France) in AD PD. 1 C 7521, and the somewhat less pessimistic comments made two years later by a state inspector in AD PD 1 C 510 and 511.

6. Montgolfier output: Rosenband, L.N. 1980. Work and management in the Montgolfier paper mill 1761–1804. Doctoral thesis, Princeton University. Chap. 5.
French estimates: de Lalande, J. [1761] 1984. *Art de faire le papier*. Geneva. Reprint. 104.
1688 Auvergne ruling: AD PD. 1 C 485.
Angoumois ruling: Delâge, G. 1991. *Moulins à papier d'Angoumois, Périgord et Limousin (Dix-septième siècle)*. Paris. 98.
For examples of regional customs, see Gazel, H. 1910. *Les anciens ouvriers papetiers d'Auvergne*. Clermont-Ferrand. Reynaud. 1981.
Desmarest, N. 1788. Art de fabriquer le papier. In *Encyclopédie méthodique. Arts et métiers mécaniques*. Paris. 511.

7. Mentions of improvements in:
Hills. 1988. 56–59, 61–62, 66–68.
Hunter. 1943. 177, 186.
Thomson, A.G. 1974. *The Paper Industry in Scotland, 1590–1861*. Edinburgh. 37, 43–45, 50–51.
de Lalande. 1984. 27–40.
Bibliothèque nationale. *Manuscrits français* 22188. fols. 311, 314–66.

8. F.O. Reevink attempted to chart the evolution of the quality of paper and link it to various innovations (1992. *Old and Rare*. Bilthoven, Netherlands. 24).
Discussions of quality in:
Hills. 1988. 6–7, 18–25.
Hunter. 1943. 194, 224–26, 457.
Bower, P. 1990. *Turner's Papers, A Study of the manufacture, selection and use of his drawing papers 1787–1820*. London: Tate Gallery.
de Lalande. 1984. 55–76.
Heller, J. 1978. *Paper-making*. New York. 103–11.

9. André, L. 1992. La papeterie en France 1799–1860, Aspects d'une mécanisation. Doctoral thesis, University of Paris. Chap I. 22.
Reynaud. 1981. 200.
Lacroix, H. 1863. *Historique de la papeterie d'Angoulême*. Paris. 29.
Delâge. 1991. 22–29.

10. Not taken into account here are pleas for discounts not accompanied by references to specific product shortcomings. In the following note, dates refer to: AD R. Fonds de la Conservation des Foires de Lyon, Papiers Charmette. 1726–44. Série 8B (145 letters to and from mills). For another, less systematic and more obviously biased example, see the letters accumulated to discredit the tenant of the Arcier paper mill near Besançon, France, mid-eighteenth century: Archives départementales du Doubs. 15 B 1319.

11. The letters in which problems are denounced are dated:
Quality problems: 31 May 1726, 20 September 1726, 10 June 1727, 31 August 1728, 19 November 1728, 29 March 1729, 7 October 1730, 20 October 1730, 10 November 1730, 9 December 1732, 3 February 1733, 4 February 1733, 8 May 1734, 11 May 1734, 30 March 1735, 2 September 1735, 29 January 1736, 23 September 1736, 13 June 1738, 17 June 1738, 24 June 1738, 27 July 1738, 1 September 1738, 29 October 1738, 14 December 1739.
Delays and incomplete deliveries: 2 July 1726, 15 July 1726, 10 August 1727, 4 January 1728, 29 February 1728, 9 January 1729, 7 April 1731, 9 January 1733, 7 May 1733, 20 June 1733, 1 August 1733, 2 August 1733, 21 August 1736, 28 April 1737, 25 March 1738, 2 May

1738, 20 May 1738, 4 June 1738, 13 June 1738, 14 December 1739, 17 January 1740, 25 March 1740, 16 September 1740, 5 July 1742, 21 August 1742, 6 February 1743, 15 April 1744.

Substitutions (announced or unexpected): 13 August 1726, 8 February 1728, 30 November 1728, 9 January 1729, 18 November 1732, 26 August 1736, 2 September 1736, 30 September 1736, 8 September 1737, 17 September 1737, 14, 16, 28 February 1738, 2 May 1738, 17 June 1738, 6 July 1738, 22 July 1738, 4 January 1739.

12. AD R. Fonds de la Conservation des Foires de Lyon, Papiers Joannin. 8 B 971. Letters dated 9 June 1779, 16 February 1780, 22 February 1780, 23 February 1780, 24 February 1780, 21 March 1780, 2 April 1780, 3 May 1780, 5 May 1780, 17 May 1780, June 1780, 19 July 1780, 16 August 1780, 22 October 1780, 23 October 1780, 7 December 1780, 24 December 1780, 13 April 1781, 26 May 1781, 18 July 1781, 25 January 1782, 29 January 1782, 7 May 1782.

    See also the papers of Genevet, also a paper seller at Lyon. AD R. Fonds de la Conservation des Foires de Lyon, Papiers Genevet. 8 B 919. Letters dated 2 July and 20 November 1778.

13. Archives départementales de l'Hérault. C 2674. 22 June 1743, 18 March 1744, 26 July 1744.

    Creveaux, E. 1938. Evolution de l'industrie papetière au XVIIIe siècle. *Le Papier*. 289–95. (Johannot acknowledged that some of the samples sent to Paris were '*peu unis*,' 'rusty,' etc.)

14. Darnton, R. 1979. *The Business of Enlightenment, A Publishing history of the* Encyclopédie *1775–1800*. Cambridge. 185–96.

15. In the French context, see these and many other specialized terms in de Lalande. 1984. 55–76. Frequent imperfections are mentioned in Hunter. 1943. 194, 224–26, 457. Parallel to these terms existed a vocabulary of good practices, such as the need for the vatman to reinforce the *bon carron*, the corner from which the layer would lift the sheet. Heller's list of the problems likely to plague hand papermakers includes solutions as well as English equivalents to many of these terms (1978, 103–11).

16. de Lalande. 1984. 75–77.

    Desmarest (1788. 524), who pays much attention to the quality problems plaguing French mills at the end of the *ancien régime*, mentions a finer triage.

17. See two comments, dated 31 July 1780, titled '*compte mensuel*' and '*compte de la dépense de Nizier ... depuis le 17 mars dernier jusqu'à ce jour*,' Archives nationales, Paris (henceforth AN). 131 MI(crofilm) 53 AQ. 102. A copy of this document was generously offered by Dr J.N. Rosenband.

18. The proportion of defective sheets rose over the six years of the lease, perhaps reflecting more the growing impatience of the mill owner with his tenants than a steady deterioration of their work. In a previous lease, J. Berger had not bothered to record this information. On the other hand, a further 408 reams were marked as imperfect 'in part' without further qualification, and left out of this count (AD PD. 3 J 42, 1783–88). Interestingly, the last papermakers of the Auvergne, who worked the two or three mills still active in Ambert on the eve of the Second World War, rejected the same proportion of sheets (20%) from their daily output. Dravaine, C. 1939. Les moulins à papier d'Ambert. *Revue d'histoire moderne et contemporaine* XXV: 59–83. figure 82.

19. For attitudes regarding investments and maintenance, see Reynard, P.C. 1999. Unreliable Mills: The Maintenance Practices of Early Modern Papermakers. *Technology and Culture* 40(2). The importance attached to rags directed mills to gather supplies from wealthier provinces reputed for disposing of better linen. Because of the importance and cost of light, papermakers regularly tried to postpone the start of work to daybreak, a trend resisted by workers who often also had to work on their plots of land (Gazel. 1910. 70–75). For an example of the recommendations made by inspectors, see AD PD. 1 C 504 (1742).

20. In France, wages appear to have been carefully calibrated and were higher than in many other occupations, and piecerate compensation only came into play after the regular daily work load had been achieved (for pay scales, see AN. 131 MI 53 AQ, 102, 31 July 1780; Reynaud. 1981. Chap. 3; Rosenband. 1980; Gachet, H. 1979. Les grèves d'ouvriers papetiers en France au XVIIIe siècle jusqu'à la Révolution. *Revue internationale d'histoire de la banque* 19: 171–90).

21. Rosenband. 1980, Chap. 5.

    Audebert, G. 1984. Conditions ouvrière, papeteries du district d'Angoulême (An II). *La recherche généalogique en Charente* 5: 23–28.

    Isnard, E. 1916. Les papeteries de Provence au XVIIIe siècle. *Mémoires et documents pour servir à l'histoire du commerce et de l'industrie en France*, under the direction of J. Hayem. 4th series. 39–63.

    Onfroy, H. 1912. *Histoire des papeteries à la cuve d'Arches et d'Archettes, 1492–1911*. Evreux.

    Saint Eloy, M. 1967. Vie et mort d'une industrie nivernaise : la papeterie de Sembrèves (avant 1661–1835). *Actes du 92e Congrès des sociétés savantes, Section d'histoire moderne et contemporaine*, t. 2: 327–48.

22. André. 1992. passim, and in particular chaps. 1 and 6, second part, and chap. 1, third part.

    McGaw, J.A. 1987. *Most Wonderful Machine, Mechanization and social change in Berkshire papermaking, 1801–1885*. Princeton. Chap. 2.

23. Delaunay, P. 1985. *L'industrie papetière française et la normalisation des formats, Mélanges offerts à P.F. Fournier*. Clermont-Ferrand. 215–19. The 1741 revision of the 1739 standards increased the range of acceptable weight for each format. The appearance of mechanical threading around 1700 allowed even modest mills to stock an assortment of moulds.

24. Reynaud. 1981. 241.

    Onfroy. 1912. 23.

    Roux, X. 1887. *Les papetiers du Dauphiné avant et après la Révolution*. Grenoble. 137–38.

25. Rosenband. 1980. 27.

26. de Lalande. 1984. 78, 84.

    Desmarest, N. 1788. 522 (citing a lower level of 1/15). 'Recycled' pulp only delivered a paper that was less than white. The Montgolfier record analysed above shows close to one metric ton of *cassés* after the production of just over 1,000 reams (some 10 mt). Buges distinguished between

cassés de vente and *cassés de refonte*, and close to 17,000 lb of rejected output was stored next to some 100,000 lb of ready-to-ship paper at the time of inventory. Gerbaux, F. 1903. La papeterie de Buges en 1794. *Bibliographe moderne* (1–2): 25–83. For smaller mills see: AD PD. Inventory C. Sauvade. B AM 86. 6 and 7 November 1756 (400 lb); Inventory C. Chapon, notary Journet. 14 January 1772 (263 lb *fin cassé*; 166 lb *moyen cassé*; 111 lb *bulle cassé*).

27. Archives départementales du Doubs. Arcier paper mill records. Justice consulaire de Besançon. B.J.C. 15 B. 1306–20. Arcier produced just under 220,000 lbs (local unit) of paper for writing, printing, and several other uses, in three campaigns: fall 1743 to winter 1750, fall 1751 to summer 1753 and fall 1755 to spring 1757.
28. AD R. Inventory A. Flachon. BP 2127. 16 March 1732. Inventory Joannin (19 June 1779) and purchases by Ducrest (14 August 1778), Papiers Joannin. 8 B 971.
    Papiers Genevet. Livre d'achats, commencé le 4-6-1778. Advertisement. 8B 919.
29. AD R. Inventories: J.-J. Vatard. BP 2266. 10 July 1777 (value: 6,130 lt); B. Martin. BP 2121. 6 September 1730 (76 reams, 4 types of paper); P. André. BP 2028. 7 July 1694 (1,276 reams, 5 categories of paper). Inventory of the Imprimerie royale (457 reams, 10 distinct qualities), Bibliothèque nationale, Nouvelles acquisitions françaises 2611. 15 February 1691.
30. The Ambert mills inventoried are those of Lagat-le-haut (owner C. Bégon, 193 reams, 8 categories of paper), Crottes and Escalon (C. Sauvade, 617 reams, 11 categories), la Boule and Tranchecotié (P. Favier, 172 reams, 9 categories), Boule-basse (C. Bégon, distinct from previous of same name, over 200 reams, 8 categories), Frédière-basse (P. Artaud, 800 reams, 8 categories). All in AD PD: notary J. Gladel. 27 February 1719; not. B. Collangette. 16 September 1726 and 12 May 1727; not. E. Maignet. 24 December 1761; not. P. Mathias. 10 April 1767; not. A. Journet. 19, 21 May and 10, 12 June 1779).
    The mills of J. Grivel, 1684, in Micolon de Guérines, C. 1998. Notes sur Jean Grivel (1639–1684) et Marie Buisson (1650–1734), marchands-papetiers de la vallée de Lagat. *Chroniques historiques du Livradois-Forez* 20: 107–14.
    Inventories of la Combe-basse in AD PD. B AM 86. 6, 7 November 1756; les Ardillats (Beaujolais) in AD R. 4B202. 5 September 1788; and Buges in Gerbaux. 1903. 25–83.
31. C. Arthaud, another tenant of J. Berger, produced 38 categories of paper between 1783 and 1789 (AD PD. 3J42); AD PD. 2E518. 8 April 1687 to 7 February 1688.
32. See, for instance, the remarks of Bower. 1990 and Krill. 1987.
33. Barrett, T. 1993. Fifteenth-century papermaking. *Printing History* 15(2): 33–41. (quotes 39–40). See also the remarks of Bower. 1990. 21 ff.

Papiers Briquet: The Charles-Moïse Briquet Archive in Geneva

DANIEL W. MOSSER

Abstract

C.-M. Briquet's album of watermarks, *Les Filigranes*, has been the standard reference tool for bibliographers and paper historians since its publication in 1907. Despite its importance, however, the album is not all that it could have been. Having collected approximately 60,000 watermarks, Briquet was forced by economic considerations to publish only 16,112. The unpublished tracings, which comprise part of the Charles-Moïse Briquet Archive (Papiers Briquet) held by the Bibliothèque publique et universitaire in Geneva, usually show variant states or twins of those that were published.

In July 1998 the author spent ten days working with the Papiers Briquet and, in a small test which he designed to assess the usefulness of the resource, was able to make exact or nearly exact matches with 21 of 30 watermark images which he had taken with him to Geneva. The author proposed to the administrators of the Bibliothèque publique et universitaire that he publish Briquet's unpublished watermark tracings on the World Wide Web and, in January 1999, received written permission to do so.

In this paper, the materials in the archive are described, the uses to which they can be put are illustrated, and plans for incorporating these unpublished tracings into a searchable Web database are discussed.

Briquet's *Les Filigranes*

C.-M. Briquet's album of watermarks, *Les Filigranes: Dictionnaire historique des marques du papier dès leur apparition vers 1282 jusqu'en 1600*,[1] has been the standard reference tool for bibliographers and paper historians since its publication in 1907. Despite its importance, however, the album is not all that it could have been. Allan Stevenson remarks on some of its deficiencies in his introduction to the 1968 jubilee edition of *Les Filigranes*:

> As all handmade paper has been manufactured on twin moulds, employed together at the vat, collections of watermarks should show both members of a pair. Together the two marks that make one paper greatly increase the ease of identifying that paper, even when they occur underneath type, for one of the marks may be confusingly similar to another mark. Briquet was misled by an imperfect understanding of these companion marks and their function for paper study, and was hampered by the economic necessity of presenting as many marks as possible. As it was, he cut his collection from some 60,000 to 16,112, thus jettisoning numerous twins, as we learn from examining the Briquet Archive at Geneva. The fact that inclusion of twins would have made a more valuable work is apparent in those few instances where twins did get in.[2]

A researcher attempting to make an identical match of a given watermark with a facsimile in Briquet faces very slim odds of accomplishing that end. Stevenson has calculated those odds at 'no more than five percent' (given that Briquet reproduces approximately 16,000 of an estimated 250,000 marks dating prior to 1600).[3] Assuming one finds a morphological similarity between the mark on hand and one in Briquet, one is then likely to find in Briquet's description of the mark a reference to other instances of the mark found in artefacts produced over several years or even decades. The problem, of course, is that one has no easy means of consulting those other examples.

To cite a specific case, in the course of my work on the manuscripts of the *Canterbury Tales*, I attempted to refine the dating of the earliest manuscript of that text to be copied on paper, Cambridge University Library MS Dd.4.24, which consists of paper gatherings with inner and outer bifolia of parchment.[4] The manuscript contains two paper stocks, both folded quarto. The first eight quires (originally 192 folios, which have suffered some losses, primarily in the first quire) are comprised of a single stock showing a pair of twin marks: dragons, or in Briquet's taxonomy, Basilic, similar to the pair of twins listed in Piccard as Drache 266 and 319, dated 1401, Utrecht.[5] In *Les Filigranes*, the closest match was no. 2630 ('**Udine**, 1384. ... Var. ident.: **Lucques**, 1381; **Paris**, 1385; **Venise**, 1390–92; **Voorne** [Pay-Bas], 1391'),[6] but none of the published examples come anywhere near providing an exact, or even a very close, match. The other paper stock in MS Dd.4.24, found only in the last of the surviving gatherings,[7] in fols. 194–203, is a dog, Chien Entier, very like Briquet 3597 ('**Palerme**, 1413–16. ... Voy. Zonghi [LX, n°2], **Fabriano**, 1400'). The Zonghi watermark — no. 989, dated 1400 — proves to be a better match with the mark in MS Dd.4.24 than the tracing reproduced in *Les Filigranes*.[8] From the evidence cited to this point, the manuscript would appear to have been copied very early in the fifteenth century. No manuscript of the *Canterbury Tales* has been convincingly dated to before 1400, the year of the poet's death.[9] I will return to this example and detail two others later in this essay.

Papiers Briquet: The Briquet Archive in Geneva

Tantalized by Allan Stevenson's allusion to the Briquet Archive at Geneva, I made some further enquiries, discovered that Briquet's papers were archived at the Bibliothèque publique et universitaire in Geneva (where the collection is referred to as Papiers Briquet), applied for a grant and spent 10 days in July 1998 working with the collection.[10] The Briquet papers include a great deal more than the published and unpublished tracings.[11] I have published an annotated translation of the Bibliothèque's

typescript inventory as part of the Thomas L. Gravell Watermark Archive on the World Wide Web (http://ada.cath.vt.edu:591/dbs/gravell/).[12] The unpublished tracings, on tracing paper cut to approximately 12 × 9 cm, are stored in envelopes measuring 15.5 × 13 cm, arranged according to Briquet's taxonomy, and archived in five cartons (F 78–82). The tracings show laid lines and attendant chain lines, a Briquet number in red,[13] and information about distances between chain lines, paper size (with an *R* indicating trimmed sheets) and the name of the archive holding the original watermarked paper. Most, but not all, tracings are dated.

The published tracings in *Les Filigranes* are very close reproductions of the original tracings (preserved in cartons F 75–77); that is, they are faithful to the size of the watermark and the spacing of chain and laid lines. Occasionally the chain lines are slightly 'off'; for example, when the tracing of Anneau 692 is superimposed on and aligned with its reproduction in *Les Filigranes*, it appears that the attendant chain on the right has been straightened in the reproduction and has been shifted 1 mm (at the top) to 5 mm (at the bottom) from the configuration of the tracing. In addition to the red accession numbers that accompany the unpublished watermarks, the published tracings also bear the number assigned to them in *Les Filigranes*, usually in green, but in some cases in red with a circle around it.

As a test of the usefulness of the archive, in advance of my visit I reproduced 30 facsimiles of watermarks that I was interested in matching.[14] I was able to make exact or nearly exact matches with 21 of the 30 watermark images that I took with me. This high success rate was no doubt achieved with a certain amount of serendipity. Nevertheless, following Stevenson's method of reckoning, since the archive holds some 60,000 tracings, the chances of making good matches should be almost one in four (24%). Among the matched materials were the reproductions I had of marks from the paper stocks of the Cambridge *Canterbury Tales* manuscript, MS Dd.4.24. I found a near match for one of the dragon marks which is much closer than any I had previously found in published reproductions: Basilic, accession number 9024, 30/44 **Udine**, dated 1402. The chain-line spacing is identical and most of the morphological features match as well. The MS Dd.4.24 stock is probably from the same mould in a different state. Notably, this dated example is not alluded to in the Briquet commentary. This near match would seem to support the early-fifteenth-century dating of the manuscript.

An even better match was found for the dog/Chien Entier mark previously noted and also from the Cambridge *Canterbury Tales* manuscript MS Dd.4.24: accession number 6652, 30/R/44 Cancelleria no. 22, dated 1416, from Archiv. **Palerme**.[15] This tracing is one of the examples referred to in Briquet's comments on the published tracing, Briquet 3597. The congruity of the two marks provides compelling evidence for a later dating of at least the final gathering of the manuscript (figs. 1, 2). The front legs in the two reproductions have a slightly different alignment. Although Briquet has not traced the full length of the chain line that bisects the figure horizontally, it appears that a line extrapolated from where his tracing ends would run through the upper and lower jaws at a slightly higher point than the chain line does in an example from MS Dd.4.24. The rear halves of the two images could not be more congruent. The two examples are, almost certainly, slightly different states of the mark from one mould. Other evidence in the manuscript suggests that it

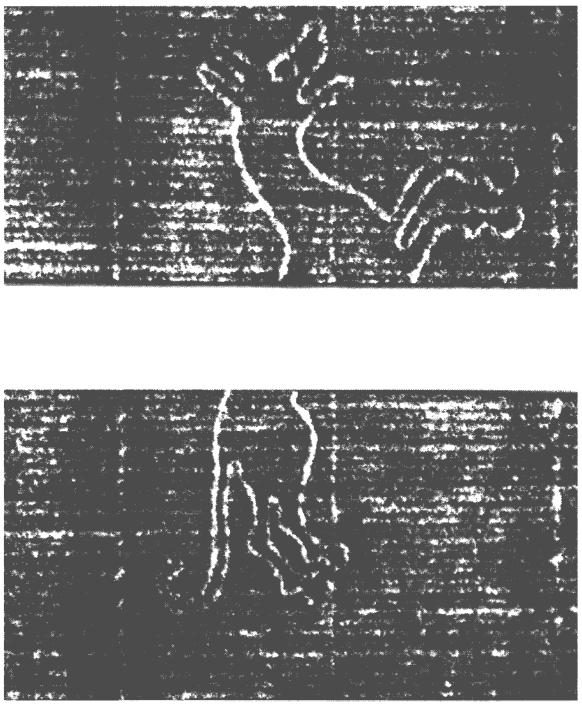


Fig. 1 Cambridge University Library MS Dd.4.24, fols. 197+199. By permission of the Syndics of Cambridge University Library.

Fig. 2 Bibliothèque publique et universitaire, Papiers Briquet, *Carton 79: Filigranes non reproduits C–F*, Chien, accession number 6652 (1416).

was copied and corrected over a period of time long enough for the scribe to exhaust one supply of paper and to acquire another stock, perhaps a decade newer, to finish the book.

Another manuscript of the *Canterbury Tales*, British Library Egerton MS 2864, is assigned the date 1460–80 by Manly and Rickert.[16] It contains six paper stocks.[17] Manly and Rickert identify the grapes/Raisin mark on one of these stocks as Briquet 13055, dated 1453. There are, however, closer matches among the unpublished watermarks in the Papiers Briquet: the closest — with identical laid lines and chain lines — is accession number 22042 (**Constance**, 1465). Figures 3 and 4 reproduce the Briquet tracing and an example of the mark on the Egerton MS 2864 paper stock from fol. 52 (the paper stock comprises fols. 50–78, and 80–98 in the manuscript).

A third manuscript of the *Canterbury Tales*, Bodleian Library MS. Rawl. C.86 (actually a miscellany compilation of four booklets, including *The Clerk's Tale* and *The Prioress's Tale*), contains several paper stocks made over a lengthy period of time.[18] Although the second booklet has been broken up and disordered, what was originally the first gathering of that booklet — the present fols. 77–89 (wants i and, the watermark distribution suggests, xv and xvi) — contains a single paper stock, with a distinctive bull's head/Tête de Boeuf watermark which resembles one identified by Paul Needham as similar to Piccard's Ochsenkopf Abteilung IX, no. 6 (Sutfen, 1473),[19] the 'general class' of which Piccard localizes to Burgundy-Lorraine.[20] While *Les Filigranes* contains no close match with this watermark, the unpublished tracings include an identical match: Papiers Briquet, *Carton F 82: Filigranes non reproduits R–T*, Tête de Boeuf, accession number 23420, dated 1469 (figs. 5, 6).

There are several pieces of textual evidence for dating other parts of the manuscript, which was copied over a period of time by several scribes. Immediately preceding Chaucer's *The Prioress's Prologue* and *Tale* is a Latin poem on the death of Edward IV, which occurred on 9 April 1483. The stock on which this elegy appears is in a quire made up of paper bearing an unidentified hand/Main watermark, of the same general type as Briquet 10708, dated 1478, but proportioned very differently. The final booklet in the manuscript contains the poem entitled in the *Index of Middle English Verse* as 'Verses on the Kings of England' (IMEV 444, 3431),[21] which alludes to Henry VI's re-interment at Windsor on 12 August 1484. These two historical references, then, could not have been copied before 1483 and 1484, respectively.

We may speculate with some confidence that, while the second booklet could not have been finished until after 1483, it could have been begun, and the first gathering of it completed, as early as 1469. This finding is somewhat at odds with the dating suggested by Jeremy Griffiths, who describes the main scribal hands in this booklet as belonging to 'the early sixteenth century.'[22] Given the date of the paper stocks, it would seem more plausible that the copyists were innovative practitioners

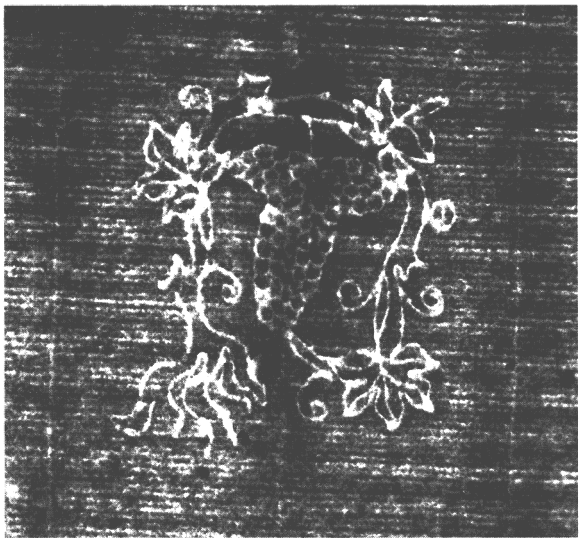


Fig. 3 British Library MS Egerton 2864, fol. 52. By permission of the British Library.

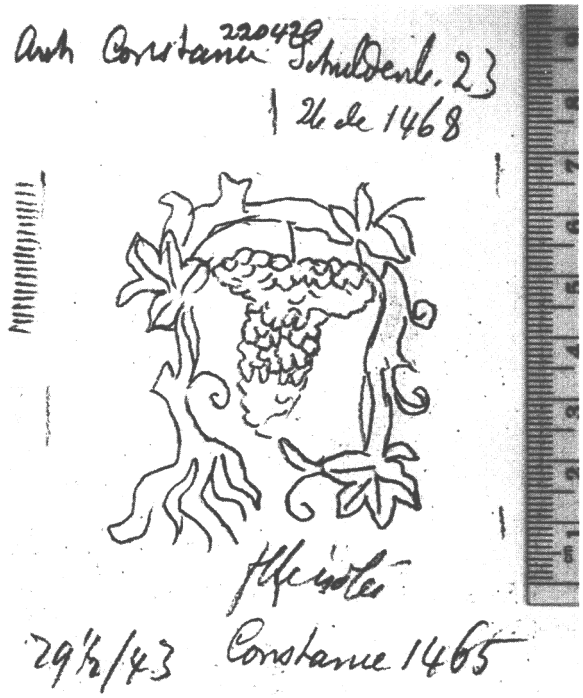


Fig. 4 Bibliothèque publique et universitaire, Papiers Briquet, *Carton 82: Filigranes non reproduits R–T*, Raisin, accession number 22042 (1465).

of the secretary script working in the last quarter of the fifteenth century. In any event, one now has to account for the very firm dating provided by the evidence of the paper stock.

Incorporating Briquet's unpublished tracings in a World Wide Web database

These examples should suffice to demonstrate the potential that these unpublished tracings hold for scholars and others seeking matches with dated examples. The impediment, of course, is that the tracings are housed in what, for many, is an inaccessible archive in a city where the cost of living quickly exhausts the resources of most academic researchers. A possible solution to this dilemma beckons.

Following my research trip to Geneva in July 1998, I proposed to the administrators of the Bibliothèque publique et universitaire that I publish Briquet's unpublished watermark tracings on the World Wide Web, and in January 1999 I received written permission to proceed. Sample entries (from photocopies made during my visit to Geneva) have been incorporated into the Thomas L. Gravell Watermark Archive.[23] To access these, one should select the 'Search the Database' option at the Archive's home page, and type 'Briquet' in the field labelled 'Image Collector.' Clicking on the 'Start Search' button will provide the user with a screen of results, including thumbnail images of the watermarks.

In early 2000 we received funding from the College of Arts and Sciences at Virginia Tech to have the Briquet papers digitized. This process is well under way, and by the time this is published, we should have all of Briquet's unpublished tracings and data burned onto one or more CD-ROMs at 300 dpi. Thus we will have created a digital backup copy of the fragile collection in Geneva, and will have the material in hand and readily available for incorporation into the Thomas L. Gravell Watermark Archive. The timing of its appearance on the Web will, of course, depend on funding.

The present platform of the database component of the Gravell Archive is FileMaker Pro 4.0, which includes Web Companion. The database is searchable by any or all of the data-record fields, and the results can be sorted. The Web front end was constructed using Claris Home Page and CDML (Claris Dynamic Markup Language) tags, while maintaining a straightforward FileMaker Pro database structure as the back end. The Web interface is able to access the database content dynamically, and it interacts seamlessly with the Web resources that have been part of the Gravell Archive since its inception in 1996 (for example, our Bibliography and Supplemental Reference Materials).

We have recently restructured the database to make the fields more congruent with standards adopted by the International Association of Paper Historians (http://www.paperhistory.org/wmclass.htm) and the Watermark Initiative (http://www.bates.edu/Faculty/wmarchive/wm-initiative/).[24] We have not provided for all of the IPH data fields since we often do not have access to the information they solicit (neither Gravell nor Briquet recorded much of this information) and because it is desirable to keep the data records to a manageable size (a single screen is the optimum goal). A data-record page now contains two columns; on the left is a thumbnail image of the watermark along with information about the watermark and paper, and on the right is information pertaining to the artefact and to the process of incorporating the watermark into the Gravell Archive.

We are also in the process of changing the platform from FileMaker Pro on a Macintosh server, to a multiprocessor, Linux SQL (Structured Query Language) database server. SQL will allow multiple simultaneous users to access a robust database with very fast retrieval times. During this transformation, we will try to achieve even greater congruency with the IPH and Watermark Initiative standards. We have found the FileMaker Pro platform to be a comfortable one to work in as we complete the final structuring of the database, and we plan to use it until we feel certain we have the structure in final form. The front-end Web interface should remain essentially the same regardless of the identity of the back-end database platform, and export and import of data from one to the other should be straightforward.

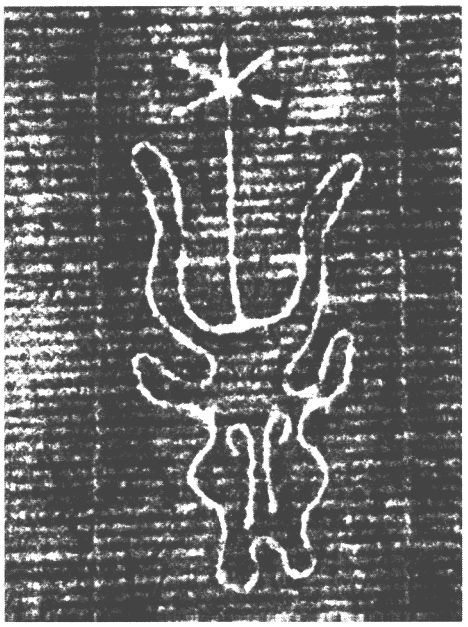


Fig. 5 Bodleian Library MS. Rawl. C.86, fol. 81^{v}. By permission of the Bodleian Library, Oxford.

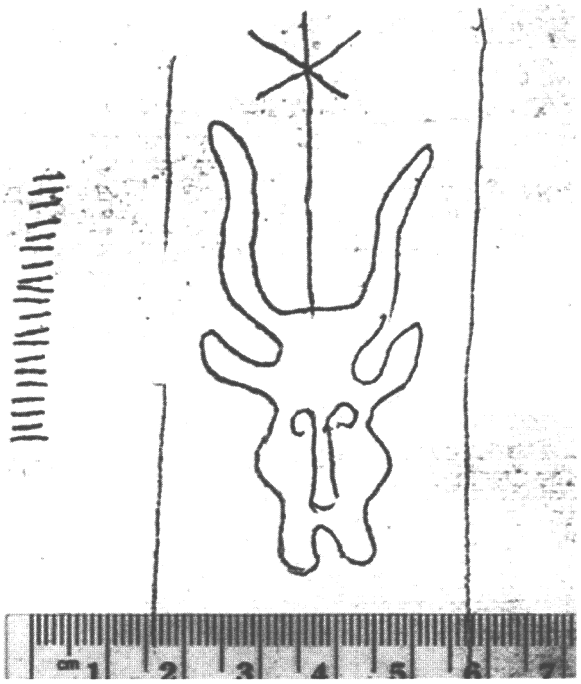


Fig. 6 Bibliothèque publique et universitaire, Papiers Briquet, *Carton 82: Filigranes non reproduits R–T,* Tête de Boeuf, accession number 23420 (1469).

While the prospect of keying in data for an additional 45,000 watermarks is a daunting one, I believe it is a worthwhile endeavour, and I am grateful to the

proprietors of the Briquet papers for extending their generous cooperation and for contributing to the possibility of a very rich database of watermarks on the World Wide Web.

Notes

1. Briquet, C.M. 1907. *Les Filigranes: Dictionnaire historique des marques du papier dès leur apparition vers 1282 jusqu'en 1600*. Genève: A. Jullien.
   I am grateful to Paul Needham and Len Hatfield for their helpful comments in connection with earlier drafts of this essay.
2. Stevenson, A.H. [1907]. 1968. Introduction to *Les Filigranes: Dictionnaire historique des marques du papier dès leur apparition vers 1282 jusqu'en 1600* by C.-M. Briquet. Facsimile of the 1907 edition with supplementary material contributed by a number of scholars, ed. A. Stevenson. 4 vols. Amsterdam: Paper Publications Society. 18.
   Stevenson discusses twins and the process of paper production that creates them in: Stevenson, A.H. 1951–52. Watermarks are twins. *Studies in Bibliography* 4: 57–91.
3. Stevenson, A.H. 1950. [Introduction] Briquet and the future of paper studies. In *Briquet's Opuscula: The Complete Works of Dr. C. M. Briquet without* Les Filigranes, by C.-M. Briquet. Hilversum: Paper Publications Society. 42.
4. Cambridge University Library, MS Dd.4.24 is described by the following:
   Manly, J., and E. Rickert. 1940. *The Text of the Canterbury Tales: Studied on the basis of all known manuscripts*. 8 vols. Chicago: University of Chicago Press. Vol. 1: 100–107.
   Owen, C.A., Jr. 1991. *The Manuscripts of the Canterbury Tales*. Cambridge: D. S. Brewer. 11–13, 15–20, et passim.
   Seymour, M.C. 1997. *A Catalogue of Chaucer Manuscripts*. Vol. II, *The Canterbury Tales*. Aldershot and Brookfield, VT: Scolar Press. 43–46.
   Mosser, D.W. 1996. *Witness Descriptions. The Wife of Bath's Prologue on CD-ROM*, ed. P. Robinson. Cambridge: Cambridge University Press.
   Mosser, D.W. 2000. *Witness Descriptions. The General Prologue on CD-ROM*, ed. Elizabeth Solopova. Cambridge: Cambridge University Press.
5. Piccard, G. 1980. *Wasserzeichen Fabeltiere*. Findbuch X of *Die Wasserzeichen Piccard im Hauptstaatsarchiv Stuttgart*. Stuttgart: Verlag W. Kohlhammer. 21, 90, 97.
6. The descriptive notations in this paper follow the pattern used by Briquet (Avis au lecteur. In Briquet. 1907.) The name of the place where a given paper was most likely to have been used, for writing or for printing, appears in bold.
7. The final gathering is fragmentary, ending at VIII/G 855 (*Canon's Yeoman's Tale*). Another two-and-a-half gatherings would have been required to complete the manuscript.
8. Zonghi, A[urelio], and A[ugusto] Zonghi. 1953. *Zonghi's Watermarks*, ed. E.J. Labarre. Hilversum: Paper Publications Society.
9. Although Blake, following Scott's suggestion that the work of the border artists in the Ellesmere Manuscript (Huntington Library, MS El 26 C 9) should be dated to 'a period beginning in or just after 1400 and ending no later than 1405,' urges that other manuscripts, arguably earlier than Ellesmere — National Library of Wales, Peniarth 392 D ('Hengwrt'); Corpus Christi College, Oxford, MS 198; and British Library, Harley MS 7334 — be considered to have been 'issued' by Chaucer in his lifetime. See Blake, N.F. 1997. Geoffrey Chaucer and the manuscripts of the *Canterbury Tales*. *Journal of the Early Book Society* 1: 96–122; and
   Scott, K.L. 1995. An hours and psalter by two Ellesmere illuminators. In *The Ellesmere Chaucer: Essays in Interpretation*, eds. M. Stevens and D. Woodward. San Marino, CA & Tokyo: Huntington Library & Yushodo Co. Ltd. 106.
   See also Scott, K.L. 1996. *Later Gothic Manuscripts 1390–1490*. 2 vols. Volume Six of *A Survey of Manuscripts Illuminated in the British Isles*, ed. J.J.G. Alexander. London: Harvey Miller Publishers. Vol. 2, 140, catalogue no. 42.
10. I am grateful to the Programs in the Humanities in the College of Arts and Sciences at Virginia Tech for granting me a Humanities Summer Stipend to make this research trip possible. I would also like to thank Monsieur Philippe Monnier, Associate Director of the Bibliothèque publique et universitaire, for his assistance.
11. Included in the collection are five notebooks on paper history, notes on French paper mills, studies of the earliest papers used in the West and East, lectures and published articles, notes on paper production and watermarks of other European countries, and other material, much of which is published or republished in Briquet. 1950.
12. Mosser, D.W., and E.W. Sullivan II. 1996–. Thomas L. Gravell Watermark Archive. <http://ada.cath.vt.edu:591/dbs/gravell/>.
   Mosser, D.W. 1998. Annotated translation of the inventory of the Papiers Briquet at the Bibliothèque publique et universitaire. Geneva. <http://ada.cath.vt.edu:591/dbs/gravell/briquet/briqeng.html>.
13. Although I found no explicit statement to corroborate this, my inference is that this is an accession number, and I refer to it as such.
14. To accomplish this, I digitized beta-radiographic reproductions at 100% with a resolution of 300 dpi, and then printed the images on overhead transparency sheets.
15. The paper folios (folded quarto) in MS Dd.4.24 measure approximately 29 × 20 cm, trimmed, which suggests that the original size of the whole sheet must have been greater than 58 × 40 cm, or considerably larger than Briquet's example, which he notes is trimmed (*R* stands for *rogné*); the original size may simply be half of a royal-sized sheet.
16. Manly and Rickert. 1940. Vol. 1: 144. The Egerton MS is also described in the following: Owen. 1991. 90–92; Mosser. 1996; Mosser. 2000; and Seymour. 1997. 111–16.
17. i. Raisin, nearest to Briquet 13002 (1460), but the mirror image (possibly the twin) of the Briquet mark: fols. 1–48;
   ii. Raisin, similar to Briquet 13055 (1453) and 13056: fols. 50–78, 80–98;
   iii. Basilic, not in Briquet or Piccard, but closest to Briquet 2691: fol. 79;
   iv. Tête de Boeuf, nearest Piccard Ochsenkopf 859 (1452), but certainly not from that mould (see Piccard, G. 1966. Ochsenkopf Wasserzeichen. Findbuch II. 1–3 of *Die*

Wasserzeichen Piccard im Hauptstaatsarchiv Stuttgart. Stuttgart: Verlag W. Kohlhammer: fols. 103–49);
v. Mont, nearest Briquet 11894 (1430): fols. 151–298;
vi. Sun (compare numbers 178–81 [1473–75] in Beazeley's tracings of watermarks at Canterbury, Vol. 1, British Library, Additional MS 38637), and compare Briquet *lettres assemblées* 9477 [variations from 1466–79]).

18. For descriptions and detailed accounts of the contents of Bodleian Library MS. Rawl. C.86, see the following:
Manly and Rickert. 1940. Vol. 1, 472–75;
Griffiths, J. J. 1982. A Re-examination of Oxford, Bodleian Library, MS Rawlinson C.86. *Archiv fur das Studium der neuren Sprachen und Literaturen* 219: 381–88;
Boffey, J. 1986. The Reputation and circulation of Chaucer's lyrics in the fifteenth century. *Chaucer Review* 28: 23–40;
Boffey, J., and C. Meale. 1991. Selecting the text: Rawlinson C. 86 and some other books for London readers. In *Regionalism in Late Mediaeval Manuscripts and Texts: Essays celebrating the publication of* A Linguistic Atlas of Late Mediaeval English, ed. F. Riddy. Cambridge: D.S. Brewer. 143–69;
Owen. 1991. 114–15;
Dixon, L.J. 1995. The *Canterbury Tales* miscellanies: A Contextual study of manuscripts anthologizing individual *Canterbury Tales*. 2 vols. Diss., University of Delaware. 175–84, 359–68;
Seymour, M.C. 1995. *A Catalogue of Chaucer Manuscripts*. Vol. I, *Works Before the* Canterbury Tales. Aldershot and Brookfield, VT: Scolar Press. 94–95, 150–51.
19. Needham, P. 1980. Four Strasburg incunables incorrectly assigned to Anton Koberer of Nuremberg. *British Library Journal* 6: 130–43.
20. The structure of the book is a very complicated one. Griffiths (1982. 383), and Boffey and Meale (1991. Fig. 1) correctly argue that the present structure of the second booklet — ordered e, b, a [Booklet 3], c, d — should be reconfigured to restore the original sequence of signatures: a, b, c, d, e [Booklet 3]. This section contains a number of works by Lydgate (most of the gathering with the bull's-head paper stock consists of Lydgate material), Gower, and others. The *Canterbury Tales* extracts occur in what were the fourth and fifth gatherings of the second booklet (156^{v}–173^{v}, *Clerk's Tale*; and 174^{v}–177^{v}, *Prioress's Prologue* and *Tale*). One of the paper stocks in this section, with a pair of bull's heads, closely resembles a paper stock used by Caxton in the *Dicts and Sayings of the Philosophers*, translated by Anthony Woodville, Earl Rivers (18 November 1477 [*circa* June 1480] STC 6828. See Needham, P. 1986. *The Printer and the Pardoner*. Washington, D.C.: Library of Congress. 86, Cx 38). Compare also Briquet 14237 (**Namur**, 1470–74; **Maëstracht**, 1473) and 14238 (**Paris**, 1469; var. ident. **Troyes**, 1471).
21. Brown, C., and R. H. Robbins. 1943. *The Index of Middle English Verse*. New York: Columbia University Press. IMEV 444, Verses on the Kings of England, from William the Conqueror to Henry VI, and IMEV 3431, The Kings of England (wrongly attributed by the IMEV to Lydgate: Boffey and Meale. 1991. fig. 1).
22. Griffiths. 1982. 384.
23. This project was begun by Ernest W. Sullivan II and me in 1996, but only since the reconfiguration into the current database structure (carried out by our colleague Len Hatfield in December 1998) have we begun to add records on a regular basis.
24. International Association of Paper Historians. *IPH Classification of Watermarks*. Alphabetically sorted according to the English class denotation. Version 2.0, 1997. <http://www.paperhistory.org/wmclass.htm>;
Allison, R.W., and J.A. Hart. 1997. The WWW Watermark Archive Initiative. <http://www.bates.edu/Faculty/wmarchive/wm-initiative/>.

Fickle Friends: Watermarks and Paper Evidence in Sixteenth-Century Italian Ornament Prints

VICTORIA BUTTON AND ELIZABETH MILLER

Abstract

The focal point of the paper is the interpretation of paper evidence with particular reference to the rediscovery of sets of ornament prints from a volume published by one of the most influential print publishers of the sixteenth century — Antonio Lafrery. The process by which the volume was unearthed is discussed alongside research into the paper on which the sets were printed. A number of factors relating to the physical similarities between the sets are discussed, for example, the size, type of paper and stitching holes left behind by the now lost binding. Moreover, the presence of a particular pair of watermarks and their repetition throughout the volume can be seen as an indicator of one publisher's output and illustrates our key use of watermarks in this instance. This offers some insight into a publisher's working practice by using sets of prints as the focus.

This research is part of a catalogue published by the Victoria and Albert Museum in 1999 which includes an appendix of watermarks compiled by the curator and conservator who authored this paper.

'Fickle Friends' has been chosen as the title of this article as a reflection of some of the difficulties of interpreting the evidence gathered from studying watermarks in sixteenth-century Italian ornament prints. Over a two-year period 759 Italian prints from the sixteenth century were examined to determine if they were on watermarked paper. These watermarks were then related to the published literature on watermarks. David Woodward's *Catalogue of Watermarks in Italian Printed Maps ca 1540–1600*,[1] which reproduces watermarks by radiography or photography, was particularly useful and relied upon much more than the tracings found in older reference works. The overlap between Italian map and print publishers during this period also made this comparison especially valuable. The results of this project can be read in the watermark appendix in the recently published catalogue *16th-Century Italian Ornament Prints in the Victoria and Albert Museum* by Elizabeth Miller.[2]

This article focuses solely on a volume which was purchased by the V&A Museum in 1873, which once contained nine items mentioned in the *c.* 1573 stock list of the Roman print publisher Antonio Lafrery (1512–77). These nine items consisted of architectural treatises by Antonio Labacco (*c.* 1495–1559) and Giacomo Barozzi da Vignola (1507–73) along with seven sets of ornament prints. Henceforth the volume will be referred to as the Lafrery volume.

Since the sixteenth century, 'ornament' has been one of the categories used to organize large collections of prints by subject. One of the earliest theoretical formulations of the category 'ornament print' dates from 1565, when possible subdivisions were listed as 'foliage, frames, grotesques, animal designs, trophies, fruits and designs of mixed type.'[3] A recurrent feature in ornament prints is a concern with surface decoration. They were frequently published as sets in the form of a number of variations on a theme, rather than as individual images. Ornament prints form a subgroup within any period and national school of printmaking prior to the twentieth century. They have played an essential role as sources of inspiration for designers and craftsmen and as repositories of design ideas for those studying the decorative arts. Ornament prints form the nineteenth-century nucleus of the V&A Museum's print collection, and were acquired specifically to contribute to the museum's founding mission of educating craftsmen and designers. The collection of ornament prints numbers some 35,000 examples and is one of the most important of its kind in the world.

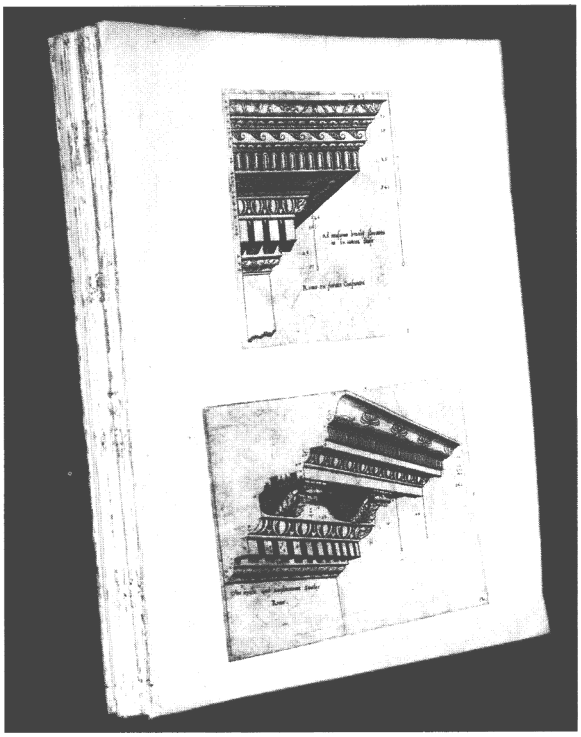


Fig. 1 The disbound Lafrery volume reassembled in a pile.

All the unbound ornament prints in the collection are housed in Solander boxes arranged alphabetically by artist, regardless of period or school. In 1996 all the prints due for inclusion in the forthcoming Italian ornament print catalogue were removed from their boxes and temporarily rehoused according to broad subject category: friezes, grotesques, trophies and so forth. This resulted in the revelation that many of the subject categories contained sets of prints on paper of the same size, that were accessioned in 1899. When all these sheets were assembled in accession number order, one arrived at what amounted to a volume with the binding removed (fig. 1).

Research for this symposium led to the rediscovery of a volume which must now be recognized as one of the great treasures of the museum's print collection. No such volume had previously been known to exist in any museum collection, and no description of such a volume existed in the literature on prints. On the principle of the whole being more than the sum of its parts, the contents of this volume had a far-reaching impact on the cataloguing of sixteenth-century Italian ornament prints, leading to major revisions of attribution and chronology. These prints had been stored in four separate boxes since 1899, and it was only by paying attention to the paper on which they are printed that they could be properly understood. In a lecture given by Antony Griffiths in 1996, he spoke on 'the archaeology of the print.'[4] This concept was very helpful, and it has been used here to refer not only to the printing technique, the size of paper used, fibre content, tone, texture, weight and watermarks, but also to the housing history of particular prints, which may have resulted, for instance, in alterations or damage.

Research in the V&A Museum's archives has revealed that in 1873 the museum paid 13 guineas for a vellum-bound volume containing seven sets of ornament prints, and two sixteenth-century Italian architectural treatises, *Libro d'Antonio Labacco*[5] and *Regola delli cinque ordini d'architettura*[6] by Giacomo Barozzi da Vignola, first published in 1552 and 1562 respectively. These two architectural works have since been rebound individually. Apart from a few letterpress pages of introductory material in the Labacco, both these architectural books are printed from copper plates.

Antonio Lafrery (1512–77) was the most important print publisher in Rome in the third quarter of the sixteenth century. No earlier than 1573, he issued a letterpress stock list itemizing the subjects of around 500 single-sheet prints and 19 books or sets of prints, he was offering for sale in his shop. This is the first list of its kind in the history of European printmaking, and survives in a unique copy in the Bibliotheca Marucelliana in Florence.[7] Both of the architectural books and all seven sets of ornament prints contained in the volume purchased in 1873 can be matched to entries in Lafrery's stock list. This is the first time it has been possible to put faces to some of the hitherto enigmatic names on Lafrery's stock list, such as 'Book of Masks.'

The seven sets of ornament prints consist of impressions of 133 copper plates printed on 90 folios. The seven sets of prints are Book of Cornices, Capitals and Bases after the Antique Ruins That You Can Daily Discover in Rome; Book of Various Frames; Book of Trophies, after Drawings by Polidoro Imitating Antique Examples; Book of Masks; Book of Grotesques; Book of Friezes and Foliage; and Book of Vases and Candlesticks.

The number of copper plates used to print each set ranges from 13 in the Book of Various Frames to 30 plates in the Book of Cornices, Capitals and Bases. The vellum-bound volume was broken up by the museum in 1899, when the sets of ornament prints were transferred from the collection of books to that of engravings. At this time the individual impressions were given accession numbers. The destruction of the vellum binding in 1899 is to be deplored, since the date of that binding cannot now be determined. However, the loss of the binding meant that it was possible to examine the method by which the sets of ornament prints were assembled and the paper on which they are printed, far more easily than would be the case if they were still bound.

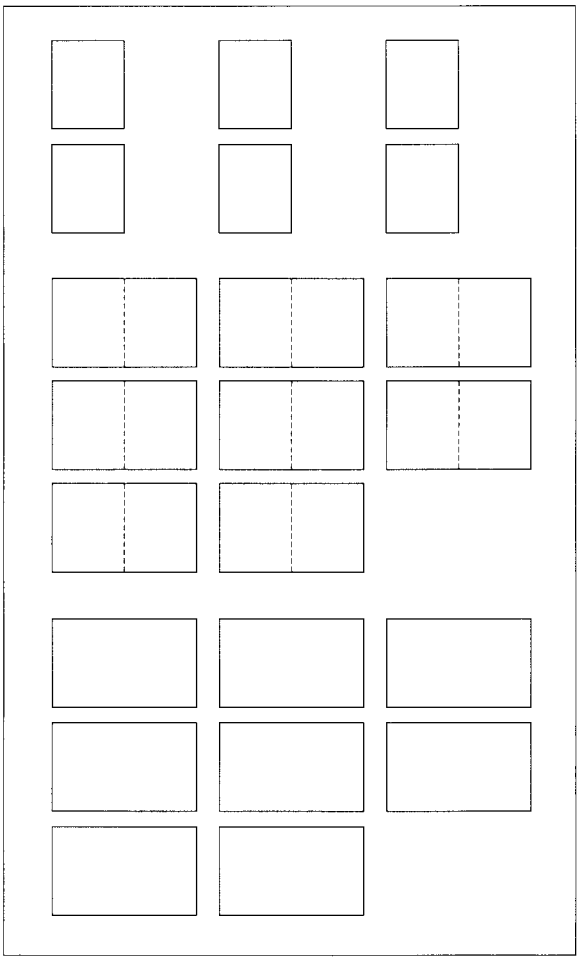


Fig. 2 Variations in folio composition of the sets. Top: Masks, single folios; Middle: Grotesques, folios tipped together; Bottom: Trophies, bifolia.

Figure 2 shows the three main variations in the make-up of the sets. Every folio throughout the volume is printed on one side of the paper only. At the top is the Book of Masks, printed on six single folios. Each folio in this set has either four or three copperplates printed on it. In the middle is the Book of Grotesques, printed on sixteen folios, which have been turned into eight bifolia by tipping them together on guards. Each folio has a single copperplate printed on it. At the bottom is the Book of Trophies (fig. 3), printed on true bifolia (full sheets). Each bifolium has two copperplates printed on it, resulting in one copperplate per folio when the bifolia are folded and made up into a set.

The remaining sets of ornament prints consist of permutations of these formats. In the sets made up of true bifolia, each is made up of gatherings of two or three bifolia slipped inside each other. The Book of Trophies is made up of eight bifolia arranged in four gatherings of two bifolia each. As each of the Trophies has an engraved plate number on it, they had to have printed the plates in

Italian drawings on blue paper.[10] The positioning of the blue paper in the Book of Masks within the set and not at the beginning or end is problematic, but there is further evidence to support the idea of temporary bindings. This is provided by the presence of holes which could correspond to a tacket on one of the other sets. A tacket is commonly a length of gut or thread used to keep the wrapper in place on a binding. These holes are consistently placed 19 mm from the top edge on all the folios making up the Book of Cornices, Capitals and Bases. The bifolia measure 388 by 548 mm and are consistent throughout the volume. This, together with the pattern of printing the plates described above, would indicate an intent to publish in sets or volumes. The bifolia sizes remain intact throughout the volume, despite being disbound, with the exception of the candlesticks, which were cut down sometime after being acquired by the museum.

Discovering the size of the moulds on which these papers were made is not straightforward, not least because there is little clarity about paper size standards during the Renaissance period.[11] Dard Hunter notes that 'In the early years of printing, the paper was seldom cut, the sheets being printed upon in the original sizes formed in the moulds, although in many cases the deckle edges were trimmed away.'[12] In binding a folio volume the sheets were folded in the centre, the chain lines running parallel to the fold. Despite the confusion surrounding the mould sizes, it seems probable that the sheet would not have been significantly bigger than it is now, for the following reasons. First, there is consistency in the position of watermarks between the true bifolia in the Book of Trophies and Book of Vases and Candlesticks and the tipped-together bifolia and single folios in other sets. That the watermarks are centred or almost centred in each of the folios where they occur supports the theory that the position of early watermarks is nearly always in the middle of each half-sheet.[13] Second, there is the presence down the centre of several bifolia of what appear to be rope marks. These occur during the drying stage of the papermaking process when the damp sheets are hung over a drying rope. Third, there is the consideration of the cost of paper, which would surely curtail needless waste from excessive trimming.[14] Finally, the arrangement of the copperplates on the folios, as described above, would seem to indicate a concern for the economical use of materials.

The paper within the volume can be described as cream-coloured rag paper. It is a laid sheet of medium weight with a moderate to heavy texture from the mould wires and pronounced felt-marks from pressing. Seen in raking light, the felt impression as well as distortions from the lost binding are clearly visible (fig. 6). Subtle differences do occur in the papers, such as the amount of size used, slight discrepancies in weight, imperfections and different watermarks, but overall they are good-quality papers with well macerated fibres. Visible imperfections include the thinning of fibres caused by splashes of water from the papermaker's hands. Seen in transmitted light, the anatomy of a typical bifolium becomes clear. The chain-line spacing is around 30 mm — a spacing that in a French paper of that time would have been

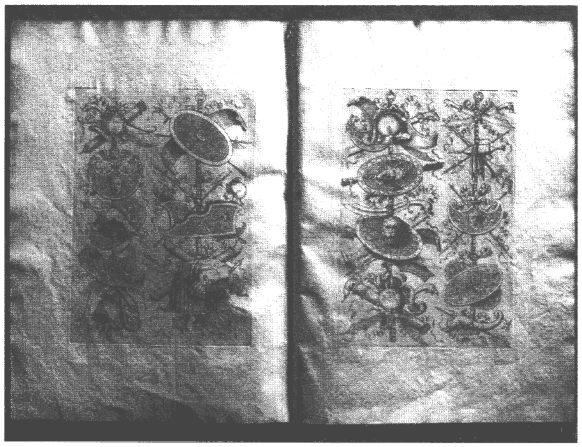


Fig. 6 Book of Trophies bifolia in raking light, from the Lafrery volume.

significantly smaller. The watermarks are anchored to the chain lines. These characteristics are typical of sixteenth-century Italian paper, during a period when the paper industry was firmly established in Italy, with little or no need to import papers from other countries.[15]

Table 1 represents the distribution of watermarks in the separate items which make up the Lafrery volume. Every box down the left-hand side corresponds to one item on Lafrery's stocklist. There are eight watermarks present. The letterpress folios of the Labacco contain two watermarks, these being Crossbow in Circle[16] and Blacksmith[17] (also know as Arms of Fabriano). In the papers used to print the Labacco copper plates there are two different watermarks, the letter M under Fleur-de-Lys in Shield[18] and Pilgrim Vertical Crook in Circle.[19] This makes a total of four watermarks in this item. In the Vignola there are three watermarks, one of which, the letter M under Fleur-de-Lys in Shield, is the same type as one in the Labacco, thus linking these sets.

Moving from the bound architectural treatises to the unbound group of seven sets of ornament prints, we find that the next two sets, Book of Cornices, Capitals and Bases and Book of Various Frames, have the same watermark, Tulips in Shield under Six-Pointed Star.[20] This is also present in the Vignola and links these sets. The next set, the Book of Trophies, has a new watermark, Man's Head with Headband,[21] which is different from those already encountered. The Book of Masks, the Book of Grotesques, and the Book of Friezes and Foliage all have the watermark Tulips in Shield under Six-Pointed Star (fig. 7), already found in the Vignola, the Book of Cornices, Capitals and Bases, and the Book of Various Frames — again making a link between these sets. The Book of Vases and Candlesticks has two watermarks, Man's Head with Headband (present in the Book of Trophies) and Anchor in Double Outline with Star,[22] which stands alone.

To summarize, of the seven sets of ornament prints, six have only one watermark type, and of these six, five are the same: Tulips in Shield under Six-Pointed Star, which is also present in the Vignola. This distribution of watermarks surely represents the use of a batch of paper and ties the architectural books and the ornament sets closely together.

	Crossbow in Circle	Blacksmith	Letter M under Fleur-de-Lys in Shield	Pilgrim Vertical Crook in Circle	Tulips in Shield under Six-Pointed Star	Fleur-de-Lys in Circle under Six-Pointed Star	Man's Head with Headband	Anchor in Double Outline with Star
Labacco letterpress	●	●						
Labacco copperplate			●	●				
Vignola			●		●	●		
Cornices, Capitals and Bases					●			
Various Frames					●			
Trophies							●	
Masks					●			
Grotesques					●			
Friezes and Foliage					●			
Vases							●	
Candlesticks								●

Table 1 Distribution of Watermarks in the Lafrery Volume

The above approach focusses on the distribution of watermarks. The copper plates for printing certain ornament prints were in use for very long periods of time, amounting in some instances to centuries. Examining the distribution of watermarks within a related group of prints such as the Lafrery volume, independent of the dating of the prints, is one way around this problem. As is clear from the Lafrery volume, the presence of several watermarks does not prove there is no connection between the prints. In cataloguing the ornament prints every case had to be judged on its merits, and the watermark evidence was taken in tandem with other considerations such as similar subject matter, style, technique and even plate size.

Dating of either the prints themselves or other instances of the use of paper with the same watermark should not, of course, be ignored. The Book of Cornices, Capitals and Bases includes images which are dated 1537 in the plate, while the first plate of the Book of Friezes and Foliage is dated 1570 in the plate. Nevertheless, both sets are on paper with the same watermark, Tulips in Shield under Six-Pointed Star, which was recorded by David Woodward on maps first published from 1542 to 1570. In the Fabriano archives two versions of this watermark were found in paper used in 1572 and 1573.

The first plate in the Book of Trophies is dated 1553 in the plate, while the last two plates in the same set are dated 1550. Twelve out of the 14 vases in the Book of Vases and Candlesticks are dated 1543 in the plate, yet they are on paper with the same watermark as the Book of Trophies. The vases and the candlesticks in the Book of Vases and Candlesticks are on paper with two different watermarks. The explanation given for this in the published catalogue is that Lafrery had a business agreement with his rival publisher Antonio Salamanca (and subsequently with his heir) that they would exchange impressions of each other's prints on a wholesale basis. It is suggested that the Candlesticks were in fact printed under this agreement by Salamanca's heir.[23] This explanation has divided print scholars between those who accept it and those who reject it, saying that the conspicuously

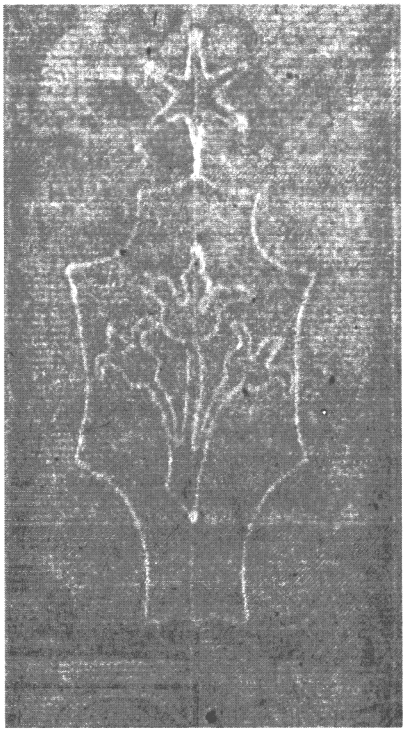


Fig. 7 Radiograph showing watermark of Tulips in Shield under Six-Pointed Star.

poor impressions of the Candlesticks in comparison with all the other prints in the volume indicate the substitution of poor impressions for good ones at some time after the volume was assembled. Some of these questions remain unresolved, and in the absence of other Lafrery volumes, watermark studies are unable to resolve them.

In the longer term, the issue facing both the curatorial and conservation staff charged with the care of the Lafrery volume is how it will be stored and hence consulted by future visitors. Any solution to this needs to combine doing justice to its enormous richness as a resource for the understanding of sixteenth-century Italian paper, watermarks, copperplate printing, and

publishing, while at the same time recognizing its true nature as a collection which entered the V&A museum as a bound volume.

Acknowledgements

We would like to thank the departments of Conservation (Paper and Book Section), Prints, Drawings and Paintings, and Research at the Victoria and Albert Museum for their support in preparing this paper. Victoria Button is grateful for a grant from the Museums and Galleries Commission which enabled her to participate in the symposium where this paper was given. Paul Robbins of the V&A photo studio took the transmitted- and raking-light photographs which illustrate this article. Radiographs of some of the watermarks in the Lafrery volume were kindly taken by Janet Lang of the British Museum Department of Scientific Research, and we are grateful to her and the head of department, Dr Sheridan Bowman, for their assistance.

Notes

1. Woodward, D. 1996. *Catalogue of Watermarks in Italian Printed Maps (ca 1540–1600)*. Florence: Casa Editrice Leo S. Olschki.
2. Miller, E. 1999. *16th-Century Italian Ornament Prints in the Victoria and Albert Museum*. London: V&A Publications. No 62.
3. Hajós, E.M. 1958. The concept of an engraving collection in the year 1565: Quicchelberg, inscriptiones vel Tituli Theatri Amplissim. *Art Bulletin* 40(2) June: 151–56.
4. The Collecting of Prints and Drawings in Europe *c.* 1539–1750. London: National Gallery, 20–21 June 1997. Conference organized by the *Burlington* magazine with the support of the Provenance Index, Getty Conservation Institute.
5. Savage, N., A. Shell, P.W. Nash, G. Beasley and J.M. Coast. 1995. *British Architectural Library, Royal Institute of British Architects early printed books 1478–1840*. Volume 2. London: Bowker-Saur. 897.
6. Hart, V., and P. Hicks. 1998. *Paper Palaces, The Rise of the Renaissance architectural treatise*. New Haven, London: Yale University Press. 199–218.
7. Ehrle, F. 1908. *Roma prima di Sisto V. La pianta di Roma Du Pérac-Lafréry del 1577*. Rome: Danesi. 54–59.
8. Woodward, D. 1991. The evidence of offsets in Renaissance Italian maps and prints. *Print Quarterly* 8(3) September: 235–51.
9. Bruckle, I. 1993. Historical manufacture and use of blue paper. In *American Institute for Conservation of Historic and Artistic Works, Book and Paper Group Annual* 12: 5–7.
10. Ames-Lewis, F., and J. Wright. 1993. *Drawing in the Italian Renaissance Workshop*. Exhibition catalogue. London: Victoria and Albert Museum.
11. Landau, D., and P. Parshall. 1996. *The Renaissance Print 1470–1550*. New Haven, London: Yale University Press. 16.
12. Hunter, D. 1947. *Papermaking, The History and technique of an ancient craft*. New York: Dover Publications.
13. Hills, R.L. 1988. *Papermaking in Britain 1488–1988: A Short history*. London; Atlantic Highlands, N.J.: Athlone Press. 32.
14. Woodward, D. 1996. *The Panizzi Lectures 1995, Maps as prints in the Italian Renaissance: Makers, distributors and consumers*. London: British Library Humanities and Social Sciences. 49.
15. Lunning, E. 1989. Characteristics of Italian paper in the seventeenth century. In *Italian Etchers of the Renaissance and the Baroque*, ed. S.W. Reed and R. Wallace. Boston: Museum of Fine Arts.
16. Similar to watermarks in Woodward. 1996. No. 207, 208, 209 and 213.
17. Similar to watermarks in Woodward. 1996. No 311 and 312.
18. Similar to watermark in Woodward. 1996. No 4.
19. Similar to watermarks in Woodward. 1996. No 124 and 125.
20. Similar to watermarks in Woodward. 1996. No 28, 29, and 30.
21. Similar to watermarks in Woodward. 1996. No 167.
22. Similar to watermarks in Briquet, C.M. 1968. *Les Filigranes: Dictionnaire historique des marques du papier des leur apparition vers 1262 jusqu'en 1600. A Facsimile of the 1907 edition*. ed. A. Stevenson. Amsterdam: Paper Publications Society. No 7558.
    Also similar to a watermark in Zonghi, A., A. Zonghi and A.F. Gasparinetti. 1953. *Zonghi's Watermarks, Monumenta chartae papyraceae historiam illustrantia*, Vol 3, ed. E.J. Labare. Hilversum: Paper Publications Society. No 1747.
23. Miller. 1999.

Martha and Mary, 1568–70: The Use of a Pair of Watermarks in Reconstructing the Venetian Map Trade

DAVID WOODWARD

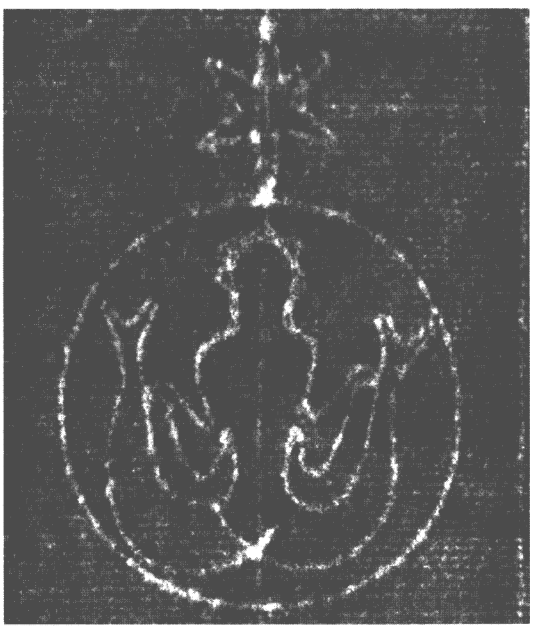
Abstract

A key pair of watermarks, in many ways archetypal of the use of paper in the Venetian map trade, depicts a siren with two tails in a circle surmounted by a star. From various kinds of contextual evidence it is possible to infer that the marks were current from 1568 to 1570. The abundant use of this pair of watermarks makes it possible to reconstruct a cohort of map plates that was used contemporaneously in the map-publishing workshops in Venice. This paper addresses the level of precision with which states of these watermarks during this short period can be used to reconstruct the order of paper use. In addition to detailed comparison of the watermark states, evidence of map offsets, PIXE techniques to establish the chemical consistency of paper bearing these watermarks and contextual bibliographical evidence (such as the occurrence in composite atlases) is employed. By focussing on this pair of paper moulds that was short-lived but centrally important to the Venetian map trade, the paper will suggest ways in which detailed watermark analysis of this type can (and cannot) provide useful bibliographical and historical information.

A key pair of watermarks, in many ways archetypal of the use of paper in the Venetian map trade, depicts a siren with two tails in a circle surmounted by a star. This watermark design exists in two variants, and I have gathered a total of 44 high-quality images (fig. 1). The chances are very high that these constitute a twin pair of paper moulds, for three reasons. First, no other examples of these designs came to light in a sample of over 1,100 watermarks from sixteenth-century Italian printed maps.

Second, when these occur on two-sheet maps, they most often appear (75% of the time) on respective sheets. Two-sheet maps were usually printed in tandem. That is, while plate one was being printed, plate two was being inked. In a normal stack of paper, alternating twin watermarks are found, so that normally twins are found on alternating sheets. This can be confirmed with evidence of offsets.[1] Breaking and shuffling the stack would confound this rule, of course, so it is possible that sheets of a two-sheet map have the same watermark, but they do so in only 25% of the cases.

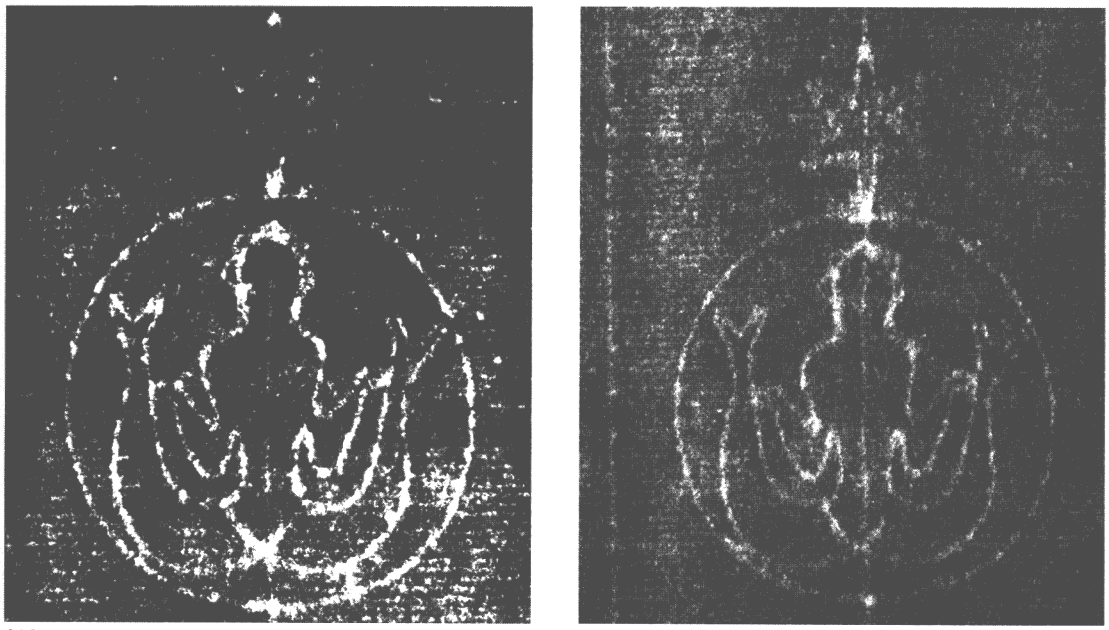
Finally, the amounts of key elements (iron, potassium, and calcium) in the paper on which these two watermarks appear were measured using PIXE (particle-induced x-ray emission) at the Davis Crocker Nuclear Laboratory, University of California. Using discriminant analysis, differences in the chemical makeup of the paper bearing the two watermarks were found not to be significant. This suggests that both batches of paper used a similar papermaker's recipe. It should be added that data gathered from paper watermarked with different motifs showed a significant difference in chemical makeup.[2] Paper made from a given paper mould shows



A08

Y16

Fig.1 Examples of a twin pair of siren-in-circle-with-star watermarks (A08 and Y16). A08 is a map of the Peloponnese published by Claude Duchet in Venice in 1570, from an impression in the Newberry Library, Chicago, Novacco 2F192. Y16 is from a map of the world by Giovanni Paolo Cimerlino dated 1566, and is from a positive radiograph print of the map in the Nordenskiöld Collection, University of Helsinki (2586, 3R).



A16 A20

Fig. 2 Comparison of details of shape in A16 and A20. Note the longer right shoulder in A16. A16 is a contact photographic print from the marginal strip used to bring maps to standard size in a Venetian composite atlas assembled in 1570, offered for sale by Sotheby's on 27 September 1988 and now in the possession of a private collector in the United Kingdom. A20 is from an undated map of Greece in the Roy V. Boswell Collection at California State University, Fullerton.

marked consistency in the relative amounts of chemical elements, implying either highly consistent recipes on the part of papermakers or a rather short production period for each mould.

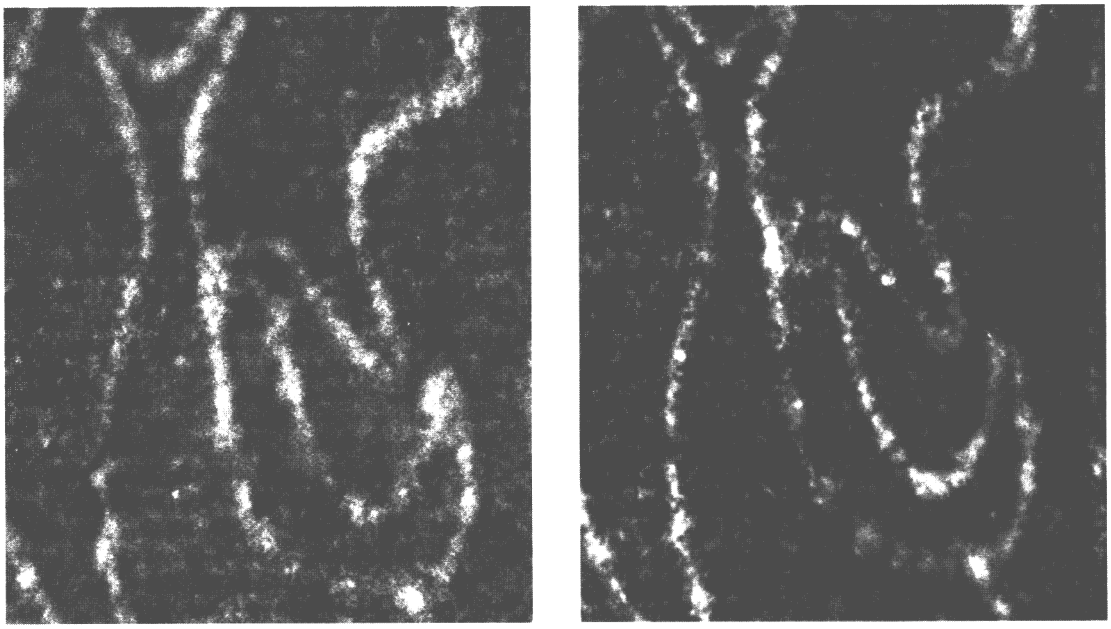
The twin designs were nicknamed Martha and Mary for convenience. Following the biblical allusion that Martha was generally beefier than Mary, the siren with the enlarged right shoulder earned the name Martha. A confident discrimination of these watermarks could not have been undertaken without the use of contact photography, beta radiography and access to many hundreds of maps owned by or loaned to the Newberry Library, Chicago, while I was employed there. The bulk of the radiography was done in 1979 and 1980.

Maps that bear the Martha/Mary pair of watermarks all bear Venetian imprints, and are associated with the engravers Paolo Forlani, Girolamo Olgiato, Domenico Zenoi and Giovanni Francesco Camocio, all extremely active from 1565 to 1570 in the print workshops of the Frezzaria, between Piazza San Marco and the Rialto. Claude Duchet, who usually worked in Rome, was in Venice in 1570 and brought some of his plates there.

I do not know where the paper was made. It is not a Fabriano watermark and I am inclined to think it was from a paper mill in the Veneto, but given the state of archival studies in sixteenth-century Italian papermaking, this is presently difficult to document.

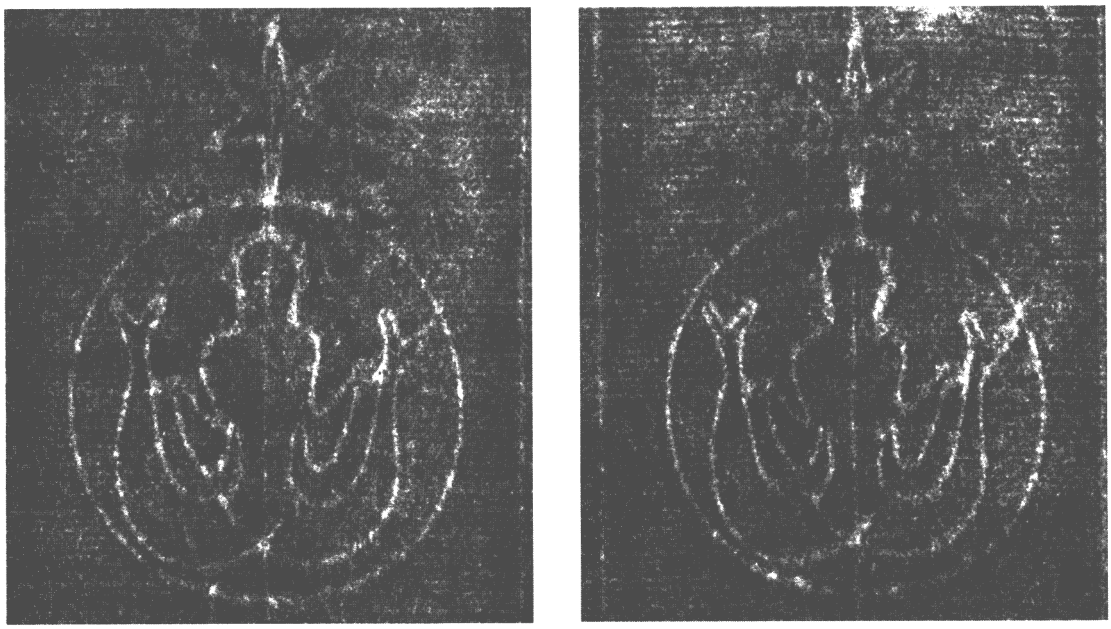
To what extent can internal variations in these watermarks be observed? When my watermark studies started, Allan Stevenson's incredibly detailed study of the changing watermarks in the incunable *Missale Speciale* captured my imagination. Stevenson showed that paper moulds could go through identifiable stages in their lives analogous to the states of a printing plate. They could be increasingly distorted with use as excess pulp was brushed from it during the end-of-day cleanup. More dramatically, when the mark was situated between chain lines Stevenson even estimated the rate of movement along the wire lines as averaging about a millimetre a month, a distance certainly discernible on a radiograph.[3] The precision of this analysis fascinated me, and I thought I might be able to apply it to sixteenth-century Italian maps. Given the quantity of good radiographs available, a close study of Martha and Mary seemed a good place to start.

The radiograph negatives were carefully scanned into Photoshop at 600 dpi and the brightness levels were manipulated using the histogram to standardize the contrast of the images. The Martha images were labelled A01–A26 and the Mary images Y01–Y18. The images were taken from various collections and included maps with printed dates between 1559 and 1570. In both sets of images minute changes were observed in the shape of the right shoulder (sharp versus more rounded) (fig. 2, A16 versus A20), the angle the shoulder made with the crook of the right arm/fin(?) of the siren and the angle between the branches of the tail (sharp versus rounded, with a difference in the number of sewing dots) (fig. 3, A08 versus A21). The difference in the character of the sewing dots in figure 3 could mean that A01 is earlier and the mould was later strengthened in that area with more attachments. In some cases a slight bending of the central chain line was also observed (fig. 4, A05 versus A14). These variations were in keeping with a slight movement of the design leftward in response to the repeated stress of cleaning the mould. In the Mary watermarks, the angle of the crook of the right arm/fin



A08 A21

Fig. 3 Comparison of details of shape in A08 and A21. Note the difference in sewing-dot pattern in the branches of the siren's tail and the difference in the number of sewing dots. A08 is a map of the Peloponnese published by Claude Duchet in Venice in 1570, from an impression in the Newberry Library, Chicago, Novacco 2F192. A21 is a positive radiograph print from a map of the Brabant by Girolamo Olgiati, in the Nordenskiöld Collection, University of Helsinki (2586, 16L).



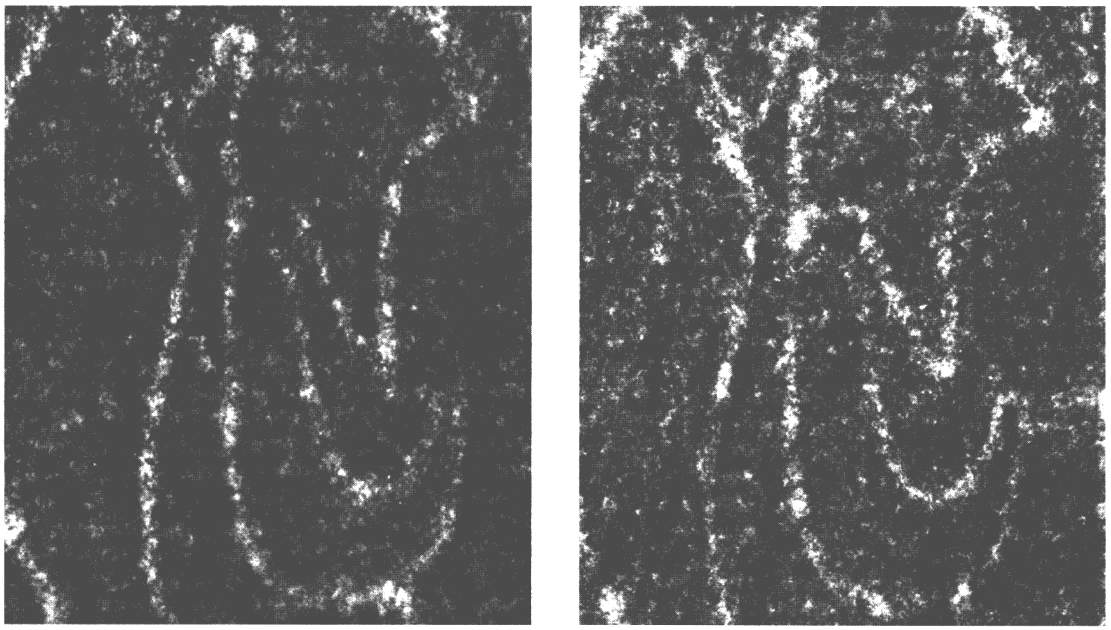
A05 A14

Fig. 4 Comparison of details of shape in A05 and A14. Note the slight bowing to the left of the central chain line in A05 and the elongated shape of Martha's right shoulder. A05 is a map of Poland by Paolo Forlani, from a plate dated 1568 in the Roy V. Boswell Collection at California State University, Fullerton (GHB 'T455').

also appeared to change (compare Y08 and Y13 in figure 5).

How can these be fitted into known *termini a quo* and *ante quem*? A *terminus ante quem* is 1570, for no maps bearing this pair of watermarks have been found dated after 1570. George H. Beans gave a range of 1561–70, but also found none after 1570.[4] Something happened to this pair of moulds in 1570, and the search is on for maps with such a mark bearing a publication date of 1571 or after. However, on the basis of the large sample already gathered and the length of time I have been looking, it is unlikely that such maps will be found.

A *terminus a quo* is 1566, because we have two pieces of evidence. One is what is arguably the earliest



Y08 Y13

Fig. 5 Comparison of details of shape in Y08 and Y13. Note the difference in shape in Mary's right shoulder and the angle of the crook in the arm/fin(?) of the siren and the width of the gap between the fin and the shoulder. Y08 is from a map of Zara and Sebenico by Martino Rota dated 1570, from an impression in the Newberry Library, Chicago, Novacco 4F103r. Y13 is from a map of the Brabant by Girolamo Olgiati (same map, different impression from that in fig. 3), in the Roy V. Boswell Collection at California State University, Fullerton (GHB 216).

surviving Italian composite atlas, in the Biblioteca Nazionale Marciana, Venice. This atlas contains no map dated after 1565 and characteristically contains tree-in-a-circle-under-a-star watermarks (no Marthas or Marys).[5] Furthermore, this atlas lacks a map of the siege of Malta, which is most unusual for an atlas appearing after mid- or late 1565. Another piece of evidence is in the Forlani map of North America, which occurs in two states of the plate, one undated state without publisher and a later state with the name of Bolognino Zaltieri, dated 1566.[6] The earlier state is in the Marciana atlas and can be dated to 1565; it does not have either Martha or Mary. Nineteen examined impressions of the second state bear a variety of watermarks, but the siren-in-circle-under-star now becomes common.

Further evidence may push the *terminus a quo* to 1568. There is another composite atlas (clearly Venetian) in the Biblioteca Casanatense, Rome, that contains no map dated after 1567; here the siren-in-circle watermark (without star) is the most common, but Marthas and Marys are missing.[7] This may suggest that the pair of watermarks under consideration here started their widespread use after the Casanatense atlas was bound, in 1568.

Within this window of 1568–70 it is regrettably not possible to order the variations within the paper moulds in any meaningful way. Paper stocks were unlikely to have been used in strict rotation and there does not seem to be a consistent pattern of change. For example, maps with 1570 imprints do not consistently show variations in their watermarks that might be associated with more wear.

In conclusion, this study shows that radiographs, when gathered in quantity, can precisely identify and pinpoint the life of a pair of paper moulds within two to four years. This evidence allows us to link almost any document printed on such paper with a few engravers and publishers working in Venice in the late 1560s. Unfortunately, the very precision that narrows the window of when this pair of moulds was active does not help with microdating within that two-to-four year period. Although subtle changes in the shape of the watermark designs during the period are observed, they cannot be correlated with the date the documents were printed. The reason for this lies no doubt in the random rotation of paper stocks shared among various printers during the short period. The kinds of changes that Stevenson observed for the fifteenth century are not possible for this short-lived pair of Venetian paper moulds in the late 1560s. It is not even possible to analyse variation in ink batches to provide more positive corroborative evidence. Copperplate inks have proved to be more variable in their elemental content across a given map when analysed using PIXE, and it is very unlikely that clear discrimination could be made between different printers.[8]

The general lesson is that we need to match the precision of our methods with the precision of our needs. If sixteenth-century printers had carefully used paper stocks in rotation, they would have provided us with a more useful clue. The lack of such evidence is a weak link in the chain. To paraphrase a comment on the recent bombing of the Chinese embassy in Belgrade, 'a combination of smart bombs and dumb maps,' we have a combination of smart radiographs and dumb paper.

I want to end on a more hopeful note, however. I believe I have demonstrated what photographic and

radiographic images can tell us about an energetic, if short, period of Venetian map and print publishing in the mid-sixteenth century. I think that, given the level of precision we need to keep constantly in mind, such images may have more utility in identifying the origins and dates of historical pieces of paper — whether they carry maps, music, archival documents, prints or anything else — where the life of the paper mould was longer, so that more corroborating historical and bibliographical evidence can be brought into play.

Notes

1. Woodward, D. 1991. The Evidence of offsets in Renaissance Italian maps and prints. *Print Quarterly* 8: 235–51.
2. Woodward, D. 1990. The Correlation of watermark and paper chemistry in sixteenth-century Italian printed maps. *Imago Mundi* 42: 84–93.

3. Stevenson, A. 1967. *The Problem of the Missale Speciale*. London: Bibliographical Society. 248–52.
4. Beans, G.H. 1938. *Some Sixteenth Century Watermarks Found in Maps Prevalent in the 'IATO' Atlases*. George H. Beans Library Publications, No 13. Jenkintown, PA: George H. Beans Library.
5. Gallo, R. 1954. *Carte geografiche cinquecentesche a stampa della Biblioteca Marciana e della Biblioteca del Museo Correr di Venezia*. Venice.
6. Woodward, D. 1994. The Forlani map of North America. *Imago Mundi* 46: 29–40.
7. Ganado, A. 1982. Description of an early Venetian sixteenth century collection of maps at the Casanatense Library in Rome. *Imago Mundi* 34: 26–47.
8. Woodward, D. 1990. 84.

Digital Imaging: Watermarks, Rare and Fragile Books, Palimpsests

IAN RUSSELL CHRISTIE-MILLER

Abstract

There is a variety of means available for the recording of information contained both on and in bound and unbound materials. After consideration of the differing requirements of individuals and institutions, and in light of the advantages and disadvantages of the various techniques, a full description is given of a new recording method that uses reflective surfaces and a cold, ultraviolet-free light source. The practical use and value of this new system is discussed and examples of digital images of watermarks used to date a sixteenth- and a seventeenth-century book are presented. Means of reducing or eliminating overprinting from images of watermarks are described along with ways in which the system may be used for forensic purposes or for the recovery of text in palimpsests.

The intention here is to survey the varied means available for the recording of information contained on and in bound and unbound materials. After noting the relative merits of those systems, a full description is made of the digital imaging system I have developed. This system not only allows one to look *at* paper and parchment, but *into* and *through* these materials as well.

The varied means available for imaging watermarks have been surveyed usefully by de la Chapelle, Monbeig-Goguel and le Prat.[1] They divide the means available into traditional methods and radiological methods. In the traditional group there are tracing by hand, direct photographic contact, Dylux paper, transmitted light and ultraviolet light photography. In the radiological group are x-rays, electron radiography and beta radiography. The fact that there are so many methods indicates that there is no particular one that is the best under all circumstances. Many of the advantages and disadvantages of the various methods were discussed by de la Chapelle et al. It should be noted that their survey was carried out in 1994. Recent advances in computer technology and digital imaging since then have ushered in new possibilities. The survey reviewed watermarks in the 125,000 samples of paper in the Louvre. Although the Louvre survey favoured beta radiography, the authors recommended that alternatives be considered. The alternative proposed here is the Bookmark system.

The Bookmark system has the advantage of being carefully designed to ensure the integrity of even tightly bound volumes; it allows one to image watermarks in books using a very small opening and therefore reduces the chance of damage to the binding. It can also be used to solve the problem posed by the presence of watermarks in or near the gutters of books. It is a portable system that provides digital images (though it is not limited to digital output) and is a very economical process that poses no health or safety concerns. The most significant drawback is the presence of overprinting on images of watermarks, but there are ways in which this can be reduced. In some circumstances overprinting can be entirely eliminated. The records produced are both preserved and disseminated easily in an age when our society is part of a global network.

The Bookmark system is comprised of a flat, cold, ultraviolet-free light source and a reflective system. It can be assembled in a variety of different configurations. When an electrically stimulated light source is placed under the paper to be examined, light passes through the paper — illuminating the watermark and paper structure — to the reflective mirror assembly. This assembly uses front-surface-silvered Lexan Margard. It uses no glass. There are two reasons for silvering the front surface as opposed to the conventional rear-surface silvering. It eliminates the very faint reflection from the transparent surface — that is to say, the front. It also eliminates the colour shift that occurs when light passes through plastic or glass. The disadvantage is that the silvered surface is delicate, so gloves must be worn. The mirror assembly, which is inserted into the book, is set at an angle of 45 degrees, with no angular distortion of the image, though it is a reversed, mirror image. The watermark may be seen directly, although it is being viewed at an angle. In order to obtain a distortion-free image, the camera is placed on the working surface and pointed at the reflective surface to view, via a single reflection, the sheet in question. Where necessary, the side arms can be removed and exchanged, which reduces the angle to 30 degrees so that tightly bound books can be imaged. In this case there is a slight convergence of parallels. It is a simple matter, with a graphics software package, to 'stretch' the image to remove the convergence. There are three other modes in which twin reflective units can be mounted. For easy portability the mirror assembly can be folded flat.

Once the light source under the paper is turned on, with the mirror assembly positioned in the book, the image can be recorded by the camera on the working surface. A transparent graduated scale should be on the sheet to serve two purposes. First, the scale provides a direct measure of the dimensions. Second, the image in the first configuration of the system is the product of a single reflection; therefore it is a mirror image and needs to be flipped. The appearance of the reversed numerals on the scale in the image is a good reminder of this.

The cheapest method to record the watermark by transmitted light is to use a simple 35 mm camera. The image may then be transferred to a CD. Once digitized it can be archived electronically and enhanced. Some disadvantages arise when large-scale projects are to be undertaken. However, I believe the use of 'digital capture' is environmentally preferable and has the advantage of

producing images that are immediately available for inspection (fig. 1).

A common problem encountered with these recordings is overprinting. Computer software can do a lot to eliminate this. There is, however, another technique that with some sorts of paper is extremely successful. It involves the use of a piece of black card in the imaging process. A typical example of overprinting is to be found in the letter dated 5 January 1999 from the organizers of this symposium. The paper has a watermark near the top in the region of the date. Figure 2 shows an image of that part of the letter taken with transmitted light. The date is partially obscuring the watermark. Consequently, the paper, should be turned over and illuminated by reflected light. The date can still be seen through the paper, so the next step is to place a black card under the sheet. The black printing of the date is now masked by the black of the card and can no longer be seen. The observer or camera is now looking at a black sheet filtered by the watermarked white sheet. This can be enhanced on a computer, as figure 3 shows. The watermark is now clearly visible and entirely free from overprinting. There are, however, limits to the usefulness of this technique. A pronounced watermark is needed, and there must not be overprinting on the side facing the observer.[2]

We now turn to other uses of the equipment. It can, of course, be used for imaging the contents of a book or details such as blind stamps. When recording surface topography such as blind stamps, the light sheet would be reversed and angled to provide a raking light. There is the simple, convenient option of taking a film record using a 35 mm camera and transferring it to CD-ROM later. For better results such a raking-light image may be taken using a studio camera.

My research on an early manuscript by Jean Thenaud illustrates the practical value of this imaging system. Jean Thenaud was a French Franciscan monk from Angoulême who died around 1542. Only one of his works was ever published — an account of his journey to Cairo and Jerusalem on behalf of the French royal family, to whom he was devoted. However, a number of his works were manuscripts destined for the personal possession of the family of his beloved Francis I. Two of those works were of direct interest to me. These were the 1519 and 1521 kabbalistic works written on the direct order of the king. One of his other works was a moralistic celebration of the triumph of virtue, currently manuscript 3358 in the Arsenal Library in Paris. With grateful thanks to the librarian, an image was taken of page 207 using a small digital camera. The image was then enhanced, enlarged and finally made negative. Reference to Briquet's *Les Filigranes* showed that the watermark Gauntlet and Fleur-de-Lys, revealed and stored digitally, matched that recorded in Thenaud's native Angoulême dated 1522.[3] This is a useful corroboration of Thenaud's movements after his return from the pilgrimage.

Earlier, reference was made to the possibilities offered by computer enhancement. In the following case it did not lead to a welcome discovery, but one from which lessons can be drawn.

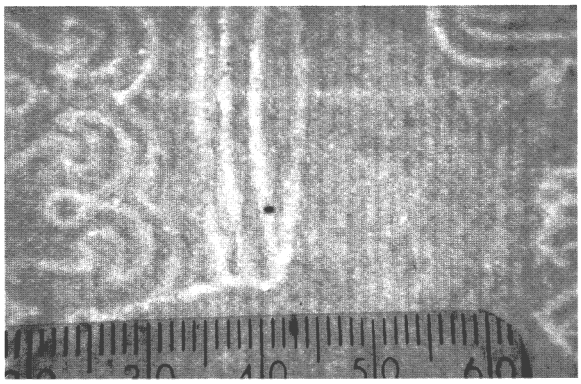


Fig. 1 Watermark from H. Wolfe, *The Unknown Goddess*, 1927 (London: Methuen and Company) in transmitted light.

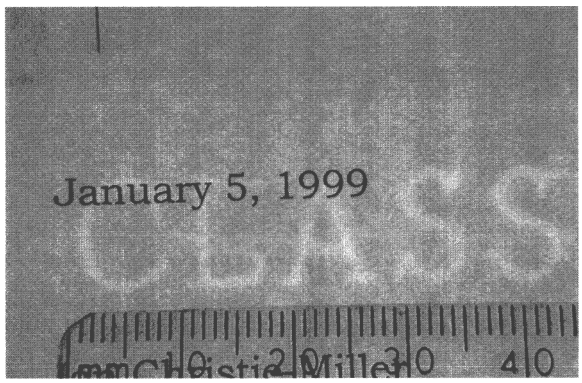


Fig. 2 Image of part of a letter showing watermark partly obscured by date 'January 5, 1999.'

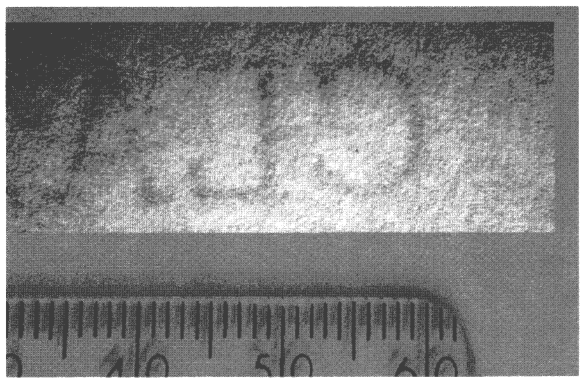


Fig. 3 Reflected-light image of letter in figure 2 with a black card underneath; computer enhancement of selected rectangle.

The thesis is that conventional microfilms may be corrupted. This corruption is not just unwanted data from the other side of the paper or parchment being examined, but also from the underlying folio. The folio in question was 105 verso of Jean Thenaud's Arsenal MS 5061. With computer enhancement the lettering on the underlying folio (104 verso) could be clearly discerned through an examination of the folio (folio 105 verso).[4] The lesson here is that all such recording of information should be done with a black card under the sheet being imaged. An incidental advantage of using a black card is, as has been discussed and demonstrated above, that watermark data may be revealed. A second lesson is that the person taking the image may be quite unaware of some of the data being gathered. Indeed, a future researcher, armed with

more powerful apparatus, may unearth data that are currently overlooked.

Another more general lesson to be drawn is that, for most purposes, fairly low-grade images are perfectly acceptable. For instance, the portable camera used for the images of the 1522 Arsenal manuscript gave a colour image of just over one megabyte. One such image can be stored on one high-density diskette. However, in the future there might be a need for far more detailed data. Databases therefore need to have the capacity to hold large files. Some 600 of the relatively low-grade images may be held on one CD, but when handling images of the quality of the raking-light image of a blind stamp mentioned earlier, only a dozen can be held on a CD. Clearly there are formidable amounts of data to be archived.

Not only does such data have to be archived, but it also has to be made accessible. Conventionally databases of watermarks have been in printed form, such as Briquet's *Les Filigranes*. More recently some databases have become electronic, where searching may be done by using a keyword. It is now possible to search a database of images without using a keyword. One example of this type of system is being developed in Britain and is called ARTISAN (Automatic Retrieval of Trademarks by Shape ANalysis).[5] The current two-year project is being jointly funded by the Institute for Image Data Research at the University of Northumbria and the U.K. Patent Office. The aim is to develop the prototype shape-retrieval system into a working system for the search and registration of abstract trademark images. Such work has exciting possibilities for watermark study and is actively being investigated.

Finally, I would like to make brief mention of a patented imaging technique with great potential. This is the Four Images scanning technique. It can be used with the above-mentioned mirror system in a configuration where two of these mirror units are placed facing each other. They are linked, with the page inserted between the units. The sheet may be illuminated from one side. The light is reflected from one unit and simultaneously transmitted through the sheet to be reflected from the other unit as well. The viewer then observes one side by reflected light plus the watermark on the other side by transmitted light. Now, the sheet may be illuminated from the other side and the view would be reversed. In this way four images may be obtained from one sheet. This abundance of images may be of value in certain circumstances. Perhaps computer software could be used to process and combine the images for forensic purposes, or to recover data erased from the surface of a sheet.

A notable example of such an erasure occurs at folio 110 verso of Jean Thenaud's parchment manuscript mentioned above. The four lines that are missing are in the middle and are not evident on a paper printout. The image used for recovery of the missing lines came from a conventional black-and-white silver-based microfilm. The image was then digitized and stored on a CD in the form of an 18-megabyte file. Even with such an indirect product, some of the words could be recovered, thanks to computer enhancement. The image was cropped, inverted and enlarged and the levels adjusted.[6] Even better results could be obtained using a black card under the folio, a high-quality camera and colour image, and perhaps the Four Images scanning technique.

In conclusion, the following considerations should be noted. The needs of the digital age must be recognized. There is room for a variety of techniques for recording watermarks. The Bookmark system provides an economical, efficient and versatile method of obtaining digital images of watermarks. When used with the techniques mentioned here, researchers can record, sort and search for a great range of information locked within the written and printed materials themselves.

Notes

1. de la Chapelle, A., C. Monbeig-Goguelle and A. Prat. 1994. Les filigranes des dessins anciens et les relèves betaradiographiques. *Annals of Radiology* 37(4): 249–58.
2. An animated sequence of this may be viewed at http://www.christie-miller.demon.co.uk
3. Briquet, C.M. 1968. *Les Filigranes: Dictionnaire historique des marques du papier des leur apparition vers 1262 jusqu'en 1600: A facsimile of the 1907 edition*, ed. A. Stevenson. Amsterdam: Paper Publications Society.
4. See URL in note 2.
5. Eakins, J.P. 1997. The shape of things to come: Automatic retrieval of similar shapes. *British Library Research Bulletin* 16(6–7).
6. See URL in note 2.

Historical and Literary Papers and the Application of Watermark Descriptions: A Case Study Based upon the Archival Records of the 1st and 2nd Earls of Oxford

RUBY REID THOMPSON

Abstract

Robert Harley, 1st Earl of Oxford (1661–1724), and Edward Harley, 2nd Earl of Oxford (1689–1741), are well-known to historians and English literary scholars. The first earl is better known as a statesman, the second as a bibliophile. Both left substantial archival holdings, notably in the British Library and in the Portland Collection at the University of Nottingham. The literary series of the Bentinck dukes of Portland from Welbeck, the context in which the records at Nottingham survive, has recently been the subject of detailed analysis. The project was driven by a need to establish associations between loose-sheet manuscripts in an effort to identify authors, copyists and provenance groupings. It expanded to include non-literary documents in an effort to establish probable date ranges in the use of specific papers.

This study describes the evidential significance of watermarks in identifying documents drawn from a particular circle. It demonstrates the value of linking paper descriptions with paper usage as determined by document function. The paper will discuss the creation of a database of paper evidence, assess the problems involved and suggest how scholars and researchers in other fields could apply its evidence.

My interest in the application of watermark descriptions within a database started in 1995, when I participated in the creation of the computerized catalogue of the Portland Collection of Literary Manuscripts in the Hallward Library at the University of Nottingham.[1] At that time my role was to provide physical descriptions for the 5,500 entries in the collection. Records of the dimensions of each manuscript and of their watermarks and countermarks assisted in the precise identification of the entries. This dimensions field, together with the watermark field, allows relationships to be established between single-leaf manuscripts, thus rejoining some which had become separated through author indexing or subject-matter cataloguing. The use of this approach in the new computerized catalogue resulted in happy reunions of previously isolated papers. For example, there are two anonymous and undated poems that had been catalogued by first-line entries. These are written on conjugate but separated quartos. They were compared side by side because their dimensions, watermarks and scripts matched. It then became clear that one was the continuation of the other and the two manuscripts are now rejoined.

This type of physical information will further assist in the identification of texts, authors and dates, since many of the manuscripts from the Portland Literary Collection remain anonymous and undated. I was not involved in the indexing of content. This was considered a separate task that would bring its own data.

A subsequent application of the computerized catalogue is to compare the physical characteristics of the literary manuscripts with similar information arising from dated, and often signed, correspondence and political documents, all within the main Portland archive. This experiment, aimed at providing brackets of dates and perhaps places of issue to unidentified manuscripts, can be performed at Nottingham because both the Literary Collection and 15 other collections share one provenance: Welbeck Abbey, in Nottinghamshire.[2]

Table 1 sketches the main family members whose manuscripts are part of the Portland holdings from Welbeck. The family records start in the early sixteenth century, continue to the late 1920s and consist of many thousands of manuscript documents.[3]

The Welbeck archives were preserved and enriched by subsequent dukes of Portland and were sorted into independent collections during the time of the sixth and seventh dukes. In 1949 the seventh duke divided the bulk of the records according to subject matter among five national repositories: the British Library, the Bodleian Library in Oxford, the Nottinghamshire and Hampshire Record Offices and the Nottingham University Library. The portion allocated to Nottingham University contains mostly political and literary papers.

The Harley family contribution appears to be small when compared to that of the Cavendish-Portland-Welbeck conglomerate, but nevertheless the two earls of Oxford, Robert and Edward Harley, are the central figures of this study because they have been credited as the main contributors to the Portland Literary Manuscripts. They were not the only manuscript collectors in this extended family, but they were among the most serious and dedicated literary members of it. Both earls kept close relationships with major literary figures of their time, such as Samuel and John Wesley, Alexander Pope, Jonathan Swift and many others. Aside from their collecting passion, the earls were engaged in copying and exchanging literary texts. Their personal roles in the formation of the Portland Literary Collection may have been considerable, but the extent of their direct responsibility has not been tested.

One of the methods available to narrow the gap that separates us from those who put together original documents is to let those documents speak for themselves. This requires that the container, as well as what it contains, are given an equal chance to be weighed. Much can be learned from the tangible materials that hold the recorded message of an anonymous manuscript. The physical analysis of written papers produces impartial information that can be measured, described and subsequently assessed. The significance of this data is separate from the historical importance of the contents held in a text. The

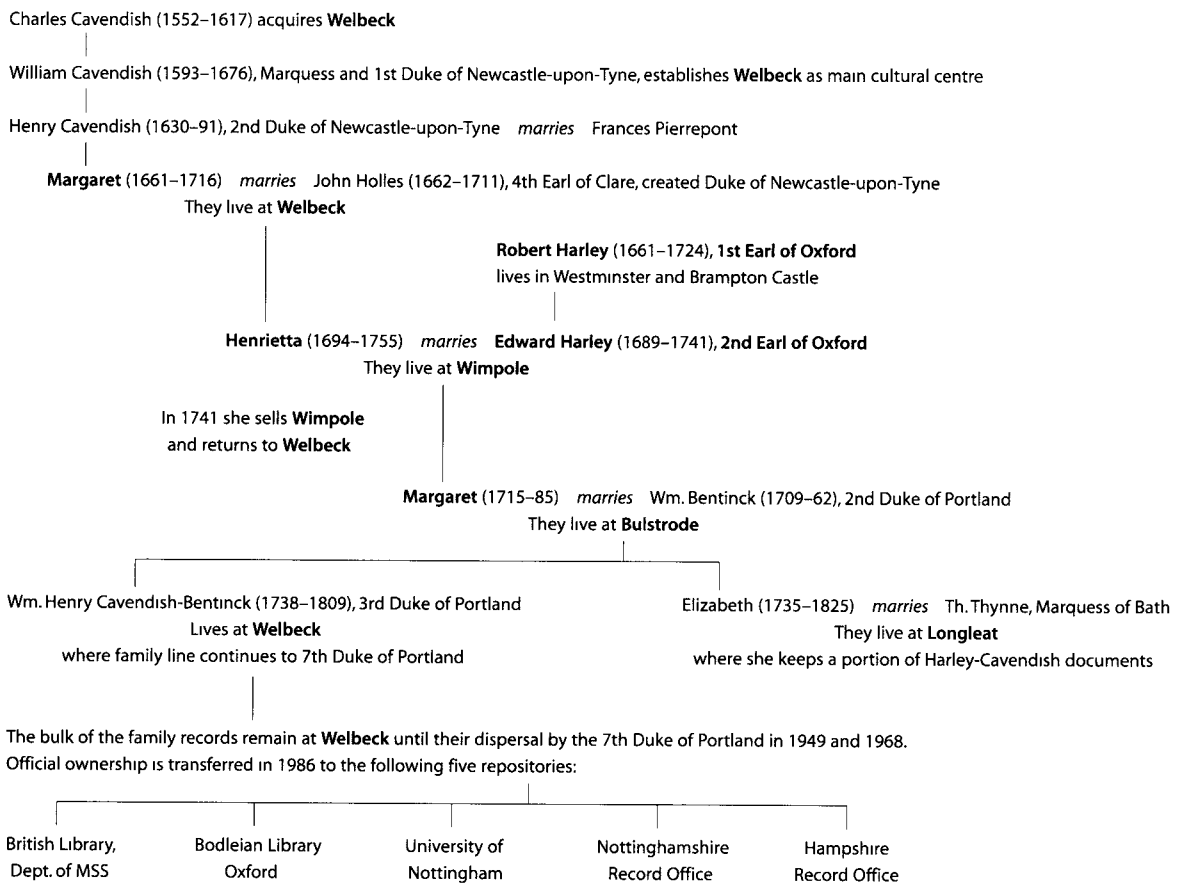


Table 1 Cavendish, Harley and Bentinck Connections Within the Portland/Welbeck Archive

5,500 entries stored in the computerized catalogue of literary manuscripts at Nottingham include the following fields related to physical features for each manuscript:

- paper, watermark and countermark dimensions
- watermark family and variants
- physical condition of the paper
- other characteristics such as gilt edges, deckled edges and bindings
- nature of the document, such as draft, fair or presentation copy
- comments on page set-up
- comments on script

This catalogue of physical descriptions sparked the formation and became the origin of a separate watermark database, also prepared at Nottingham and referred to in this study as NULWD (Nottingham University Library Watermark Database). It contains watermark information from a further 12,000 records which date from *circa* 1580 to 1820.[4] It is hoped that eventually it will hold details of many more manuscripts originating from the Portland Archive. This will be a reliable pool of information and will assist enquiries regarding the use of paper in England between the sixteenth and nineteenth centuries. At the moment it is primarily a tool for accurate cataloguing and allows very limited use to researchers.

I have identified a total of 131 main watermark families in NULWD, the names of which are listed in table 2.

The study prepared for this paper concentrates on this most basic element of paper identification: watermarks and countermarks. Even though it is based on this aspect of physical evidence, the scripts of the two earls of Oxford were also included because they give fundamental clues regarding their choice of paper. This is a trial run of the evidential value of the database. For this purpose I designed a separate mini-database dedicated to the most prolific watermark family identified in the Portland archives: the Posthorn in Crowned Ornate Shield (fig.1). This generic type of watermark was present in over 2,000 manuscripts, that is, nearly 15% of the total entered in the main database. This finding agrees with classic studies on paper that describe the Posthorn as a 'prolific' and 'widely current' watermark, although references to Posthorns are not always precise.[5]

This small, purpose-built database contains material from 20 archival sources; 18 of them encompass the life spans of the two earls of Oxford (from 1661 to 1741) and 2 consist of the literary collections that date from the late sixteenth century to the early twentieth century. Ten collections belong to the Portland Archive at Nottingham University; 5 come from the ex–Portland Loan, now part of the Additional Manuscripts in the British Library; and 5 belong with the Portland Papers at Longleat (table 3). As a token control group, the 38 Posthorn in Crowned Shield watermarks from manuscripts recorded by Heawood are also included. The total number of entries in the mini-database is 1,714.

Anchor	Crown	Name, H. SALMON
Arms:	Crozier:	Name, J. WHATMAN
Amsterdam	Plain	Name, LIBERTAS
Q. Anne	+ Post horn	Name, MALMENDAIDE
Bern	of Basle	Name, RUSE & TORNERS
Colbert	Dagger	Name, T.H. SAUNDERS
England	Eagle	& CO
Eng & Holl	Fir cone	Obelisk
France	Flag	Orbes
France & Navarre	Flag pole and banners	Oval form and quatrefoils
Genoa	Fleur de lis, plain	Oval form and fruit
Great Brit.	Fleur de lis, in shield	and foliage
GB & Holl	Flower	Paschal Lamb
Hanover	Foolscap	Paschal Lamb, double
Le Tellier	Grapes	Peacock
London	Hand	Post-horn:
Lond, plain	Hand and star	free standing
Lond, ornate	Hats, three	large, free standing
Medici	Hats, three double	small, free standing
Memmingen	Heart	in ornate shield
Marq of Pompone	Horn, freestanding	in crowned ornate shield
William III	Horse	Posts
Banners	HIS	Posts, large
Bell	IHS and Strasbourg Lily	Posts, small
Bird	Insignias	Posts and fir cones
Bird within circle	Ladder	Pot
Boat	Letter B	Pro Patria
Britannia	Letter L	Sceptre
Cardinal's hat	Letters AR	Sceptre and crown
Cartouche	Letters E&P	Serpent
Cartouche,	Letters QQ	Shield
crowned	Lion, free standing	Star
Circle:	Lion, Seven Provinces	Star of David
Circles, three	Monogram AXA	Strasbourg, Bend
Circles, two	Monogram CC	Strasbourg Lily
Circles, six	Monogram IONG	Sun
Coat of Arms:	Monogram IXS	Swan
double	Monogram JW	Sword
within laurels	Monogram VAL	Tower
Cockatrice	Monogram XSX	Trefoil
Columns	Mounds, three	Tyger
Crescent	Name, CONCEL	Unicorn
Cross	Name, CURTEIS & SONS	(Unclear c. 25)
Cross, Roman	Name, DURHAM	
Cross and Horn	Name, G. PIKE	
Crossbow	Name, GARLAND	
Crossbow, double	Name, GOMBIER	

Total number of main families within NULWD: 131

Table 2 Abbreviated List of Main Watermark Families in NULWD

The largest incidence of Posthorn in Crowned Shield within a single collection is 45%, found in Volume 7 of the Portland Papers at Longleat. The second-largest occurrence of this type of watermarked paper is 43.5% recorded from additional MS 70295, a composite volume of verses related to the Harley family. The following manuscript collections also have an unusually high proportion of this watermark:

- PwD, with 35.9%, is the correspondence and documents of the 2nd Duke of Portland, who was Edward Harley's son-in-law;
- Plc1, with 32.6%, is the Portland London correspondence that contains legal documents issued by agents of the Harleys;
- Plc2, with 31%, is a continuation of Plc1;

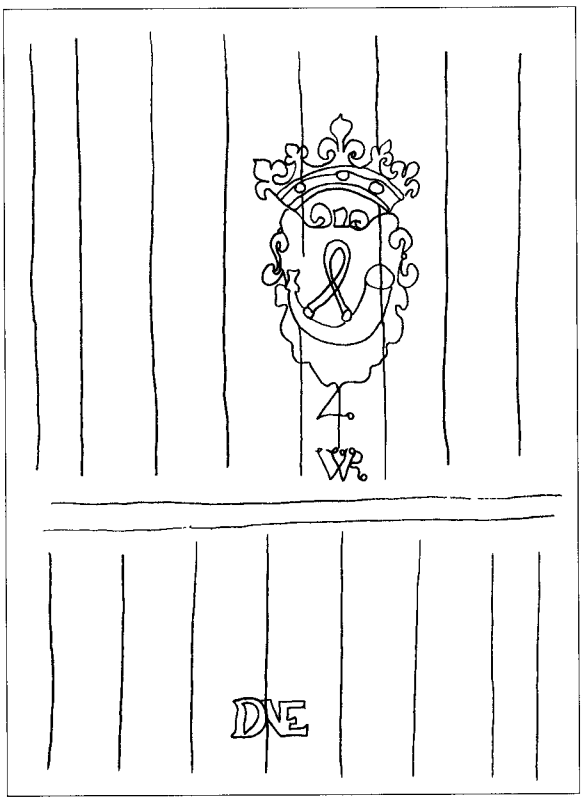


Fig.1 Posthorn in Crowned Ornate Shield and conjugate folio with countermark monogram *DVE*.

- Pw2Hy, with 29.9%, is the main repository of the Harley family records and correspondence at Nottingham University Library.

In these six Harley-related collections, the percentage of paper bearing a Posthorn in Crowned Ornate Shield watermark is well above the general average of 15% given by the large watermark database in Nottingham University.

This high-quality writing paper was available in Europe and England from the late sixteenth century to the nineteenth century, inclusive. The great majority of this type of paper is very smooth, without much grain, comes in a variety of cream colours and has a translucent quality that visually distinguishes it from other papers. In spite of being light in weight, it is dense, but does not permit clear writing on both sides of the leaf. It usually came neatly cut in half-sheets, showing gilt edges all round. When the single folios were used for correspondence, they were usually folded in half along the longer side to form two conjugate quarto leaves. The text was written following this format. The paper would then be folded again, addressed and sealed.[6] The majority of the 1,714 documents entered in the mini-database actually carry the chosen watermark. In addition, the total includes countermarked records that can be assigned with certainty to the watermark family. This assignation was made only when a manuscript shared its origin with another one that bears the actual watermark form. This would be the case for records where the place and date of issue, as well as the correspondent, are one and the same in both manuscripts. A further condition is that both records would

Coll. ref.	Collection's Full Title and Content	Recs. Used	Total Recs.	% Psthrn in Cr. Shield
Pw1	Portland Welbeck correspondence and documents of William and Henry Cavendish,1st and 2nd dukes of Cavendish	34	673	5.05
Pw2	Portland Welbeck correspondence and documents of John Holles, Duke of Newcastle, father of Margaret	70	653	10.72
Pw2Hy	Portland Welbeck correspondence and records related to the Harley family	429	1,432	29.96
PwA	Portland Welbeck political papers and correspondence of William Bentinck, 1st Duke of Portland	318	2,860	11.12
PwD	Portland Welbeck correspondence and documents of William Bentinck, 2nd Duke of Portland	42	117	35.90
PwE	Portland Welbeck correspondence and documents of Margaret Cavendish Holles Harley, Duchess of Portland, daughter of Edward Harley	12	81	14.81
PwV	Portland Welbeck literary manuscripts (1st deposit)	269	c. 5,000	5.38
Pw2V	Portland Welbeck literary manuscripts (2nd deposit)	22	c. 500	4.40
Plc1	Portland London correspondence 1st series (filtered records with Harley references)	196	c. 600	32.66
Plc2	Portland London correspondence 2nd series (filtered records with Harley references)	31	c. 100	31.00
LtPP7	Longleat Portland Papers vol. 7 Robert Harley, 1st Earl of Oxford correspondence	90	c. 200	45.00
LtPP10	Longleat Portland Papers vol 10 Harley family correspondence	28	c. 200	14.00
LtPP11	Longleat Portland Papers vol. 11 Political verses *c.* 1589–1769	14	c. 150	9.33
LtPP12	Longleat Portland Papers vol. 12 Correspondence between A. Pope, Swift etc. and Edward Harley, 2nd Earl of Oxford	25	c. 150	16.67
LtPP13	Longleat Portland Papers vol. 13 Correspondence between Pope, Swift etc. and R. and E. Harley, 1st and 2nd earls of Oxford	12	c. 150	8.00
ADD 70053	(British Library ex Portland Loan) Additional manuscript 70053, Miscellaneous Documents Cavendish-Holles	6	88	6.82
ADD.70054	(British Library ex Portland Loan) Additional manuscript 70054, Miscellaneous Documents Cavendish-Holles	11	80	13.75
ADD.70055	(British Library ex Portland Loan) Additional manuscript 70055, Miscellaneous Documents Cavendish-Holles	12	75	16 00
ADD.70056	(British Library ex Portland Loan) Additional manuscript 70056, Miscellaneous Documents Cavendish-Holles	18	119	15 13
ADD.70295	(British Library ex Portland Loan) Additional manuscript 70295, Verses to Harley Family	37	85	43.53
Hwd 30	E. Heawood 1930,'Papers used in England: I'	11	98	11.22
Hwd 31	E. Heawood 1931,'Papers used in England: II'	3	77	3.90
Hwd Bk	E. Heawood book, *Watermarks Mainly of the 17th and 18th Centuries* (1950)	24	4,078	0.59

Table 3 Contents of Mini-Database

have other physical characteristics in common, such as colour, weight and dimension. In cases where these requirements were not met, the document was not included. This policy was especially important when faced with folios that carry certain countermarks, such as *H, HR, IB* and *IV*, which accompany watermarks from other main families as well as this type of Posthorn.

The mini-database shell reflects the aim of this project, which is to find the subject and date contexts of Posthorn in Crowned Shield watermarked paper, with particular reference to the Harleys. The ten fields are:

1. Document reference
2. Document nature
3. Author
4. Recipient
5. Place of issue
6. Date
7. Date comment
8. Harley input
9. Additional elements
10. Countermark[7]

The first one is the reference number as it appears in the main catalogue. The second contains the nature of the document and covers two aspects; one is its purpose, for example, a letter, bill or report; the other relates to its scribal quality, such as draft or copy, either professional or autograph. In the third, fourth and fifth fields the author, recipient and place of issue (if known) are recorded.

The sixth and seventh fields are Date and Date Comments. Both entries are necessary because the system requires a day, month and year to sort entries by date, and these three parts of the date are not available for many documents. Another requirement was to indicate assigned dates, old/new calendar dates, ranges of dates or

Categories	No. of Different Insignias	No. of Different C/marks	Total No. Variants	Date Range
a. Crowned shield with no additional elements suspended from it	0	25	25	1652–1740
b. Crowned shield with insignia suspended from the base of the shield and attached to it by the figure 4; the insignia comprises letters, names or icons	10	7	18	1696–1788
c. Crowned shield with the ancient Wendelin Riehel insignia *4WR* suspended from the base of the shield	1	60	60	1616–1796
d. Crowned shield with insignia *4WR* suspended from the base of the shield plus an additional monogram below the insignia	6	4	10	1659–1744
e. Crowned shield with unattached letters or names below the shield	28	9	34	1682–1714
Total variants of Posthorn in Crowned Ornate Shield in the mini-database	45	105	147	1616–1796

Table 4 Categories of Posthorn in Crowned Ornate Shield and Number of Variants in Each

approximate dates, none of which could be entered in the main Date field. The extra Date Comment field overcame these difficulties. The eighth field records any input made by Robert or Edward Harley, and these are entered according to the nature of the contribution, as in full autographs, annotations, endorsements, corrections et cetera. This field derives partly from the content and partly from the physical evidence of the script.

The last two fields relate to watermark description. Since all the entries consist of one family of watermarks, the field title Watermark Variant describes the additional elements of the shield. The final field lists the countermarks. These two fields represent the two separate parts of a full watermarked sheet of paper. In documents that consist of an entire sheet, both the variant and the countermark, or the absence of one, are stated with certainty. Where records consist of single folios, the missing variant or countermark could sometimes be assigned by looking at twin documents as described above.

The appendix to this study lists the extensive variety of the Posthorn in Crowned Shield watermark contained in the mini-database. The total 1,714 entries were divided into five categories according to the presence and type, or absence, of an additional element beneath the shield. This obvious distinguishing feature did not prove to be a useful element for dating the paper, but was useful when sorting this watermark family. The appendix is summarized here as table 4. Each of the five categories contains additional elements and/or countermarks, which in combination amount to 147 different variants of the Posthorn in Crowned Shield watermark.

The most useful filter that was applied to the mini-database sorted the records by countermark, then by the additional element of the main watermark and then by date. This filter produced date ranges for each of a total of 147 variants. However, several of these date ranges are of limited value when a precise period of time is required to date the use of one of the variants. The reason for this drawback is that many entries carry dates that are vague. Documents that have *circa* preceding a year or a century, and manuscripts that were written on single folios or on fragmented folios where a conjugate leaf is missing fall into this category. Once these classes of documents are excluded from the mini-database, 73 variants that hold precise date information remain. These can give time brackets as to when a specific watermarked paper was used in the Portland-Welbeck archive. The results of this reduced but accurate exploration are listed in alphabetical order in table 5.

This small database containing information on a single watermark family resulted in the assignation of reliable date ranges to 29 manuscripts, 16% of the total 179 undated literary manuscripts that were entered. These are listed in table 6. Their suggested dates will be filed in the main computerized catalogue, and the date fields in each entry will carry a qualification to indicate that these were assigned on grounds of their watermarked paper.

These 29 watermark-dated literary manuscripts can be considered as benchmarks for helping assign dates to other manuscripts that share enough physical characteristics within that collection. There are various paths to follow, the first of which is to return to the Folio Dimensions file within the main database and use it to list those manuscripts that share dimensions with the 29.[8] All manuscripts that correspond with any of the 29 in size will now be physically compared with them again in the muniment store. The condition for confirming that two separate leaves are of one type of paper is that the quality is identical, the pattern of laid and chain lines is congruent and any watermark or countermark information is a direct or concordant match. It may be possible in this way to assign a watermark variant, and consequently a date, to some of documents.[9]

Any manuscripts paired by this secondary method would be assigned the same date as its match from the 29 watermark-dated documents. In these cases the date field in the main catalogue will have to carry the further qualification 'date assigned on basis of watermarked paper of match' (+ reference of match). If any manuscripts extracted by these means are found to also share their page set-up and script, they will be considered twins.

I have started to test this procedure using the watermark variant *4WR* with countermark *HR* that is found in 7 of the 29, and in 23 dated manuscripts in the mini-database. By comparing PwV 68/29 with other literary manuscripts of similar dimensions, two further perfect matches were found: PwV 693 and Pw2V 55, that can now be assigned a date.[10] If all 29 benchmarks were used in this way it is clear that a greater percentage of literary manuscripts would be given brackets of dates.

Countermark	Add'l Element to Shield	No. of Mss.	Date Range
AI	4WR	1	1666
AI	nil	2	1667–76
AXA	4WR	8	1705–18
AXAB	4GR	5	1723
AXEA	4WR	15	1704–17
CI small	4WR	1	1711
CIA	4WR	1	1705
DR small	4WR	1	1711
DS	4WR	1	1699
DV	4WR	3	1707–10
DVE	**4WR**	**8**	**1705–14**
DVEmon	4WR	1	1713
DVL	4WR	1	1713
GMT	4WR	1	1708
GRcrwnd	4SCK	1	1761
GRcrwnd	CADmon	25	1758
GRcrwnd	VDL	1	1746
H	nil	5	1695–1739
H	4WR	19	1695–1713
HDAE	4WR	3	1693–1711
HDL	nil	1	1700
HDV	4WR	2	1696–1710
HDVE	nil	4	1696
HDVE	4WR	15	1696–1713
Hearts twined	nil	2	1704
HIB	**4WR**	**13**	**1704–11**
HP	4WR	2	1699
HR	nil	6	1697–1741
HR	**4WR**	**23**	**1704–29**
HR	Beehive	1	1727
HR	GR	4	1742–43
HV large	4WR	2	1707–8
I qtrefoil I	4WR	2	1673–78
I HONING	nil	2	1733
IAC	4WR	1	1654
IAC+H	nil	1	1696
IB	nil	7	1696–1723
IB	4WR	60	1686–1718
ID	4WR	4	1721–28
IS	4WR	23	1707–17
IV	**4LVGerrevink**	**4**	**1742–46**
IV	4LVG	15	1719–44
IV	**4WR**	**9**	**1707–44**
JR	4WR+CA	1	1710
KWM	**4WR**	**8**	**1713–21**
LABriglla	Beehiv+GV	1	1812
LG	4A	1	1783
LL	HG	3	1687
LR	4WR	1	1706
LR	FG	1	1695
LR	HG	2	1680–91
LS small	4WR	1	1705
LVGerrevink	4WR	1	1725
MCMD	nil	8	1676–96
MCMD	**4WR**	**2**	**1683–1707**
nil	4WR	1	1659
nil	**HG**	**3**	**1681**
nil	**nil**	**5**	**1676–1734**
PvL	4WR	3	1692–1715
R	4WR	1	1708
R	nil	1	1678
RW1797	GR	1	1799
SB	4WR	2	1704
SH	nil	25	1692–97
SH	4WR	8	1691–96
SVB	4WR	18	1713–18
SVDP	4WR	5	1710
TB	4WR	3	1706–19
TI	4WR	2	1691–94
WAK	**4WR**	**16**	**1704–10**
WAK sm	4WR	4	1705
WV	4WR	1	1705
WVE	4WR	3	1708

Highlighted variants provide brackets of dates to undated literary manuscripts. Only dated mss. have been entered in this list.

Table 5 Mini-Database: Posthorn in Crowned Ornate Shield Watermark Family. The total 73 watermark variants are listed alphabetically by countermark, followed by the corresponding additional element to the shield, and by the date ranges when the paper was used.

A further use for the 29 benchmarks would be the identification of other documents within the collection that share the same script and page set-up, including those manuscripts where either the paper and/or the dimensions do not match. In these cases the dated benchmarks would offer a provisional range of dates to different families of watermarks.

The results of this exploratory study of a single family of watermarks are promising. When the remaining 130 watermark families present in the main database are sorted and filtered, using the same procedure as applied to the Posthorn in Crowned Shield, the number of literary manuscripts with newly assigned dates will increase considerably.

The Welbeck listings of the Portland Literary Collection served as a base for the present revised and computerized catalogue at Nottingham University. The archivists and librarians involved have an accumulated knowledge of the manuscripts and have classified them accordingly, offering in some cases brackets of dates based on the contents. The present study of the paper of the manuscripts should be considered as a complement to those dates when given. Furthermore, brackets of dates given through watermarks will necessarily be refined as the watermark database increases, becoming more accurate.

The mini-database has pointed to the value of including documents from related collections now housed in scattered locations. Many questions about the literary manuscripts were answered through the watermark data found in other collections within the Portland manuscripts at Nottingham. Additional information that was

	Reference Number	Content (and date assigned on grounds of content)	Watermark Variant Add. Elem.	C/M	Date Assigned by WM
1	PwV 8/ff 1–16	Copy patents John Holles (1705–11)	4WR	DVE	(1705–14)
2	PwV 40/i–ii	Copy poem (late 1600s)	nil	nil	(1676–1734)
3	PwV 54/215–18	Draft warrant – Ratisbon (1.5.1699)	4WR	MCMD	(1683–1707)
4	PwV 67/35	Political document – Ryswick (1697)	4WR	MCMD	(1683–1707)
5	PwV 68/29	Copy of Political document (1697)	4WR	HR	(1704–29)
6	PwV 74/19	Copy of legal document, Westminster (1697)	4WR	MCMD	(1683–1704)
7	PwV 142	Copy of poem by A. Alsop	4WR	HR	(1704–29)
8	PwV 143	Copy of poem by A. Alsop	4WR	HR	(1704–29)
9	PwV 155	Autograph poem by M. Barber	4WR	WAK	(1704–10)
10	PwV 180	Copy of poem by W. Congreve	4WR	HIB	(1704–11)
11	PwV 200	Copy of poem by J. Dryden	nil	nil	(1676–1734)
12	PwV 279/1–8	Autograph poem by B Kennett (1710)	4WR	KWM	(1713–31)
13	PwV 327	Copy of poem by W. Murray	4LVGerrevink	IV	(1742–46)
14	PwV 367	Copy of poem by C. Scroop	nil	nil	(1676–1734)
15	PwV 370	Copy of poem by T Shadwell	HG	nil	(1681)
16	PwV 383	Copy of poem by E. Singer	4WR	HIB	(1704–11)
17	PwV 449	Copy of poem by S. Welsley Jr.	4LVGerrevink	IV	(1742–46)
18	PwV 636	Copy of poem (anon.?)	nil	nil	(1676–1734)
19	PwV 1236	Copy of poem by E. Waller	4WR	MCMD	(1683–1707)
20	PwV 1248	Copy of poem (anon)	nil	nil	(1676–1734)
21	PwV 1276	Professional copy of poems (anon.?)	4LVGerrevink	IV	(1742–46)
22	PwV 1290	Fair copy of Latin verses, Westminster School (1712)	4WR	HR	(1704–29)
23	PwV 1308	Copy of Latin verses, Westminster School (1730)	4WR	HR	(1704–29)
24	PwV 1343	Copy of Latin verses, Westminster School (1711)	4WR	HR	(1704–29)
25	Pw2V 204	Draft notes on logic	4WR	IV	(1707–24)
26	Pw2V 204/9–10	Draft notes on logic	4WR	IV	(1707–24)
27	*Pw2V 3/3/1	Imprinted family-tree forms	4WR	TI	(1691–94)
28	*Pw2V 3/3/2	Imprinted family-tree forms	4WR	HR	(1704–29)
29	*Pw2V 3/3/3	Imprinted family-tree forms	4WR	ID	(1721–28)

* = Pw2V 3 is a single document consisting of three files of genealogical information, recorded on pre-imprinted sheets. They contain 6 variants of Posthorn in Crowned Ornate Shield, with insignia 4WR below the shield. Only three of these variants could be dated through the database.

Table 6 Literary Manuscripts Which Have Been Assigned Dates Through their Watermarked Paper as a Result of the Present Mini-Database. All entries refer to the watermark family Posthorn in Crowned Ornate Shield.

not available in the university archive was gleaned from manuscripts with a Harley link and a shared Welbeck provenance in the British Library and Longleat House. This specific database reconstructs the Harleys' working environment in terms of the use they made of paper.

The first and second earls of Oxford gave a human focus to this study. It is now clear that they were not the only members of the English aristocracy who used this elegant writing material. They did not each have an exclusive source of paper that could identify either of them personally. This is why it is not feasible to assign a manuscript to either Harley on grounds of its paper alone. Nevertheless, a substantial majority of their autograph drafts and letters are written on Posthorn in Crowned Shield watermarked paper. It was issued from many of their residences, and secretaries and other members of their staff used it for presentation copies.

Other types of European and English contemporary papers were also present in their offices and homes. For example, a portion of the Harleys' autograph drafts found in Nottingham, Longleat and the British Library are written on less fine papers, which also appear among the undated literary manuscripts. The common origin of these papers is identified by both quality and shared watermarks. The mini-database has illustrated the availability of Posthorn writing paper in England and has reproduced the Harleys' use of it. The remaining Harley-related documents now require the same treatment: to be placed back in their original historical context by means of their physical analysis, which should be entered into the database. The choice and format of the paper and the distribution of the text on the page, as well as the script used, may identify the works of the two earls and those of their agents. These characteristics form a meaningful total that must be evaluated as a whole. Nevertheless, the watermarks in the paper remain the essential strand of the physical make-up of manuscripts.

Watermark databases have a wider purpose. They are reference tools to be used and applied by scholars and researchers from a variety of historical disciplines, particularly with reference to dating. The make-up of manuscript paper is generally different from that used for printing; therefore watermark data from one category is of limited relevance to the other. The precision of assigning dates to individual manuscripts increases in direct relation to the number of documents entered into the

database. The wider the breadth of contemporary collections included, the more likely the identification of undated papers becomes. Similarly, the date ranges for the use of any paper within any variant of a particular watermark family become more accurate as the database grows. A comprehensive watermark database is a reliable pool of historical information that complements other bibliographical reference works. Above all, the database serves as a springboard to the field of physical identification of documents.

Appendix

Mini-database: Summary of the watermark family Posthorn in Crowned Ornate Shield and its variants. The range of dates indicates the period when the paper was used.

A. Posthorn in Crowned Ornate Shield and no insignia below the shield, with countermark if any

No. of Records	Posthorn in Crowned Ornate Shield: Variants	Insignia	Countermark	Date Range
6	Posthorn in Crowned Ornate Shield and no insignia below the shield		nil	1685–1734
18	"		nil	1652–1711
2	"		nil	1710
2	"		nil	1719–34
1	"		3 mounds & cross	?
1	"		AB	1697
2	"		AI	1667–76
1	"		AXA	1705
1	"		AXEA	(1668–1709)
1	"		DIS	1709
1	"		DS	1704
5	"		H	1695–1739
2	"		HDAE	1693
2	"		Hearts twined	1704
1	"		HDL	1700
4	"		HDVE	1696
3	"		HG	(1692–99)
7	"		HR	1697–1743
2	"		I. HONING	1733
1	"		IAC+H	1696
10	"		IB	1696–1723
1	"		IS	1707
1	"		IV	?
6	"		MCMD	1692–96
4	"		MCMD	1676
12	"		nil	1676–88
1	"		PvL	1692
1	"		R	1678
26	"		SH	1692–97
1	"		WVE	1708

B. Posthorn in Crowned Ornate Shield and insignia suspended from the shield, with countermark if any

No. of Records	Posthorn in Crowned Ornate Shield: Variants	Insignia	Countermark	Date Range
1	Posthorn in Crowned Ornate Shield and insignia suspended from shield	4+Bell		1741
1	"	4A	LG	1783
11	"	4GR		1719–61
3	"	4GR	AXAB	1723
1	"	4GR	ID	?
3	"	4GR+HS		1738
2	"	(4GR)	AXAB	1723
1	"	4GV		1696
1	"	4IVG		1718
31	"	4LVG		1717–72
17	"	4LVG	IV	1719–43
74	"	4LVGerrevink		1713–88
19	"	4LVGerrevink		1732–52
1	"	4LVGerrevink	AI	?
6	"	4LVGerrevink	IV	1742–46
2	"	4LVGerrevink	IV	1720–61
1	"	4LVGerrevink	nil	1720
1	"	4LVGerrevink	nil	1761
1	"	4LVGerrevink+B	(1756–57)	
1	"	4SCK		1761
1	"	4WT	DE	(1668)

C. Posthorn in Crowned Ornate Shield and insignia 4WR *suspended from the shield, with countermark if any*

No. of Records	Posthorn in Crowned Ornate Shield: Variants	Insignia	Countermark	Date Range
120	Posthorn in Crowned Ornate Shield and insignia *4WR* suspended from the shield	4WR		1616–1796
28	"	(4WR)		1688–1726
1	"	4WR	A	
1	"	4WR	AI	1666
1	"	4WR	AV	?
2	"	4WR	AXA	1718
5	"	(4WR)	AXA	1718
2	"	4WR	AXEA	1718
17	"	(4WR)	AXEA	1704–14
1	"	4WR	CI	1711
1	"	(4WR)	CIA	1705
1	"	(4WR)	DP	(1702–4)
1	"	4WR	DR	1711
2	"	(4WR)	DR	(1708–15)
3	"	4WR	DS	1689–1702
4	"	(4WR)	DS	(1689–1702)
1	"	4WR	DV	1707
1	"	(4WR)	DV	1710
1	"	(4WR)	DV	1707
7	"	4WR	DVE	1705–13
6	"	(4WR)	DVE	1708–13
1	"	(4WR)	DVL	1713
1	"	4WR	GI	(1703–9)
1	"	4WR	GMT	1708
3	"	4WR	H	1695–1708
16	"	(4WR)	H	1704–13
1	"	4WR	HC	(1699–1790)
1	"	4WR	HD	(1694–97)
1	"	(4WR)	HDAE	1711
1	"	4WR	HDV	1696
1	"	(4WR)	HDV	1710
5	"	4WR	HDVE	1696
10	"	(4WR)	HDVE	1687–1713
1	"	4WR	HI	?
7	"	4WR	HIB	1709–11
8	"	(4WR)	HIB	1704–11
1	"	4WR	HIP	1703–4
3	"	4WR	HP	1697–99
1	"	(4WR)	HP	1699
10	"	4WR	HR	1711–30
24	"	(4WR)	HR	1704–20
1	"	4WR	HV	1707
1	"	(4WR)	HV	1708
2	"	4WR	I quatrefoil I	1673–78
1	"	4WR	IAC	1654–55
28	"	4WR	IB	1686–1718
38	"	(4WR)	IB	1703–18
4	"	4WR	ID	1721–28
2	"	(4WR)	ID	1722–28
2	"	4WR	IHD	?
1	"	(4WR)	IHD	?
1	"	4WR	IL	?
2	"	4WR	IP	?
14	"	4WR	IS	1716–17
11	"	(4WR)	IS	1707–17
1	"	(4WR)	IT	?
1	"	4WR	IV	?
4	"	(4WR)	IV	1707–44
5	"	(4WR)	IV	1707–25
7	"	4WR	KWM	1710–21
2	"	(4WR)	KWM	1713–21
1	"	4WR	LJ	1697
1	"	4WR	LR	1706
1	"	(4WR)	LS	1705
1	"	4WR	LVGerrevink	1725
8	"	4WR	MCMD	1692–1707
4	"	(4WR)	MCMD	(1684–97)
2	"	4WR	nil	1659–88

C. (continued) Posthorn in Crowned Ornate Shield and insignia 4WR *suspended from the shield, with countermark if any*

No. of Records	Posthorn in Crowned Ornate Shield: Variants	Insignia	Countermark	Date Range
1	Posthorn in Crowned Ornate Shield and insignia *4WR* suspended from the shield	4WR	PT	?
1	"	4WR	PH	?
2	"	(4WR)	PvL	1706
1	"	4WR	R	1708
1	"	(4WR)	RS	?
2	"	(4WR)	SB	1704
6	"	4WR	SH	1691–96
2	"	(4WR)	SH	1693–96
11	"	4WR	SVB	1717–18
9	"	(4WR)	SVB	1713–21
3	"	4WR	SVDP	1710
2	"	(4WR)	SVDP	1710
2	"	4WR	TB	1706–19
1	"	(4WR)	TB	1719
3	"	4WR	TI	1691–94
4	"	4WR	WAK	1705–10
16	"	(4WR)	WAK	1704–6
1	"	4WR	WG	(1699)
2	"	(4WR)	WV	(1706)
1	"	4WR	WVE	1708
1	"	(4WR)	WVE	1708

D. Posthorn in Crowned Ornate Shield and insignia 4WR *suspended from the shield plus monogram below the insignia, with countermark if any*

No. of Records	Posthorn in Crowned Ornate Shield: Variants	Insignia	Countermark	Date Range
54	Posthorn in Crowned Ornate Shield and insignia *4WR* suspended from the shield plus monogram below the insignia	4WR+AJ	PT	1682–98
1	"	4WR+AJ	GMD	(1683–86)
1	"	4WR+AJ	nil	(1704)
4	"	4WR+AJ	RSMD	?
1	"	4WR+CA		1714
1	"	4WR+CA	JR	1710
2	"	4WR+HG		1689
2	"	4WR+JB		(1699)
1	"	4WR+LJ		1695
1	"	4WR+star		?

E. Posthorn in Crowned Ornate Shield with letters (or name) below the shield, with countermark if any

No. of Records	Posthorn in Crowned Ornate Shield: Variants	Insignia	Countermark	Date Range
3	Posthorn in Crowned Ornate Shield with letters (or name) below the shield	AB		1695–98
2	"	ACB		1800–1804
1	"	AI		1687
1	"	AJ		?
12	"	Beehive		1725–28
1	"	Beehive+C&IH	IV	1785
1	"	Beehive+GV	LA Briglia	1812
1	"	(Beehive)	HR	1727
25	"	CAD mongr.	GR crowned	1758
1	"	CS		1790
1	"	FG	LR	1695
1	"	FT		1699
15	"	GR		1739–90
3	"	GR	HR	1742
1	"	(GR)	HR	1742
1	"	GR	R. Williams 1797	1799
1	"	GRV		1741
1	"	GS in shield		?
1	"	HC		1689
13	"	HG		1691–97
3	"	HG	LL	1687
2	"	HG	LR	1680–91
4	"	HG	nil	1681

E. (continued) Posthorn in Crowned Ornate Shield with letters (or name) below the shield, with countermark if any

No. of Records	Posthorn in Crowned Ornate Shield: Variants	Insignia	Countermark	Date Range
1	"	JAV Kool		1758
1	"	LVGerrevink		1772
1	"	LVGerrevink+B	(1770)	
1	"	LVGerrevink+B	IV	(1770)
6	"	LVG		1714–79
5	"	LVG+star		1748–49
1	"	PL&A		1822
1	"	Scroll work	IV	1843
1	"	Trefoil	Cobb&Co London	?
1	"	Trefoil+D&CB	GR crowned	(1764)
1	"	Trefoil+GR		1780
1	"	VDL		1758
1	"	VDL	GR crowned	1746

Notes

1. I am grateful to Dr Dorothy Johnstone and to the members of her staff for facilitating my research in the Department of Manuscripts and Special Collections in the Hallward Library at the University of Nottingham.
2. A further collection, Plc, arrived at a later stage at Nottingham. It contains documents kept by London lawyers employed by a sequence of family members from this group of families.
3. At the beginning of the seventeenth century, Charles, the youngest son of Bess of Hardwick, was the first member of the Cavendish family to live at Welbeck. His son William, the 1st Duke of Newcastle, who was a major contributor to the social and intellectual enrichment of Welbeck, followed him. Henry, William's elder son, became 2nd Duke of Newcastle; after his death in 1691, three women in succession inherited Welbeck. The first was Margaret, the favourite daughter of the second duke. She married her cousin John Holles, who was created Duke of Newcastle in 1694. Margaret and John had only one daughter, Henrietta, who later married Edward Harley, the only son of Robert Harley, 1st Earl of Oxford. In 1712, when Edward and Henrietta were married, they lived at Wimpole Hall, another Cavendish-Holles property near Cambridge. The ancestral seat of the Harley family was Brampton Castle in Herefordshire. Robert Harley, as head of the family, lived there but spent much of his political life in Westminster, London, where his own residence was in Dover Street. In 1724, when he died, Edward transferred to Wimpole his father's library and collection of early manuscripts, making Wimpole the centre of his own bibliophile activities. The 2nd Earl of Oxford dedicated his life and a large part of his wife's fortune to extending his father's collections. Just before his death in 1741, the sale of Wimpole had been arranged in response to his financial difficulties. When Henrietta became a widow, she completed the sale of Wimpole and returned to Welbeck, her own family home. She inherited the Harleys' extensive library of printed books, manuscripts and other ancient records, which she transferred to Welbeck together with Cavendish-Harley family documents and personal papers. She was involved in rebuilding and enlarging Welbeck and, following her mother's example, became the second woman to be instrumental in its preservation. Henrietta and Edward's only child, Margaret, who married William Bentinck, eventually became the 2nd Duchess of Portland. In 1753 Henrietta and Margaret disposed of the 50,000-volume library of printed books and the collection of 350,000 pamphlets that had belonged to the two earls of Oxford. These two women subsequently sold to the nation the vast Harley Collection of Manuscripts, which became one of the main foundations of the British Museum. Margaret inherited Welbeck on her mother's death, but she and her husband lived in Westminster and at Bulstrode, a Bentinck property located west of London. It was Margaret's eldest son, William Henry, the 3rd Duke of Portland, who made Welbeck his home and who preserved the family archives there. Margaret's favourite child, her eldest daughter Elizabeth, married Thomas Thynne, the future Marquess of Bath, and took with her a relatively small but important portion of Cavendish-Harley manuscripts to her new home, Longleat, in Wiltshire. This seems to be the only group of family records separated from Welbeck until 1949, when the collections were systematically divided and dispersed by the 7th Duke of Portland.
4. These entries are in the process of being standardized. At this time the main purpose of the database is to supply physical characteristics of the holdings to the main manuscript catalogue, which is held in a separate database. The contents of the documents are of primary interest to researchers, and the physical descriptions are still the province of the archivist. The interplay of these two areas will be of interest to both. It is expected that the refined catalogue will be available though the World Wide Web and will answer questions that up to now could only be answered by handling the manuscripts themselves.
5. Labarre describes Post paper as 'an obsolescent size of paper, originally in three sizes varying from 20 × 16 inches..., the half sheet of which when folded formed the ordinary letter paper (Oxford English Dictionary) but now chiefly found in the following combinations, of which Large Post may be said to be the principal commercial size used in the UK.' Labarre, E.J. 1952. *Dictionary and Encyclopaedia of Paper and Paper-making*. Amsterdam: Swets & Zetlinger. 202.

   He gives a list of 13 different types of Horn paper; denominations indicate dimensions of the sheet of paper.

   In his article on paper sizes (Labarre, E.J. 1949. The Sizes of Paper, Their Names, Origin & History. *Buch und Papier: Hans H. Bockwitz zum 65 Geburstage dargebracht*. 35–54.), Labarre gives an up-to-date summary of its history,

tracing its origin to Italy in the fourteenth century, and adds, 'This mark has always been popular in the Netherlands, probably because the emblem is part of the Orange Nassau coat-of-arms. There can therefore be no doubt that this watermark was one of the most general and widely distributed of marks, and it is not surprising that it has been taken in practically all countries using paper as the name of both a quality and a size of paper.' Later on he says, 'As with practically all names of sizes derived from watermarks, it is impossible to fix the period when a name definitely passed from that of a kind of paper, that is, a paper with a known mark hence of a known *quality*, to that of a *size only*. In the case of "post" this differentiation, at least internationally, never seems to have been complete, for post is still known in the principal countries of Europe, except France, as a quality of paper, and not a size.'

And he continues, 'The earliest date quoted by the English Oxford Dictionary is 1711, in an Act of Queen Anne, obviously a customs tariff imposing duty upon "... all paper usually called or known by the name of fine Large Post which shall be imported or brought in as aforesaid, the summe of Two shillings and six pence for every Reame." It may therefore be safely stated that "Post" as a paper term entered England from Holland in the 17th century together with the paper so called, and not from France.'

6. The main central fold coincides with the centre of either the watermark form or the countermark. When the paper is worn or torn along the main fold and is subsequently repaired, or when the document is pasted onto a new leaf as part of an aggregate volume, the countermarks are impossible to identify. Obtrusive 'Bodley repairs' add a second layer of watermarked paper to many of the original documents at Nottingham University.
7. A further 3 fields — Collection Reference, Sort Reference and Item Number — were used for sorting purposes only and do not show in the printouts.
8. Only the literary manuscripts currently have the Dimensions field in the main catalogue.
9. I had already performed the 'matching' procedure using the Dimensions field, and had identified groups of related manuscripts that, in addition to dimension, shared a type of paper, a similar page set-up and/or script or common content. By this means, exact matches were located, a few of which could also be assigned dates. The 29 watermark-dated manuscripts provided a focus to test these results and to expand on them.
10. PwV 693: an anonymous poem addressed to the 3rd Earl of Burlington and another addressed to William Kent.

Beating the Forger: Case Studies in Forensic Paper Investigation

PETER BOWER

Abstract

What one man can make, another can copy; where one man can copy, another can tell a copy was made. This paper is based on the investigations and discoveries made in three individual forgery cases: a group of early-nineteenth-century watercolours; Leon Warnerke, who may be the greatest banknote forger ever; and the 1.2 billion dollars worth of U.S. Treasury bonds — that weren't.

It covers the physical investigation of the objects involved, the interpretation of those findings and the techniques used by the forgers, emphasizing the importance of background research and of collaboration between investigators. Other areas discussed include some of the basic dynamics of forging, including one of the most important elements of a 'successful' forgery — the manipulation of the victim. Reference will be made to other, similar cases involving the author, as well as some famous historical cases.

Introduction

Over the years, the forensic investigations on which I have been asked to work have varied enormously from business correspondence and banknotes, to bonds, drawings, watercolours and printed books. They also range from Jack the Ripper's so-called diary to packaging used for fake car parts. Every single case was completely unique.

'What one man can make, another can copy.' This is a truism that lies at the heart of a complex world where nothing is what it seems. Like forgery itself, it does not tell the whole truth. A second part of this truism should be 'where one man can copy, another can tell a copy was made.' That the copy can be identified as a copy is the simple basis for all forgery investigations. No matter how sophisticated forgers become, no matter how knowledgeable or technically proficient they are or how much time and money they are prepared to invest in their schemes, it is possible to uncover the deceit. Forgers work on a set of principles or assumptions, of which the victim's greed is perhaps the most powerful. Their technical skill and virtuosity are based on a simple fact: every artefact contains the marks of its making and, as such, is capable of being analysed and then replicated. The obvious fact that the artefacts they produce also contain the marks of their making, however 'aged' and disguised, seems to escape most forgers. They often underestimate the range of skills and techniques that can be applied against them. The late Eric Hebborn is a good case in point. In his various publications he railed against the so-called experts that he 'fooled' for their incompetence and ignorance, and boasted of his marvellous skill.[1] However, having examined many of his works, I find that they certainly do not stand up to his own estimation of his talents; the combination of often facile draughtsmanship with inappropriate and out-of-period papers does not succeed.[2]

Nonetheless, it is perfectly possible to produce something that will 'fool some of the people some of the time,' or at least for a sufficient length of time for the forger to make an escape. Many forgeries are not designed to have a long shelf-life; they are produced quickly to achieve a specific set of ends — the chief of which is usually money.

The three cases discussed here — a group of watercolours, some extraordinary forgeries of banknotes and perhaps some of the most inept bonds ever produced — illustrate most of the important areas in the investigation of forged paper artefacts. They show some of the often very complex methods used by forgers, something of the thinking behind such forgeries and the basic investigative methods used to uncover them. Each in its own way also shows the importance to the investigator of collaboration, the value of comparative material and the essential understanding of particular historical contexts. Understanding the thinking behind any forgery is of great importance. Each new case produces new insights from the extraordinary variety of deceptions that can be practised, not only by the forgers on their often willing victims, but by the victims of such forgery on themselves, which is a crucial element in the relative success of any forgery. I say 'relative' here because, obviously, these forgeries failed — we are talking about them now. No doubt there have been perfect forgeries, objects so well made, so anchored in their context, so technically correct and cleverly done that no one (yet) suspects that they are not what they seem. However, as the Warnerke banknote case shows, even time cannot always prevent the unmasking of a forger.

Two of the cases discussed here are based on the simplest of tricks: The forger creates something that is known to have existed, is recorded as having existed, but is no longer traceable. The forger can use whatever documentary evidence that exists about the real object as evidence for the genuineness of his own creations. The importance of provenance, whether real or manufactured, is well illustrated by the recent John Drewe case in the United Kingdom. Drewe employed John Myatt to create over 200 paintings, while Drewe's part in the fraud was the manufacture of false documentation. This included exhibition catalogues containing documentation of his fakes, and the planting of such documentation within major art history archives.[3]

There is a considerable difference between the burden of proof demanded by the art world and that required by a court of law. It is fascinating sometimes to listen to art historians defend positions that are based more on wishful thinking than on hard evidence. Any work of art is

1. Study of trees and a fence, relating to *Near Brandsby, Yorkshire*, 1805 (Ashmolean Museum, Oxford).
2. Study for *The Ploughed Field*, relating to *The Ploughed Field*, 1808 (Leeds City Art Gallery). This work also bears some relationship to *Barnard Castle from Towler Hill*, 1806 (Leeds City Art Gallery).
3. Study for *On the Tees at Rockcliffe*, relating to *On the Tees at Rockcliffe*, 1808 (Victoria and Albert Museum).
4. A sheet of studies that do not relate to any specific work by Cotman.
5. Study for *Greta Bridge*, relating to *Greta Bridge*, 1807 (British Museum).
6. Study for *Hell Cauldron* (fig. 1), relating to both *Hell Cauldron*, called *A shady pool on the Greta*, 1807 (National Gallery of Scotland) and *On the Greta*, called *Hell Cauldron*, 1806 (Leeds City Art Galleries).
7. Another study for *The Ploughed Field* (fig. 2), relating to *The Ploughed Field*, 1808 (Leeds City Art Gallery).
8. Another study for *The Ploughed Field*, relating to *The Ploughed Field*, 1808 (Leeds City Art Gallery).
9. Study for *Chirk Aqueduct*, relating to *Chirk Aqueduct* [so-called], 1806–7 (Victoria and Albert Museum). This work also relates to another drawing, *Aqueduct*, called *Telford's Aqueduct at Chirk*, 1806 (Ashmolean Museum, Oxford).
10. Another study for *On the Tees at Rockcliffe*, relating to *On the Tees at Rockcliffe*, 1808 (Victoria and Albert Museum).
11. A landscape study towards distant hills that does not relate to any specific work by Cotman but is similar to many of the *Greta* works.
12. Study of *Greta Bridge*, relating to *Greta Bridge*, 1807 (British Museum).
13. Another study of *Greta Bridge*, relating to *Greta Bridge*, 1807 (British Museum).
14. Another study for *On the Tees at Rockcliffe*, relating to *On the Tees at Rockcliffe*, 1808 (Victoria and Albert Museum).
15. Another study for *The Ploughed Field*, relating to *The Ploughed Field*, 1808 (Leeds City Art Gallery).
16. Another study for *The Ploughed Field*, relating to *The Ploughed Field*, 1808 (Leeds City Art Gallery).

Table 1 A List of Fake Cotman Paintings and the Genuine Paintings to Which They Are Related

a physical object and can be examined as such, and a serious investigation of the materials used in a particular work often solves their riddles and proves or disproves their dearly held theories.

A Group of early-nineteenth-century watercolours

Some years ago I was asked to examine a group of 16 watercolours that had been purchased as the work of John Sell Cotman (1782–1842). The owner had begun to have his doubts about them and had also heard that, in fact, doubts about this group had been expressed by several people prior to their sale.[4] At first sight these 16 works appeared to be studies for some of John Sell Cotman's most celebrated works. In table 1 I have indicated which works by John Sell Cotman these studies relate to, as well as the public collections which hold the originals.

The works that these studies relate to were also examined, as were a representative group of other works by John Sell Cotman from the collections of the Victoria and Albert Museum, the British Museum and the Norwich Castle Museum. In the case of the Norwich works and some of the other works, accurate comparisons of original surfaces, textures and colours were

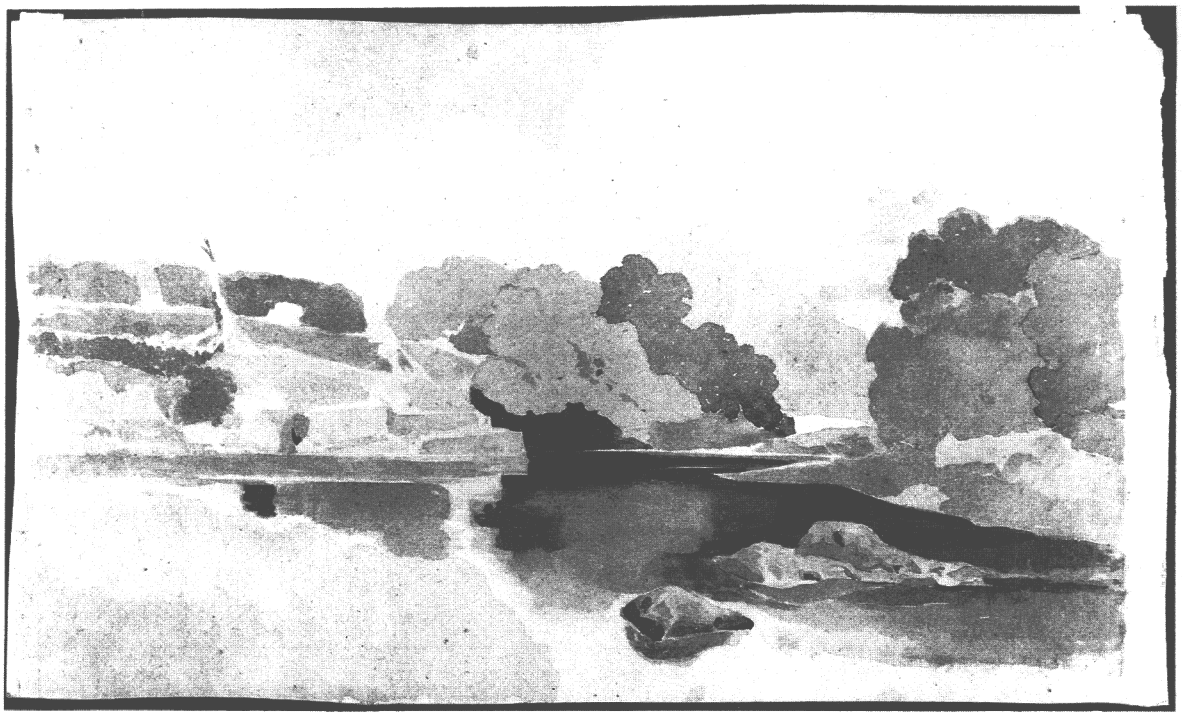


Fig. 1 Purported study for *Hell Cauldron*, based on two works by John Sell Cotman: *Hell Cauldron*, called *A shady pool on the Greta*, 1807 (National Gallery of Scotland) and *On the Greta*, called *Hell Cauldron*, 1806 (Leeds City Art Gallery).

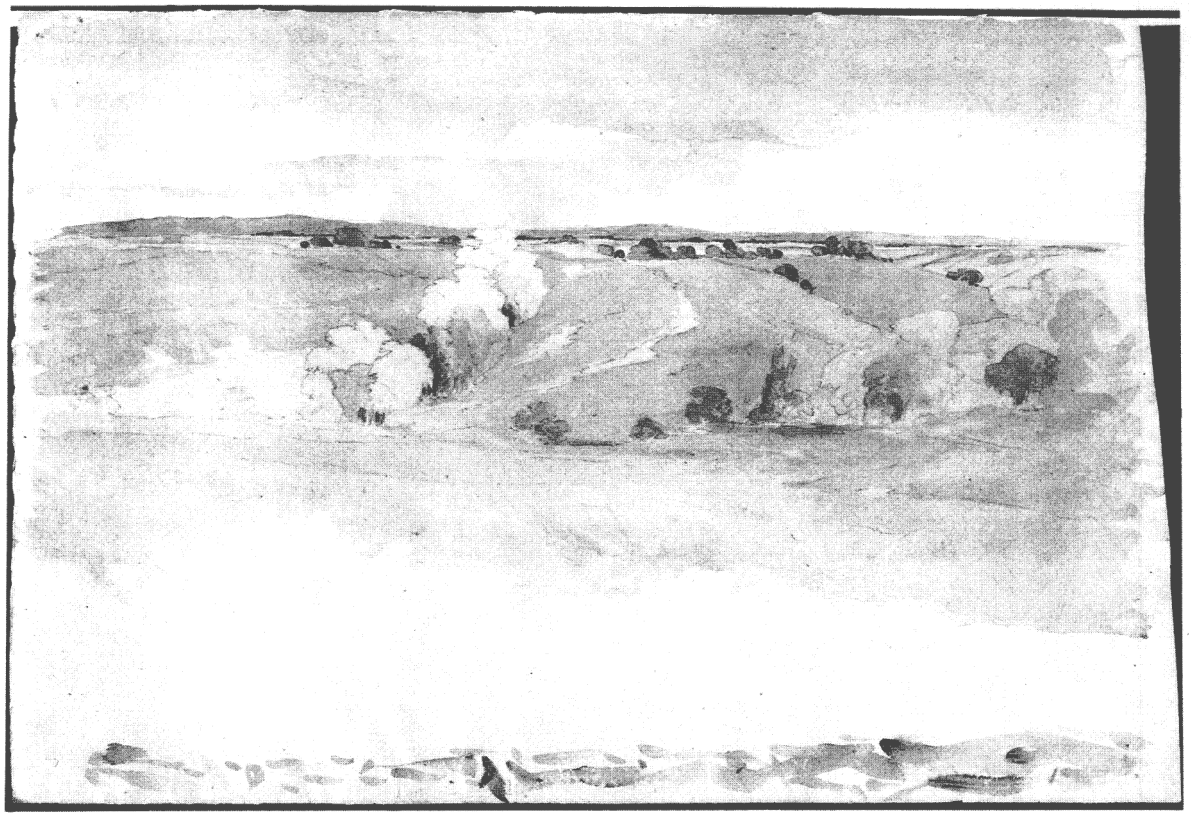


Fig. 2 Purported study for *The Ploughed Field*, based on John Sell Cotman's *The Ploughed Field*, 1808 (Leeds City Art Gallery).

somewhat restricted because of the individual histories of some of the works, particularly those at Norwich, which had been restored and conserved by Kennedy North during the 1930s. These examinations showed that none of the buff-grey laid papers used by Cotman himself during the period 1804–11, for his Yorkshire subjects and other subjects, are from the same batch of paper or made on the same moulds as the paper used in this group of fakes. None of the paper found in the Cotman works had the same colour or tone as the paper in this group. However, it is important to recognize that none of the works examined in the various museum collections has the same appearance as when it was executed. This change of state applies as much to the paper as to the paint and pigments used. The washing and cleaning treatments used by Kennedy North to deal with the moulds, iron discolouration, resinous stains and 'noxious growths living on the various pastes and glues that had been used to mount the works, not only changed the nature of the colours but also the tone and texture of the papers used.'[5] North, in his report, also describes how 'drawings responded to treatment in heightening of colour and enrichment of tone' and how it was 'possible to enhance large areas of a drawing and, indeed, in some instances, the whole of a drawing.'

During my work on the 16 watercolours, a further group of nine 'Cotman' works surfaced, as well as another single work. They all came from the same source as the 16 I was investigating and all proved to have been executed on exactly the same batch of paper from the same moulds as the disputed 16. These 10 works were also examined. They were all *Greta*-related landscape studies and included another study for *On the Tees at Rockcliffe* and another study for *Greta Bridge*, as well as a subject not encountered in the first group, a study for *Devil's Elbow, Rokeby Park* (in the Norwich Castle Museum).

The genuine works by John Sell Cotman, which were executed on various brown and buff-grey papers, are on 10 different examples of a type of strong and relatively cheap wrapping paper in common use in the early nineteenth century. These papers differed because they were either formed on different moulds, made with different blends of fibres or had different beating characteristics. Cotman had begun to use this type of laid wrapping paper in 1804 and continued to use it, primarily for works in watercolour over pencil, for many Yorkshire, Norfolk and other subjects until 1811. The brown and buff papers he used after that date are all wove papers and are generally of much better quality.[6]

The outcome of investigations such as this rarely depends upon one specific find, fact or result. More often than not it is a combination of many factors that contribute to one's conclusions. Accordingly, every possible area is explored, not merely the obvious ones such as fibre identification and watermarks. If one examines 20 different aspects of the work and 19 of them show differences or anomalies, or contradict his known working practices when compared with known works by the artist, then it probably is not by that artist. Two of the critical areas of examination in this case were the side of the sheet that had been worked on and, because these works were on laid paper, the alignment of the image to the chain lines.

Artists develop habits of working on particular surfaces, and while one cannot make hard and fast rules, it would appear that with any given paper an individual artist will have a preferred surface for working on. With laid papers, the horizontal or vertical alignment of the image in relation to the chain lines is often a matter of chance, in the sense that it depends on the format and size the artist wants to work with. What is important, however, is whether or not there is a pattern in the artist's work of wire- or felt-side usage together with a preference for chain-line orientation.

Examination of Cotman's works on brown and buff wrapping papers shows a distinct and changing pattern of usage. In the period 1804–7 Cotman seems to have preferred to work mainly on the felt side of the sheet and was more likely to work with the chain lines running horizontally across the image. From 1807–11 we find a much greater incidence of the use of the felt side and more works where the chain lines are found running vertically across the image. In the disputed works, the original 16 and the additional 10 that surfaced (all purportedly done from 1804 to 1805), the pattern is somewhat different. While the use of the sheet with the chain lines running horizontally across the image is consistent with that found in genuine Cotmans from the period 1804–7, the side of the paper worked on is completely different. Only 3 of these 26 works were painted on the felt side — Cotman's preferred surface on this type of paper during this period.[7]

All the paper in these 26 disputed works was found to be part-sheets from the same batch of a handmade, heavily flecked, self-coloured pale buff-grey laid paper made on a pair of double-faced moulds. The fibre was a blend of low-grade white linen rags and hemp derived from old rope, with a small portion of blue linen rag fibre. There was some variation in weight, bulk and tone among the various sheets, but nothing inconsistent with all these sheets having come from the same batch of paper. Quality control in wrapping-paper mills was not nearly as stringent as in the mills producing fine white papers. The furnish was not particularly well beaten and varies a little among the different sheets. The slight differences in colour among individual sheets comes from variations in the amounts of different fibres present; these would be added to the vat as more pulp was required during formation. There are many specks and shives and some process dirt present. The fibre content, degree of beating, tone, texture, surface strength and degree of original sizing all suggested that the paper was a 'strong' wrapping or press paper. Some of the sheets exhibit varying amounts of two-sidedness — colour differences between the two surfaces. This is common in handmade coloured sheets made from blended fibres, where the heavier fibres sink to the wire side during formation and drainage. Each side, therefore, has a different proportion of the two fibres present and appears slightly different in colour.

All the part-sheets, with some deckle edges as well as some rough-cut and torn edges, varied in size from 336 by 352 to 353 by 595 millimetres. The largest work was

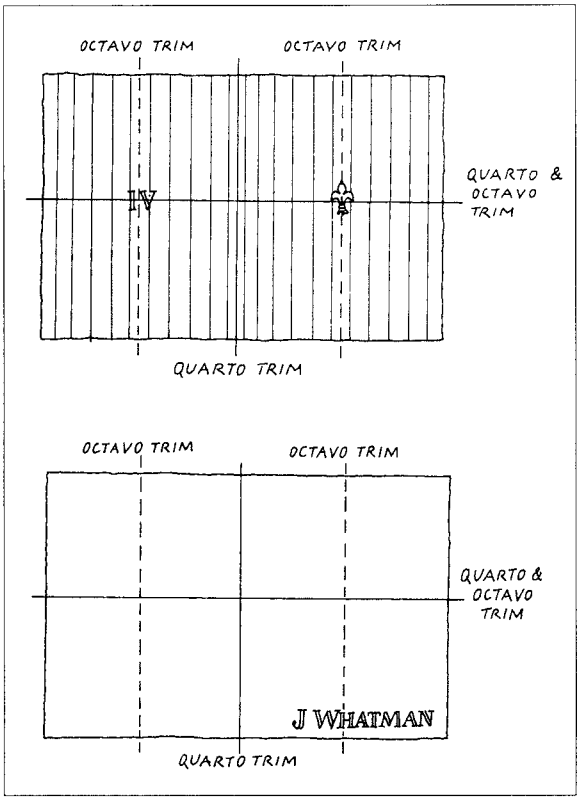


Fig. 3 Above: Traditional positioning of watermarks and countermarks in laid paper. When quarto or octavo part-sheets are trimmed the watermarks easily disappear. Below: Traditional positioning of watermark in English-made wove paper. Again, the watermark can easily be lost when a sheet is trimmed.

one of only three sheets that had deckle edges on three sides (two short edges and one long), giving us the dimensions of the whole sheet.

No complete watermark was found in any of these sheets, but 20 of the 26 contained parts of watermarks consisting of either an *F* and part of a letter, or part of a letter and an *M*. Details of these watermark fragments reveal that two moulds were in use, the most obvious difference between the two being that the letters in one mould were attached to the forming surface between the chain lines, while the other mould letters were attached across the chain line. Despite the difference in watermark alignment, the wire profiles of both moulds were very similar — a double-faced laid mould with a chain-line spacing of 27 to 28 millimetres and a variable laid-line frequency of 8 per centimetre.

Watermarks are relatively rare in Cotman's work, not because he preferred to work on unmarked paper, but because, for the most part, when working on laid paper his preferred working sizes would have come from quarter-sheets.[8] By the end of the eighteenth century, the convention developed that laid papers were watermarked with an image in the centre of one half of the sheet and a countermark, identifying the maker or mill, centred in the other half of the sheet (fig. 3, above). The traditional position for watermarks in English wove papers during this period was a maker's name or initials, placed in the bottom right or, more rarely, the bottom left of the sheet (fig. 3, below). Initially the watermark in this paper was recorded as being the letters *FDM*

in the centre of the whole sheet (fig. 4), a relatively rare occurrence in English watermarking practice at this date.

Making use of the three part-sheets that had three deckle edges each, I used the relationships between the tops and bottoms of the letters in the watermark to those deckle edges that are present in the remaining sheets, to come up with a possible sheet size of 712 by 597 millimetres, a size known as elephant (28 by 23½ inches). From the middle of the eighteenth century onwards there was an increasing correlation between the intended use of the paper and the size of the sheet. The 28 by 23½ inch elephant is found as both a wrapping-paper size and as a pressing-paper size. Pressing papers were designed for use in the woollen industry. This size was only rarely used for writing (28 by 23 inches), printing (28–30 by 23 inches, variable) or drawing (28 by 23½ inches),[9] being more commonly found as the larger double elephant (40 by 27 inches). A closer examination of the torn and cut edges of all these sheets, to the right of the *F* or the left of the *M*, revealed that none of the tears or the rough-cut edges matched with any other. One might have expected, from what is found in the works of many other artists working on a particular batch of paper, that at least some of these sheets would combine to be half-sheets with some of the tears or cuts matching up. Other indications, such as a long couch fault (visible in transmitted light) which has distorted the laid- and chain-line patterns, show that at least two pieces of this paper were once part of the same sheet, but one has a torn edge and the other a cut edge. This suggested that perhaps part of the central area of the sheet had been removed and that the long dimension of the sheet was actually more than 28 inches (fig. 4).

There are reasons why such a sheet might have its central portion removed. Handmade paper was traditionally dried by being hung over ropes. When dried too fast or with little care (as was frequently the case with wrapping papers) an often prominent back-mark remained; a series of ripple marks would be created in the area around the rope where the rope had either inhibited drying or, if the rope was uncoated, had actually accelerated drying by drawing moisture from the wet, newly formed sheet where the two came in contact with each other. Many artists did not like working across the back and would trim their paper accordingly, but Cotman was not one of them. There are many examples of Cotman's painting right across such areas of the sheet.[10] It would therefore seem unlikely that Cotman had trimmed all these different sheets for this reason. There is, however, another reason why the centre of the sheet would be missing — to remove information that might throw light on the origin of the paper, and this would only occur if the works were being forged (fig. 4). Such information could be the name of a maker or a mill, perhaps with a manufacturing date centred below it. Was this a possibility? Was there a larger wrapping- or pressing-paper size that retained the 597 millimetre (23½ inch) short dimension while having a greater long dimension? What word or words might be missing from the centre? With regard to the size, there

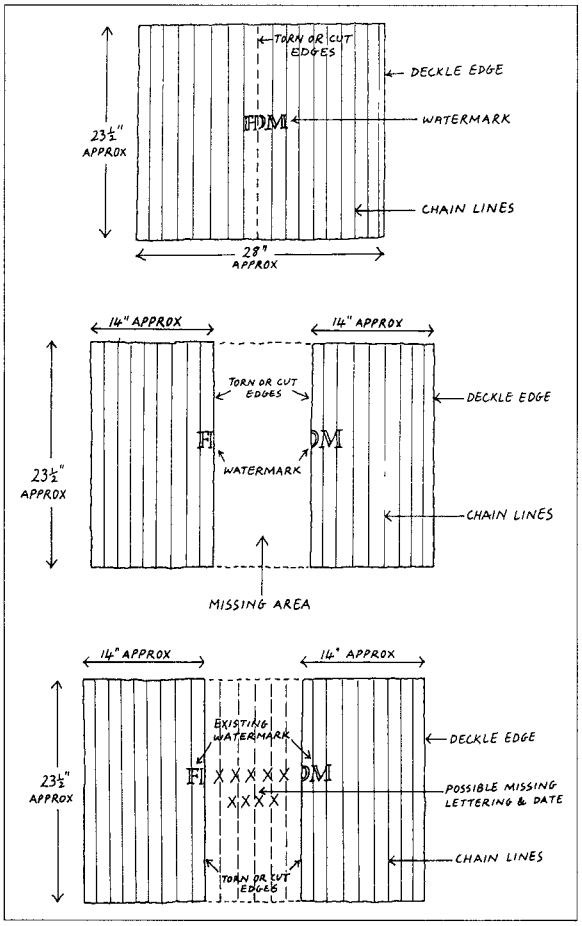


Fig. 4 Above: The presumed configuration of a whole sheet of the paper with centred *FDM* watermark. Centre: Possible configuration of a full sheet of this paper, indicating the missing area. Below: Configuration of the sheet of paper indicating the possible missing parts of the watermark, based on the design of other central watermarks.

are two that fit: wrapping imperial (found in 30–32 by 23–23½ inch sizes) or imperial casing (found as large as 33–34 by 23½ inches), depending on the mill and manufacturing details.[11]

If the centre of the sheet had been removed, then the watermark fragments, *F* with two parts of letters and an *M*, were not initials but the beginning and end of a word or words. An exhaustive survey of late-eighteenth- and nineteenth-century English papermaking records was conducted to see if any maker's name or mill name (particularly if the mill was making rope-browns, wrappings or press papers) corresponded to the potential space available in the missing centre of the sheet.

This search narrowed the possible origin of the sheet down to two Yorkshire paper mills, Freedom Mill (sometimes called Morton Mill) at Bingley, or Freedom Mills at Bishops Monkton, near Ripon. Given the size of the *F* and *M* letterforms and given the letter-spacing between both the *F* and *M* and their accompanying letter fragments, then the word *FREEDOM* would fit in an imperial casing sheet. It could never be determined if there had been a date or the word *MILL* or *MILLS* below. Consequently, a further search began for any examples of watermarks from either mill.[12]

The Freedom Mill, Bingley, was operated under this name by H. and J.W. Wright from 1862 to 1907,

producing handmade press papers and pasteboards made from 'ropes of all kinds, coal sacks, brown papers and rags' as raw materials.[13] The Bishops Monkton mill began to be called Freedom Mills in 1846 under the occupation of Thomas Hollis[14] and continued in operation until the early years of the twentieth century, operating one papermaking machine and two vats for handmade papers. It produced milled boards, press papers and glazed boards under various owners.[15] Eventually the search paid off and a part-sheet of a very similar brown wrapping paper came to light in a private collection, with the word *FREEDOM* as a central watermark. It was in a box labelled 'Yorkshire papers.' It has still not been determined which of the two mills made the paper, but this discovery places the date of the paper at 1846 at the earliest, 40 years after the works were supposed to have been done, and 4 years after Cotman's death. The paper came from the right part of the country but, unfortunately for the forger, not from the right period.

The combination of all the various anomalies in these sheets with this final piece of evidence suggested that the works were indeed forgeries. The search now switched to where and how the works had come into existence. This case was based on one of the simplest of forger's tricks, where the forger creates something that is known to have existed, is recorded as having existed, but is no longer traceable. Whatever documentary evidence that exists relating to the real object can be used by the forger as evidence for the genuineness of his own creations. In this case, he based his work on considerable research into Cotman. He discovered that in 1805 a portfolio of Cotman's drawings apparently went missing while Cotman was travelling in Yorkshire from Brandsby (where he had stayed with the Cholmely family) to Rokeby, where he was to stay with the Morritts. Accordingly, these studies were placed in an old, early-nineteenth-century portfolio and then offered to the world — not as works by Cotman, but just as a portfolio of early nineteenth-century watercolours. The forger had probably read most, if not all, of the Cotman literature, and to some extent had designed these works to fit some of the theories of Cotman's working practice held by a particular Cotman expert, knowing that as soon as these works appeared on the market he would surely be one of the first people asked to examine them. That expert enthusiastically endorsed them as being by Cotman and was ready to include them in the catalogue raisonné of Cotman's work that he was preparing.

The forger was clever. Under English law you have to 'utter' a forgery, that is, indicate either verbally or in writing (with a signature, for instance) that a work is by a particular person. The forger never stated that these works were by Cotman. Indeed, there is one account of him standing in the auction house disagreeing with the attribution to Cotman by their experts, and saying he thought it unlikely because the pencil underdrawing was weak and the washes too lifeless for Cotman. Despite his apparent cleverness, several things betrayed him. First of all, the work was just not good enough to be by Cotman. Many people who saw the group prior to the sale expressed their doubts on just these grounds. Second, there were anomalies in the portfolio story. The documentation for this event comes from two letters from Cotman's friend Teresa Cholmely to Francis Cholmely, in the Cholmely archive.[16] The first letter describes how on their return from York the Cholmely family:

> ... found y[ou]rs and Cotty's letters, & what was les agreaable, the girls prouced Cotty's most mportant frame and Porfolio w[hi]ch they had not found till after we went. I have pack[e]d it carefully up and shall send it by the York Postillon to Southern to forward it if possible today to Rokeby.[17]

Teresa wrote again to Francis on the following day:

> Cotty's portfolio ... is at York and Miss Southern at a loss how to forward it. I must write to her immed[iate]ly to desire her to send it carr[ia]g[e] p[ai]d to Ferrybridge and desiring Mr Alderson to fow[ar]d it from thence by the Glasgow mail. ... If his portfolio does not arrive in a day or two, you had best write to Mrs Southern about it.[18]

There is actually no evidence in the above that the portfolio went missing permanently, merely the fact that Cotman left it behind and it was sent on to him. Unfortunately for the forger, the group of works that he created could not be from this 'missing' portfolio. Cotman was on his way to Rokeby for the first time, and some works by the forger are studies for pictures of places he had not yet actually seen, let alone painted. Third, he misunderstood the subtleties of Cotman's working habits during this period of his life, not realizing that Cotman had particular ways of working on particular types of paper. Fourth, and more crucially, he used the wrong paper. As we have seen, although the paper was visually very similar to the wrappings Cotman was using in Yorkshire, the papers he used were 40 years or more too recent. In addition, the paper was made on a double-faced laid mould, something not seen in wrapping papers in England until after 1820.[19] Despite these errors he managed to sell the works for a considerable sum, and has never been prosecuted for his crime.

Leon Warnerke: Perhaps the greatest banknote forger ever

For as long as money has been made it has been counterfeited, usually by individuals or small groups of people motivated primarily by greed. However, the largest and most successful counterfeiting projects by far have been conceived and executed for political ends rather than from mere avarice. Such projects have generally been directed by one government against another. There are, however, other such politically motivated forgery cases directed by individuals, and this part of my paper is concerned with just such a case, the 35-year career of a late-nineteenth-century master forger and the group of

people around him, whose main aim appears to have been the destabilization of the currencies of Russia, France and Britain for political ends.[20]

The deliberate forgery by one government or power of another's currency is not new. As early as 1470, Duke Galeazzo Sforza of Milan counterfeited the money of Venice in an attempt to damage the respectability and reputation of Venetian bankers. The British have a long, if not honourable, history of such activity. During the eighteenth century the British struck gold Louis coins at Birmingham, and they also printed the currency of the infant United States during the War of Independence. On 10 May 1775 the Continental Congress had decided to issue paper money; within five years these 'continentals' had almost completely lost their value. Washington himself wrote that 'a whole wagon full of paper money barely suffices to buy a wagon load of food.'[21]

One of the most successful of these ventures was the forging by the British of assignats, the paper currency of the French Revolution.[22] Until recently, most of the relatively rare references to the forgery of assignats in Britain in the 1790s have either dismissed the whole thing as a vile slander about the probity and integrity of the English establishment, or have carried some sort of disclaimer disassociating the British government of the day, the Bank of England or any members of the establishment from any knowledge of or involvement in the project. The occasional writer has lamented the lack of evidence. However, research over the past 10 years has uncovered substantial concrete proof in the form of documentary evidence, as well as some of the actual artefacts used. It is now possible to document the whole of this operation from the foremen and workers of the paper mills to the printers, engravers, merchants, pamphleteers, the military, the court of directors of the Bank of England and finally right up to the British Cabinet, the Prime Minister and the Chancellor of the Exchequer, William Pitt.

Seldom has the introduction and use of any paper currency been the cause of as much suffering and chaos as the French issue of assignats between 1789 and 1795. The internal and external pressures that France was under — the war, the Terror and the Vendée rebellion — were to produce 13,000 percent inflation in France by 1795 and the eventual and perhaps inevitable withdrawal of assignats from circulation, followed by official destruction of the remaining currency, presses and paper stocks.[23] However, these were not the only pressures that brought financial chaos to revolutionary France. Perhaps the biggest single factor was an idea, that of destroying the financial stability of a country by flooding it with forged currency. This would be an operation carried out by a mixture of private enterprise and government. In this case, the active participation of agents of the British government went, in many instances, far beyond the power of their positions.

By 1795, when assignats were withdrawn from circulation, the economic plight of France was disastrous. Two million, four hundred thousand livres of a new paper currency, *mandats territoriaux*, were issued, but these depreciated so rapidly that by early 1797, when they were withdrawn, they were only worth one percent of their face value. Beggars would not take them and peasants wanted metal coin for their produce, saying that they would only take 'the other stuff' if their horses would eat it.

During the occupation of Vienna in 1806, Napoleon had plates of currency notes issued by the Wiener-Stadt-Banco copied; he later printed this Austrian currency in both Paris and Italy. Napoleon also had both 25- and 50-rouble Russian state credit notes (assignats) counterfeited between 1805 and 1812 in an effort to destabilize a financial system already burdened by massive devaluation. There is some evidence that he also attempted the forgery of English banknotes during the same period.[24]

During the Second World War, the United States counterfeited Japanese currency and the author John Steinbeck tried to persuade Franklin D. Roosevelt to flood Germany from the air with marks. The Germans themselves, in both Operation Andrew and Operation Bernhard, produced some of the best forgeries of British banknotes ever produced.

Forgery for personal gain has always attracted its fair share of skilled but flawed individuals. The Austrian Peter Ritter von Behr, after the failure of his business ventures in 1839, embarked on a series of exceptionally high-quality forgeries. After he and his wife were arrested in 1845 he admitted only to producing as much as he and his wife needed at any one time and denied that his wife knew anything of his activities. In Britain in the 1960s and 1970s, Charles Black also produced some quite high-quality notes, but he also was caught and spent some years in jail.

Leon Warnerke, the individual whose story forms the second part of this paper, is of a different calibre altogether. In 35 years of activity producing Russian, French and English banknotes, between *c.*1865 and 1900, he was never caught — but came very close. In fact, it is only in the past few years that his activities have come to light, with the discovery of a hoard of his printing trials, notes, letters, documents and equipment. Politics played a great part in his operation, at least initially, and remained an important motive for many of his co-conspirators throughout, although it has become obvious as I have researched this particular case that the sheer challenge of the job, the intricate and complex workmanship involving complex printing skills, chemistry, watermarking and papermaking knowledge, probably became Warnerke's chief motivation.

What both the British forgery of assignats and Warnerke's operation have in common, besides the attempt to ruin or at least destabilize a government's economy, is that the various skills and techniques involved were at their time right at the forefront of developments in various technologies. The manufacture of genuine assignats had involved great and very effective experimentation in a variety of disciplines by the French: the development of security and chiarascuro

watermarking, changes in paper technology (the bleaching and beating of rags, for example), the mechanics of printing (the rapid development of stereotype and polytype techniques), engraving methods and the hardening of metal plates and punches. The forgery of these notes involved an equal expertise, as well as considerable time, trouble and expense, all of which led to equivalent technical developments in Britain. Warnerke's use and development of the latest advances in the photographic reproduction of artwork, in paper science and technology and in various methods of printing were equally inventive and innovative.

In 1991 an extraordinary collection, consisting of banknotes, printing trials, watermarks, papermaking moulds, letters, receipts, a memorandum book, photographic material, press cuttings and ink trials, was brought to my attention.[25] Examination of this complex material revealed an extraordinary story. In 1871 a wealthy young man, with his wife and young daughter, arrived in London from Paris and settled in south-east London. Over the years he established himself as a very successful businessman and inventor dealing with the technology of photography. He won numerous prizes and awards as well as the respect of his peers. Although based for most of the latter part of his life in a large, imposing house on Champion Hill, his business and photographic interests led him to travel constantly throughout Europe. He died in Geneva in October 1900.[26] The story that emerges from the mass of documents that surfaced in 1991 tells a very different story, however, suggesting that this well-respected man had another life. For some 30 years he was also involved in forging the banknotes of Russia and other countries[27] as part of a widespread conspiracy that grew out of an alliance of survivors of the Paris Commune, anarchists, Polish exiles, rebels fighting the 'Russianization' of their country and gangsters out for what they could get.

The whole question of Warnerke's true identity and the part he played in this grand conspiracy is a complex and multifaceted problem. His public persona is briefly documented in various sources which provide a very striking image of a man of singular talent and character. Leon Warnerke was born, by his own description, in Moravia, then one of the provinces of the Austro-Hungarian Empire.[28] His entry in the 1881 census places him at Silvenhall, Champion Hill, Camberwell, and lists him as Austrian.[29] His return for the 1891 census at the same address, this time spelt Silverhowe House, Champion Hill, Camberwell, lists his place of birth as Moravia, Austria.[30] In both these returns there are considerable discrepancies between the entries for all the members of the Warnerke family.[31] The photography historian Joseph Eder was convinced that Warnerke was Russian by birth, on the basis of conversations with Eder's collaborator, Joseph Plener, who had also worked with Warnerke in London.[32] Eder says that

> Joseph Plener convinced this author that Warnerke was a Russian by birth. Plener was a Pole in Czarist Russia and at that time involved in a revolt against Russia. He fled to London as a Russian emigrant. He devoted himself to photography and invented his centrifugal machine for using silver bromide in the production of gelatine emulsions. In 1882 he came to Vienna to work in Eder's Laboratory. Later he started the dry plate factory Lowy-Plener, in Vienna, the firm which first manufactured Eder's orthochromatic erythrosin plates. In London, Plener had close personal contact with Warnerke, with whom he was able to converse in Russian, his mother tongue, and he always described Warnerke as a Russian.[33]

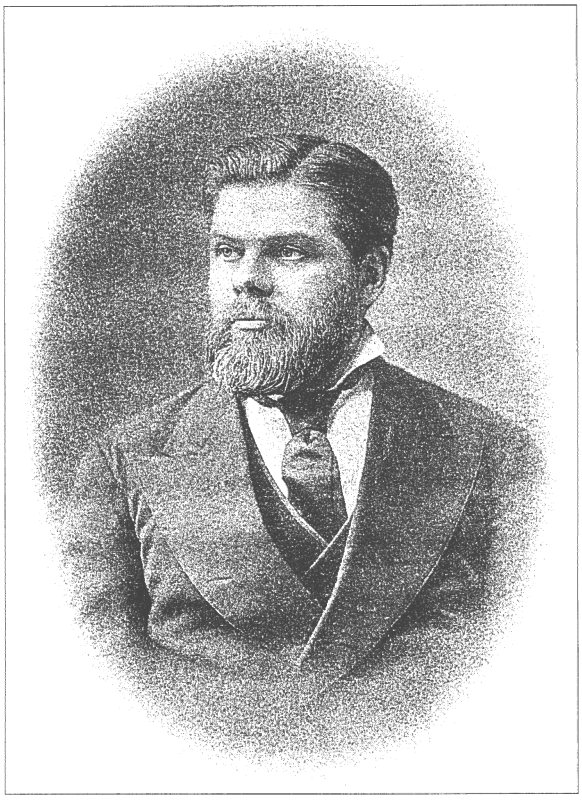


Fig. 5 Portrait of Leon Warnerke from the Supplement to the *British Journal of Photography*, 18 January 1884.

The mystery of Warnerke's origin is further compounded by examination of the letters. These consist of actual letters, draft letters and copies of letters made by Warnerke, his wife Marie and other hands. They date from the 1860s to the late 1890s and are directed to and have been received from several different people. They are in English, French, Polish, Russian and sometimes a mixture of these languages.

Among a whole series of letters relating to a court case, one in particular to Marie, Warnerke's wife, is of special interest. It is from Nicolai Pogolski, a one-time friend and co-conspirator with Warnerke who sometimes stayed with him at Champion Hill.[34] By 1897 Pogolski and Warnerke were no longer friends; the court case was an acrimonious affair, involving blackmail. One of Pogolski's letters shed much light on various groups of documents, relating to a certain Wladislaw Malachowski, that had previously been difficult to interpret. He writes to Marie Warnerke in Polish, accusing Warnerke of having several aliases:

9th November 1897

Most respected Lady

Enough of this!! This comedy makes us a laughing stock, diminishes us in the eyes of foreigners. I will bring this comedy to an end. At this moment I am busy preparing three documents, one for the Judge, one for the lawyer and the third will be lying on my desk. In each one I mention everybody, beginning with Wladyslaw Malachowski, alias Fr. Schultz from Tor. Av.; alias Fr. Wolf from Springfield Ter, alias Warnerke of Silverhowe etc one after the other.

One of these aliases, Wladyslaw Malachowski, was already familiar to me from reading some of the earlier letters, a series in Polish dating from the late 1860s to the early 1870s from a Josef Horodice to Wladyslaw Malachowski. Some in this series contain references to the organization of the network that Warnerke and others were involved with. These cryptic references mention codes, invisible inks and a range of complex communication procedures to be followed by the conspirators. There are many other Malachowski family documents, including the Last Will and Testament of Julian Simon Malachowski, Wladyslaw's father, dated 26 April 1865. There are repeated references in Warnerke's own letters to obtaining his father's family papers, including land grants and the details of various properties in Poland. But the political situation, the Russianization of that part of Poland where the family estates lay (now Belarus) and the uprisings by the Poles against the Russian occupation made it very difficult for Warnerke/Malachowski to claim his inheritance. Wladyslaw, like Joseph Plener mentioned earlier, had to flee into exile, but, unlike his friend, he felt he should make a new identity for himself, an identity which might then have been compromised by claiming his inheritance.

The problems of communication between the conspirators were immense. Among the mass of documentation in this collection there are groups of letters which relate to each other specifically. Some of these pieces provide extraordinary insight into the risks to which some of those involved in this scheme were exposed. One such group, for instance, consisting of drafts for coded letters, invisible-ink letters and a press clipping, all refer to the arrest of a certain Josephine Dobrovolska on the Polish-Russian border.[35] The press clipping, two copies of which were tucked into a notebook perhaps sent to Warnerke by colleagues on the continent, is from an undated, unnamed French-language newspaper. The notebook contains many such cuttings in English, French, Polish and Russian, all referring to the forging of banknotes and covering quite a long period of time. The Polish and Russian articles were primarily concerned with warning the public of the specific details of various forged notes, while the French and English are more general, talking in terms of the threat to economic stability posed by such anarchistic projects.[36]

One letter, written in invisible ink under a perfectly innocuous covering letter and then treated by the recipient to make it legible, is essentially an appeal for funds, with the writer asking for money to be sent to him so he can stay free.[37] The use of invisible ink seems to have been common, at least in the early stages of this giant conspiracy. There are other examples in different hands, and also examples where letters have been tested to see if such invisible messages are present. Another letter in particular actually talks of preparing the paper, and is perhaps worth quoting in full for the light it sheds on the organization:

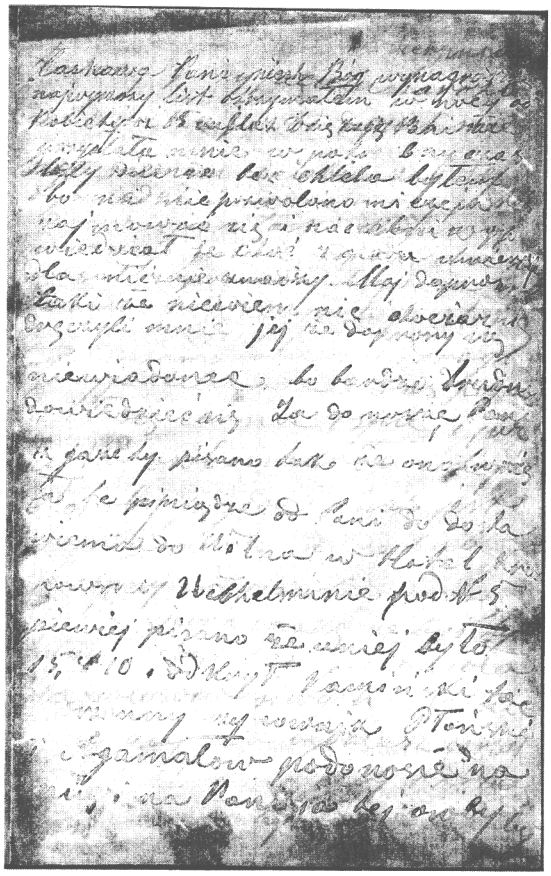


Fig. 6 Letter written in invisible ink describing the arrest of Josephine Dobrovolska. Two sets of writing are visible. The fainter lines are the letter that was written on top of the hidden message. After the letter was chemically treated, the true message appears darker and the ordinary words fade away. (Ultraviolet-light photograph taken by Marcus Leith.)

2nd September

My dear Sir

Although we still haven't received any letters from Max[38] — Don't forget that he has left here under the impression that our position is possibly dangerous. It would be best to re-assure him. And as Jos.[39] is aware that we will use the new ink it is necessary that you prepare the paper. It seems to me that the best means of despatch would be by [indecipherable] Send him the address today in invisible ink and coded. He will address the letter to himself. [crossed out: Ask Madame to write a smokescreen of a letter in French.] When you have the paper ready send it to us with the smokescreen of what you want to say. Don't forget to write to us.

H. ...[40]

Resolving all the riddles posed by these letters, where every discovery poses new questions, will be a pains-

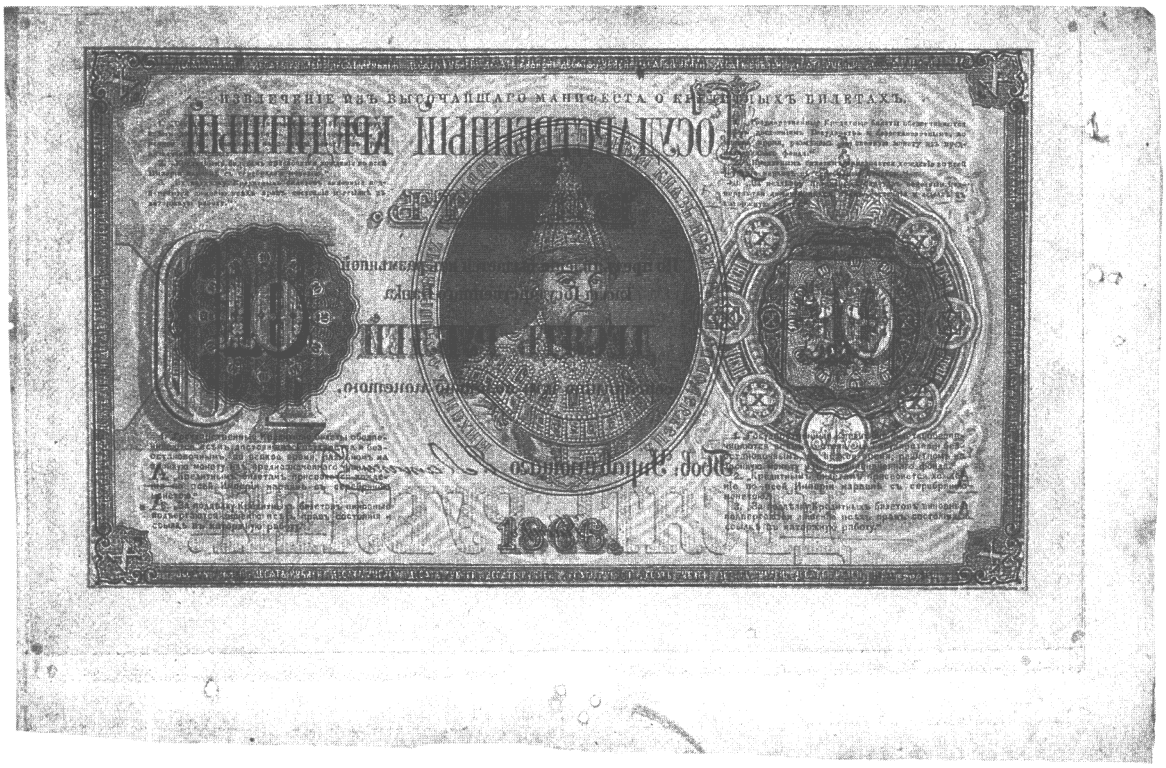


Fig. 7 Lined and patterned 10-rouble watermark and *J WHATMAN* watermark found in the same untrimmed sheet used for the 1866 10-rouble note. Letter fragments of the *J WHATMAN* watermark are just visible along the bottom edge. (Transmitted-light image by Marcus Leith.)

taking task, but with careful translation and analysis they should reveal more of the extraordinarily complex lives of those involved.

Perhaps the most fascinating part of the collection are the banknotes, and the most intriguing are the counterfeits of the 1866 10-rouble issue. Many of these were printed on English-made paper watermarked *J WHATMAN*, but they also contain the normal lined and patterned 10-rouble mark. Close examination of the two marks shows that the *J WHATMAN* mark is on the wire side of the sheet, as one would expect in a handmade sheet. The style and scale of the letterforms visible suggest that this Whatman sheet was made by W & R Balston at Springfield Mill, Kent. Balstons were supplying Russia with some handmade writing papers in the nineteenth century, but never banknote paper. The real curiosity lies in the relationship between the two watermarks. The Russian mark is on the opposite (felt) side. No papermaking process, then or now, allows watermarking from two sides of the sheet (fig. 7).

There is, however, an explanation for this apparent conundrum. A friend and colleague of Warnerke, who sat on various Royal Photographic Society committees with him and lived nearby in Camberwell, was Walter Woodbury,[41] inventor of the Woodburytype method of reproducing photographs. Woodbury also developed a further refinement of his technique which he called *photo-filigrane*. Woodbury's technique used a relief of hardened gelatin in which the lights and shades of any photograph were reproduced by varying the thickness of the gelatin. When such a gelatin film was placed in contact with a sheet of already made paper and the two were subjected to very heavy pressure, the paper was more impressed where the gelatin was thicker, and less impressed where it was thinner, thus producing a picture, on first impression, exactly like a watermark.[42] It is possible that Warnerke, who well understood the properties of gelatin and paper as well as the techniques of photography, adapted or utilized his own version of Woodbury's technique for the watermarks in some of the earlier forgeries, although he was later to make true watermarks on moulds.

The photo-filigrane process was not used much in Britain. The paper historian and collector Clayton Beadle felt that 'beautiful effects were obtained by Woodbury's process and that it no doubt ought to be capable of useful and artistic treatment,'[43] but that the problem of water affecting the image was against it. Sir Henry Trueman Wood did not consider that 'Woodbury's invention had any practical application, and doubted whether it was ever of any great value ... despite the extreme ingenuity which was exercised.'[44] When Woodbury's invention was first brought out, many bankers and others who depended on watermarking as a security device were very concerned about the possible use of this technique by forgers. Unfortunately, Woodbury's technique suffered from one fault; when the marked paper was moistened the image disappeared. It does appear, however, that the longer the period of time since the image was first impressed onto the paper, the more stable it becomes. Some of the French Woodburytype photo-filgranes made by Rives in the 1870s and 1880s are now very stable.

Woodbury's invention was in fact exploited more on the Continent and in the U.S.A. It was used commercially

under licence by both the Arches and Rives paper mills in France.[45] Indeed, the whole process was further refined by continental papermakers — 'many of the best German, Austrian and Italian notepapers of the qualities most in demand are so marked'[46] — and adopted with great success in the first years of the twentieth century by N.S. Amstutz of Chicago,[47] the Southworth Paper Company at their Mittineague Mill in Massachusetts and the New York paper merchant Charles D. Jacobs.[48]

Warnerke's methods changed constantly throughout his working life, and the curious blend of amateurish but inspired improvisation and complex technological sophistication becomes more and more marked as one examines the various trials, proofs, essays and finished products made, particularly towards the end of his working life. Warnerke's use of a version of Woodbury's photo-filigrane process, probably while Woodbury himself was developing it from his Woodburytype photographic engraving process, is a measure of his familiarity with the most up-to-date methods and techniques, and a measure of his imaginative use of anything that might further his purpose, whatever the source.

Another of his special areas of knowledge, and essential to anyone wishing to forge the banknotes of the period, was the use and preparation of the gelatin used for sizing the sheets of paper. In a report on a lecture given by Thomas Bolas as part of the Bolt Court series,[49] we find the chairman of the meeting asking Warnerke to round the meeting off by describing a method of purifying gelatin that Warnerke had recently tested:

> Mr. Warnerke said that the method in question consisted of making a solution of gelatine or glue in hot water, to which was added alum in excess, which would cause the gelatine to precipitate. In this state it could be thoroughly washed in hot water, after which it was strained out and a little citric acid added. This rendered the gelatine again soluble. The next step was to allow the gelatine to set, and to wash it in cold water to remove the excess of citric acid. The final result would be a gelatine of very considerable purity.[50]

Warnerke was a frequent visitor to such meetings throughout his life and, as an article about him states,

> Mr Warnerke is of the most sociable and genial disposition, and ever ready to assist by his advice or otherwise, in any matters photographic; and few of the regular frequenters of the meetings of the metropolitan photographic societies, or of those who have enjoyed his hospitality, but have cause to be grateful for his kind assistance in some photographic difficulty.[51]

One area where the blend of amateur ingenuity and sophisticated professional techniques can clearly be seen is in the construction and employment of the mould and watermark for the 1890s 100-rouble note. The watermark has been traced directly from a genuine note onto celluloid film using pen and ink. Warnerke was well aware, however, that all paper shrinks as it dries, and when he constructed the watermark on the mould surface he had to take this shrinkage into account. The notebook found among his papers shows several examples of such calculations. Comparisons of the handwriting identified as Warnerke's in some of the letters with the writing in this notebook shows that these calculations were all made by Warnerke. They were crucial to the success of counterfeiting this particular issue, as the printed image on the recto of the note had to align precisely with various parts of the watermark (fig. 8).

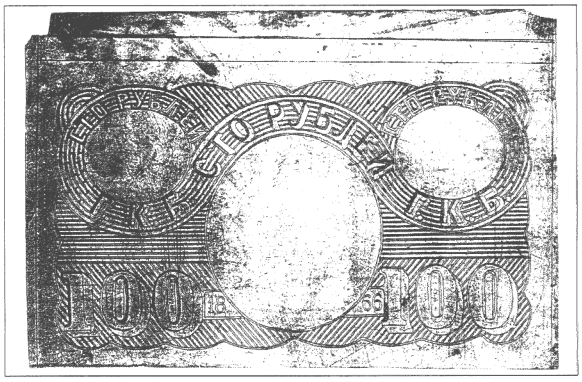


Fig. 8 Pen-and-ink tracing of the 100-rouble watermark onto transparent celluloid film.

The actual method of watermark construction is of great interest. Rather than using bent and soldered wire, which would normally be used, he employed what appears to be an enamel paint, building it up in layers and then carving it down to the correct shape. This would have been an extraordinarily laborious process, but it had the advantage of allowing very fine adjustments to the actual form of the watermark by the addition or subtraction of minute amounts of the enamel (see fig. 3, page 217).

In complete contrast to this process is the watermark used for the 1866 50-rouble note, which on close examination of the sheet shows every indication of having been produced by wires and by raising and lowering the three oval or circular areas of the wire. Unfortunately the mould for this note has not survived. This use of different levels of wire can also be seen on the forming surface of the 100-rouble mould.

The very high quality of this particular note and the 10- and 25-rouble notes from the same period suggests that at least during some periods in his career as a banknote forger Warnerke had access to some highly experienced papermakers, as well as to the necessary equipment and raw materials — if not to genuine material as well. Joseph Eder's account of Warnerke's time in St. Petersburg suggests just such a possible connection during the early 1880s, through the Imperial Russian Office of Government Papers.[52] According to Eder, Leon Warnerke was born in 1837 in Russia. He was a civil engineer, but devoted himself entirely to photography. He spent his youth in St. Petersburg and came to London in 1870. He then started a private photo-chemical laboratory, inventing the roll holder with silver-bromide collodion stripping paper. Warnerke received a prize from

Belgium in 1877 for his work with silver-bromide collodion and, in 1881, the Progress Medal of the Royal Photographic Society of Great Britain. He gave lectures before the photographic societies of England, France, Belgium and Germany. In 1880 he founded a photographic firm and a technical journal in St. Petersburg. He was also financially interested in the manufacture of dry plates in Russia. The first Russian gelatin dry-plate factory was erected by A. Felisch in 1881. Then Warnerke, with Stresnowsky, established a gelatin silver-bromide plate factory in St. Petersburg to which he later added the manufacture of gelatin silver-chloride papers.

The tempestuous political conditions during this period of the Czarist monarchy and the large amount of propaganda material, printed mainly in underground printing shops, led to the most rigorous supervision of all printing presses by the government. This was a great hindrance to the spread of new reproduction techniques:

> Official photography was advanced especially by the Imperial Russian Technical Society at St. Petersburg, which consisted of several sections, each of which dealt with one of the different technical fields as its subject proper. Urged by Warnerke, the fifth group of the Society, "The Photographic Section" was established in 1880. It became the important center of the photographic industry and of the various branches of industrial, artistic and scientific photography. From here were published the reports of the "Office for the Production of Government Papers," St. Petersburg, and of the cartographic section of the General Staff, which had in its service studios and efficient reproduction technicians.[53]

The Imperial Russian Office for the Production of Government Papers was responsible for the production of bonds, rouble notes, stock certificates and valuable printed matter of all sorts. This appears to be Warnerke's connection with the official production of Russian banknotes, but further work needs to be done to resolve this association.

The painstaking accuracy Warnerke strove for is well illustrated by the large numbers of photographic negatives and positive prints also found in this collection. Many of these bear the marks of additional alterations and the working out of specific details by hand. He also spent considerable time and effort to achieve the correct balance of inks for the 100-rouble rainbow note, listing in more than one place in his notebook the specific colours necessary. The annotation of these colour trial sheets in English, with the names of London Artists' colourmen, suggests that at least the trials and proofing were being done in England. The colours on the sheet illustrated bear such maker's names as J Winston Bronze 1893, Millar Blue, and Stanbury 1893, but most of the colours are simply labelled with their names. Some evidence in several of the letters suggests that work was also being done in France and Poland, but the heart of the conspiracy was here in England in a large and comfortable private house on a quiet and secluded road in Camberwell, where a very civilized and popular gentleman, well respected by his friends and neighbours, lived an extraordinary double life.

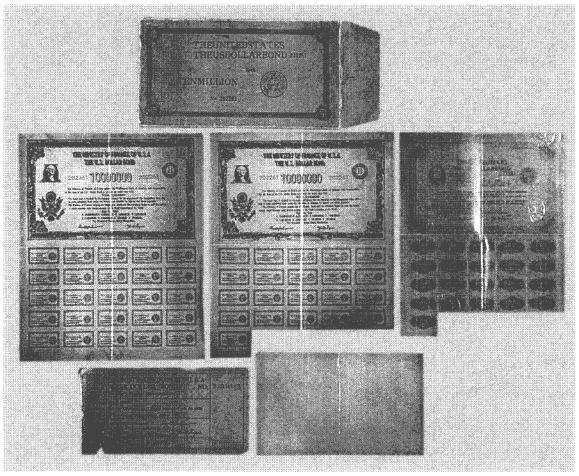


Fig. 9 A complete set of one of the bonds (evidence number DA9/3), including envelope and receipt.

The 1.2 billion dollars worth of U.S. treasury bonds — that weren't

Some cases start quietly and develop a momentum and complexity that can become very demanding. One such case began with a quiet phone call from a London solicitor who was enquiring if I would be able to look at some financial documents. It was only an enquiry, much the same as many I get; the solicitor was not sure if I would be needed, but just in case I was, he wanted to know if I would be willing. Some three months later, after I had heard nothing in the intervening period, there was another phone call asking if I would be available the following day to have a preliminary look at the material and suggest what lines of investigation might be followed. I went to their offices the following day to find a pile of evidence bags and a selection of the exhibits. What I was looking at was part of a haul of about 1.2 billion dollars in U.S. bonds, which constituted some of the material seized by police after they had arrested a man for attempting to use some German bonds as security for a loan at a bank in the city of London (fig. 9).[54]

What struck me immediately was how awful they were. Having seen hundreds of examples of such bonds from different countries and different periods, I could not imagine that anyone in their right mind could possibly think them genuine. At this preliminary examination the bonds were examined under reflected light, raking and transmitted light, ultraviolet light and 30-times magnification. Given the absence of any comparative material, it was initially difficult to interpret the physical details of the documents, but my necessarily brief examination revealed a complex series of anomalies and also showed several possible avenues for further examination and research, regarding both the materials and techniques used and relevant historical background.

The documents appeared to have been produced using a range of different papers, many of them laminated two- and four-ply sheets made up using both coated and

uncoated papers. The presence of coated papers as the base for security documents gave real pause for thought, since such papers are rarely used for security printing because of a very important drawback — they are very easily damaged if they get wet. They stick to each other and once they have dried out are next to impossible to get apart without destroying the printing on the surface of the paper. Another immediately apparent anomaly was that there were no true watermarks of any sort present in any of the documents I examined. Several of the pieces, however, contained a relatively unusual security device, the internal printing of both text and images within the laminated sheets. This is visible when the sheet is held up to the light. While it is unusual in Western security printing or papermaking, it can be seen in Asia, particularly in the various issues of Tibetan banknotes produced between 1912 and 1959.[55]

The third major anomaly was the method of printing. These bonds were all printed using both lithography and hand-set letterpress rather than intaglio or a combination of lithography and intaglio, which are processes one would expect in such valuable documents. Security printing of bonds and banknotes is a very specialized business involving some of the finest papermaking and printing skills. However, most of the printing seen in these examples is of a very low quality, especially in the use of inks that were totally inappropriate for the paper stocks used. The problems the printers had were easily visible under 30-times magnification: the spread of the ink impression and, in many cases, the partial break-up of the ink.

The point was made at this first meeting that sometimes deliberate errors are introduced into the text or images in the security printing of bonds, banknotes and other financial instruments but, and this must be stressed, this does not mean that such documents would be badly made. The errors in these documents seem much more typical of mistakes rather than deliberate errors. Deliberate errors in security printing are usually much more subtle than what appears in these bonds. Some of these mistakes are laughable. It is very hard to believe, for example, that absolutely essential information identifying the integrity of the bonds would be misspelled, as in 'MINITRY OF FIANCE' (MINISTRY OF FINANCE) — hardly a deliberate error, particularly since the United States has never had a ministry of finance. They have a Treasury Department headed by a secretary rather than a minister. It is equally unlikely that the name of the President of the U.S.A., Franklin Delano Roosevelt, would be spelt 'Fianlinn Delaoo Doosevelt.' The design and layout of the blocks of hand-set type text, and indeed some of the errors, are very reminiscent of small local print shops in the Far East, where the typesetter is working in both a language and an alphabet that are unfamiliar to them.

If these items had genuinely been produced in the 1940s for the U.S. government, as the defendant in this case truly believed, then they would have been produced by one of the security printers that specialized in such work. If they had been produced in China under U.S. supervision, then one of the companies from different countries involved in the production of bonds and banknotes for China during the 1930s and 1940s would have received the job. All the printers involved in this lucrative trade produced work of very high quality; if they had produced the shoddy workmanship seen in these bonds they would have lost their contracts.[56]

The defendant, who had worked for over 25 years for the C.I.A. (once he had been fired, they dismissed him as a 'cowboy'[57]), was absolutely convinced that these bonds had been produced as part of a covert operation without Congressional authorization, as a means of funding Chiang Kai-shek's Nationalists and allied warlords in their fight with Mao Tse-tung's Communists. There is absolutely no doubt that the American government did issue such bonds, but as we will see from the analysis of the documents themselves that what the defendant held were not the actual bonds, but later Chinese forgeries.

If these bonds had indeed been issued by the U.S. War Department, the U.S. Treasury or their agents as part of some covert operation, the obvious place to verify it would have been in the records kept by Henry Morgenthau, secretary of the treasury at the time, because Morgenthau 'seems to have kept nearly every document and summaries of all the rest: meetings, proposals, letters. He also kept stenographic transcripts of his more important phone calls.'[58] Morgenthau's papers were supposed to have been housed in the Roosevelt Library, Hyde Park, New York, but when we asked to see them we were informed that all his papers had been burnt in an accidental fire.

Although the U.S. certainly did produce such financial instruments as part of various covert funding operations during the course of the war, it was becoming clearer that these documents were not the bonds that had been produced in the late 1930s and 1940s.[59] Complex connections existed between Chiang Kai-shek and his various allies, Madame Chiang and General Clairemont, and such covert operations, via the AVG (Flying Tigers), USAAF and the later China Air Transport. The Flying Tigers were initially freelance American pilots flying for Chiang Kai-shek's Kuomintang (the Nationalists) but were later incorporated into a more formal arrangement with the U.S. authorities. They fought the Japanese air force for Chiang and flew guns, money and medical supplies into south-western China over 'the Hump,' the mountainous region between Burma and the Nationalist enclaves in China.

Given the gross inaccuracies, bad workmanship and inappropriate materials seen in these items, where practically everything about them that would normally give credence to the issue is actually wrong, it is unlikely the bonds would have been acceptable to the Chinese. Many of the high-ranking Chinese Nationalists spoke English; many had been educated in the U.S.A. (Madame Chiang was educated at Wellesley and was very familiar with the U.S.) and would never have been taken in by the crude and somewhat naive work seen here.

Because of the sheer amount of paper that had to be examined (under a very tight schedule because the case was about to come to court) and the need to provide corroborative analysis, several different people became

involved in these investigations. Some of this research was carried out by Nick Pearson and Bob Abbott of PIRA (Paper Industry Research Association), using scanning electron microscopy, energy dispersive x-ray and both macroscopic and microscopic analysis.

To summarize our various findings, it was discovered that several of the bonds contained bamboo fibres, indicating a Far Eastern origin for these papers rather than American. Several also contained eucalyptus, a tree species not widely used for paper manufacture until the late 1950s and not really used in European or American papermaking until the early 1970s. Many of these sheets are two- or, in some cases, four-ply laminates and several of the different papers fluoresced brightly under ultraviolet light, indicating the presence of optical brighteners.[60] Scanning electron microscopy showed that most of the coatings were clay-based, with two barium-rich examples, and that magnesium silicate was in four of the coated paper samples. This is an extremely unusual additive for paper coatings, being more commonly used in the paint industry, and the PIRA database contains no record of its having been used in the paper industry.[61] Examples of the furnishes found in different bonds showed the following fibre composition (percent by weight; +/-5%):[62]

Sample 1	89% hardwood chemical (gum, eucalyptus, aspen)
	11% bleached softwood chemical
	trace of bamboo
Sample 2	72% hardwood chemical (gum, eucalyptus, aspen)
	22% bleached softwood chemical
	6% hardwood semi-chemical (aspen)
Samples 3, 4, 5	100% cotton
Sample 6	79% hardwood chemical (gum, eucalyptus)
	17% bleached softwood chemical (pine)
	4% hardwood semi-chemical (aspen)
Sample 7	100% bamboo
Samples 8, 9	100% bamboo
	trace of hardwood chemical (birch)
Sample 10	71% straw
	29% bleached softwood chemical (spruce)
Sample 11	67% straw
	33% bleached softwood chemical (spruce)
Sample 12	66% hardwood chemical (gum, eucalyptus, maple)
	24% bleached softwood chemical (pine)
	10% hardwood semi-chemical (aspen)

Among the furnishes found in sheets making up the laminated papers (they had a four-ply composition consisting of two thin outer layers and two inner layers, one of which had been printed on) were the following:

Sample 13 (Printed Middle)	69% hardwood chemical (gum, eucalyptus)
	21% bleached softwood chemical (pine, Douglas fir)
	8% hardwood semi-chemical (aspen)
	2% softwood thermomechanical

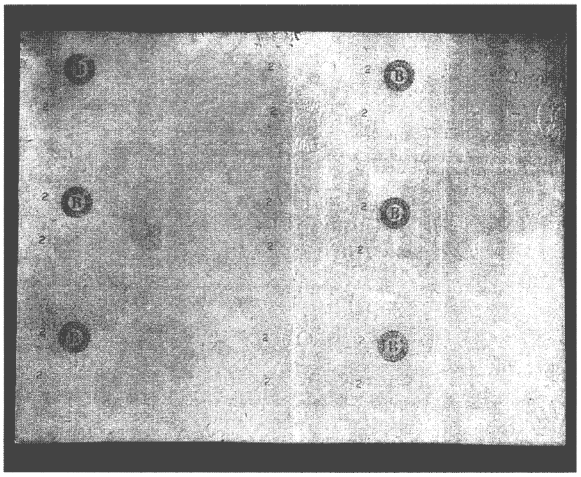


Fig. 10 Verso of bond (evidence number DA9/32) printed on an uncut sheet of counterfeit U.S. dollars. The Federal Reserve Bank letter B is clearly visible.

Sample 14 (Outer Layers)	63% hardwood chemical (gum, eucalyptus)
	25% bleached softwood chemical (spruce, Douglas fir)
	13% hardwood semi-chemical (aspen)
Sample 15 (Middle Layer)	79% hardwood chemical (gum, eucalyptus)
	21% bleached softwood chemical (spruce, Douglas fir)

Some 90 other sets of bonds similar to these have surfaced in different countries in the past five years, which suggests they were recently made. The printed middle layer in sample 13 gave the best indication of when these bonds were produced. It had been printed on uncut sheets of counterfeit 1976 two-dollar Federal Reserve notes. Other bonds, with the same design and printed at the same time, had been made using similar uncut sheets of counterfeit 1993 one-dollar Federal Reserve notes (fig. 10). This provides us with a production date of late 1993 at the earliest.

Examination of just one of the bonds will give a real sense of how bizarre these objects are. The DA 9/3 bond set consists of six elements, two of which are the same and all of which show either serious anomalies, inappropriate use of materials, design faults or other curious features. While errors and anomalies may be deliberately used as security devices, the scale and quantity of errors in these bonds make this very unlikely. It is, for example, unlikely that the issuing authority would be given a fictitious name; this would surely render the instrument invalid. By the purported date, the inclusion of apparent errors as security devices in such documents would be subtle, such as minor shifts in the alignment of letters and patterns, minute changes across printed patterning or the marking of individual letters. A good example, the MINISTRY OF FINANCE OF USA $10,000,000 Bond, consists of two copies of a similar bond, one with four coupons clipped. Among the many errors and anomalies are the following:

- The portrait of George Washington is a dot-screened copy of the engraved portrait found on U.S. one-dollar bills.

- The circled *B* stamp, surrounded by the words *FEDERAL RESERVE BANK OF NEW YORK NEW YORK*, was copied from a U.S. currency bill.
- The version of the American Great Seal, with the date 1786 on the shield borne by the eagle, is not found in this form anywhere else.
- The same erroneous post-1966 design for the U.S. Treasury seal, with the 1786 date, is used on each of the coupons.[63]
- The text on this bond contains several factual errors as previously described, and some extraordinary usage of English — commonly seen in work produced by those for whom English is little understood. Much of the text is, quite frankly, gibberish.

Many of the specific errors and anomalies found with DA9/3 are repeated in the other bonds.

Provenance is crucial in cases such as this, and the supposed provenance for this cache of bonds was that they had been inherited by the descendants of one of Chiang Kai-shek's less successful generals, Tang Engbo (or Engpo).[64] Tang Engbo's name appears as the purchaser — which is one of the few historical accuracies on these bonds. He was a very big player in the complex world that was China in the late 1930s and 1940s. One of the foremost historians of the Chinese Kuomintang regime, Professor Lloyd Eastman, described Tang Engbo as a Chiang Kai-shek loyalist corrupted by the opportunities for trade and money-making. He notes:

> After six years of desultory warfare, Chinese officers at virtually all levels of command were engaged in the traffic [of money and goods]. Tang Engpo, a favourite of Chiang Kai-shek and deputy commander of the First War Zone in Honan-Anhui was reprimanded by General Tai Li (who also was heavily involved in creating as much wealth for himself as possible) for devoting too much attention to commerce and neglecting his military responsibilities.[65]

While Tang was obviously a five-star candidate to receive such covert financial aid from the U.S. and may well have been the beneficiary of their largesse, none of the defendants had the good fortune to be descendants of his. The principle defendant was sentenced to six months in jail, having already served seven months on remand. The other five defendants were all acquitted.

Acknowledgements

All research depends on collaboration and many people have assisted me in the unravelling of all three of these cases. I would like to thank Bob Abbott, Dave Carter, Walter Eccard, Steven Fairbairn, Jack Gilbey, Mike Grey, Patricia Hare, Peter Isaac, Peter Johnson, Richard Kindersley, Marcus Leith, Charles Moore, Colin Narbeth, Michael O'Grady, Lorelei Pagano, Nick Pearson, Geoffrey Roe, Kate Rouse, Nicola Smith, Frank Summa, Rod Tidnam, Pekka Viljannen and Andrew Wilton. I must also thank the staff at Swiss Cottage Library, the Newspaper Library in Cricklewood, the British Library, the British Museum, the Public Record Office, the Probate Office and the Bar Library at the High Court. I would particularly like to thank Sally Bower, Elizabeth Einberg and Kasia Szeleynski for their help with translating and interpreting the Warnerke documents and letters. There were also several people whose help was crucial but who prefer to remain anonymous.

Notes

1. Hebborn, E. 1991. *Drawn to Trouble: The Forging of an artist*. Edinburgh: Mainstream, and Hebborn, E. 1997. *The Art Forger's Handbook*. Woodstock, New York: Overlook Press. Hebborn's autobiography is as full of deceit as his work and his handbook, while exhibiting a sure technical understanding of materials and techniques, also contains so much rubbish that it must have been intentional. If you followed some of Hebborn's recipes and techniques you would not fool anybody; he has left out important parts of some processes and added unnecessary complications to others.
2. Although superficially clever, practically every work in the exhibition *Eric Hebborn: The Difficulties of Attribution* at the Archaus Gallery, London, in 1994 contained glaring errors of both handling and materials.
3. Drewe was sentenced to six years' imprisonment at Southwark Crown Court in February 1999.
4. For legal reasons the names of various individuals are not given in this paper. While this protects the innocent, it has the added consequence, in the case of one individual, of protecting the guilty.
5. Kennedy North, S. 1936. *Report on the treatment of watercolour drawings by John Sell Cotman and John Crome in the Colman Collection, Norwich, carried out between September 1934 and August 1936*. Privately printed. 9–12 (also individual entries relating to particular works).
6. Research that is continuing seems to show that many of them were made by George Steart of De Montalt Mill, Bath, Somerset, whose blue, grey and buff watercolour papers were used extensively by J.M.W. Turner (1775–1851).
7. Full details of this information can be found in Bower, P. 1991. *An Examination of the paper used for various watercolour drawings attributed to John Sell Cotman (1782–1842)*. Bower Report No. 14 91 4.
8. See Bower, P. 1996. The evolution and development of 'drawing papers' and the effect of this development on watercolour artists, 1750–1850. In *The Oxford Papers, Studies in British Paper History* I. 73–74 for a discussion of Cotman's paper usage.
9. The earliest reference I can find to drawing papers being sold in the elephant size is a trade catalogue for Reeves and Son from 1856, Winsor & Newton Archives, London.
10. For example, *St. Luke's Chapel, Norwich Cathedral*, 1808 (Norwich Castle Museum), *Duncombe Park*, 1805 (British Museum) and *Devil's Elbow, Rokeby Park*, 1806–7 (Norwich Castle Museum).
11. Casings were originally developed as lining papers for packing cases, but their strength and large size led to their being used for all sorts of ordinary wrapping uses, as well as cartridge cases.

12. This research turned up a surprisingly large number of British central-position watermarks. The information is currently being prepared for publication.
13. *Kent's Paper Mills Directory*. Various years from 1862 to 1907.
14. *Excise General Letter*, 23 February 1846.
15. See Craig's *Directory of Papermakers*. 1876, 1885 and 1894, and *Kent's Paper Mills Directory*. 1862–1907.
16. Holcomb. A.M. 1980. *John Sell Cotman in the Cholmeley Archive*. North Yorkshire County Record Office.
17. Holcomb. 24. A letter from Teresa Cholmeley at Brandsby to Francis Cholmely at Rokeby, 2 August 1805.
18. Holcomb. 25. A letter from Teresa Cholmeley at Brandsby to Francis Cholmely at Rokeby, 3 August 1805.
19. Double-faced laid moulds first appear in English white papers *circa* 1810, but not in large numbers until after the appearance of Didot's patent regarding double-faced moulds in 1812. At first they were more expensive than single-faced moulds and few wrapping papermakers would have bothered with the extra cost, particularly when the subtle quality differences in surface density for which these moulds had been invented (for fine printings and writings) were unnecessary for wrapping papers.
20. Both these stories are the subjects of individual books currently in preparation.
21. Quoted in Kranister, W. 1989. *The Moneymakers*. Cambridge: Black Bear Publishing. 296.
22. For more on this subject see Bower, P. 1995. Economic warfare: Banknote forgery as a deliberate weapon. In *The Banker's Art: Studies in Paper Money*, ed. Virginia Hewitt. London: British Museum. 46–63.
23. In fact much important material survived, primarily because of the efforts of Armand Gaston Camus, Guardian of the Archives of the Republic. This material consists of drawings, proofs, preparatory designs, documentation, notes, stereotypes, papermaking moulds and more. Besides material held in private collections, the most important material can be found in three collections: the Conservatoire national des arts et métiers (CNAM) in the Musée national des technologies, the Archives nationales held in the Musée de l'histoire de France and the Hotel de la monnaie de Paris. Some of this material is illustrated and discussed in Alain Mercier's *L'Argent des révolutionnaires*, Paris, 1989. Camus himself documented some of the details of assignat production in his *Histoire et procédés du polytypage et du stéréotypage*, published in Paris in 1802.
24. As late as 1852 Napoleon's grandson, Emperor Napoleon III, was paying a pension to Mlle de Montant, the daughter of the engraver involved in this particular project, to ensure her silence about his predecessor's activities.
25. Offered at auction at Phillips, London, 4 October 1991, lot 277. It is now in a private collection. The description was written up for Phillips in Bower Report No. 29 91 15. Further information written up for the present owner is in Bower Report No. 47 92 11.
26. Eder, J.M. 1945. *History of Photography*, trans. Edward Epstean. New York: Columbia University Press. 452. There is, however, some doubt as to whether he actually died in Geneva as Eder states. Further work needs to be done to resolve this question.
27. There is evidence that the forgery of both French and British banknotes was also part of this widespread conspiracy, but in this paper I will concentrate on the Russian material.
28. B. Jones in *Cyclopaedia of Photography* (page 559), *The British Journal of Photography*, 18 January 1884 (page 39) and *The British Journal Photographic Almanac* (page 672) all list Warnerke as being of Hungarian origin. This is not inconsistent with Warnerke's description of himself, since Moravia was then part of the Austro-Hungarian Empire.
29. Public Record Office. 1881 Census Records. RG11/674.
30. Public Record Office. 1891 Census Records. RG12/466.
31. For example, Warnerke's wife Marie, who was 45 in 1881, is 52 in 1891 (ten years later), while Sophie lost two years going from 12 years of age in 1881 to 20 in 1891. Marie had originally given her place of birth as Belgium and Sophie's as France; by 1891 they were both registered as having been born in Austria.
32. Eder. 1945. 451.
33. Eder. 1945. 782, note 2.
34. The 1891 census places a Nicolas Pogolsky as a 'visitor' in the house on the census date. The census describes him as 'living on own means' and as having been born in 'Russia S Petersburg.'
35. Josephine Dobrovolska was a survivor of the Paris Commune.
36. For example, a French-language clipping dated 20 April 1897, subtitled '*une nouvelle maneouvre anarchiste*,' describing a massive plot to undermine the economies of France, Belgium, Germany and Russia.
37. This letter is part of a group of letters, all unsigned and undated and all written in invisible ink by the same hand. They all appear to come from the same period, are all written on the same paper, and all have been given the same chemical preparation and later treatment.
38. Max (or Maj) is frequently mentioned in several letters. He appears to have been travelling in Europe under an assumed name.
39. Possibly Joseph Horodice.
40. The signature, which is very difficult to decipher, is possibly Herve.
41. Walter Woodbury (1834–85) was a well travelled and inventive man. During his younger years he lived in both Australia and Java before returning to his birthplace, England, in 1863. Between 1866 and his death 19 years later he took out over 20 patents for photomechanical printing processes and for photographic and allied apparatus. He died suddenly at Margate in 1885 from the effects of an overdose of laudanum. Examples of his work can be seen in Bower, P. 1994. Walter Woodbury and the photo-filigrane process. *The Quarterly, Journal of the British Association of Paper Historians* 12 (September): 10–12.
42. Richard Brown of Brown, Barnes & Bell, working independently of Woodbury, also devised and patented a similar photo-filigrane process, but ran into a little trouble with the police when he tried to persuade the Bank of England to buy up and suppress his method on the grounds that it would facilitate forgery.
43. Anon. 1906. *The Process Engraver's Monthly* 13. 138.
44. Anon. 1906.
45. Bower Collection. 390–94.

46. Arnot, J. Melrose. n.d. *Journal of the Society of Arts 1852–1908*. London: Society of the Arts.
47. *The Inland Printer*. n.d.
48. Bower Collection. 921–23. It should also be noted that several mills and merchants in Europe and the U.S.A. still offer updated and adapted versions of this process for small runs of business stationery.
49. Thomas Bolas gave the fourth Bolt Court Lecture, *Gelatine as the leading colloid for process work — Compounds of chromium*. The Bolt Court School later became part of the London College of Printing, now the London Institute.
50. anon. 1898. *The Process Photogram & Illustrator* 54 (June): 87–89.
51. anon. 1884. *The British Journal of Photography* 18 (January): 39.
52. Eder. 1945. 451–52, 708–10.
53. Eder. 1945.
54. A small representative sample of the bonds and related material under consideration was examined on the 15 November 1996. This sample consisted of the following items: DA 9/3, DA 9/11, DA 9/23, DA 9/24, DA 9/36, DA 9/27, DA 9/30 and DA 9/36. See *Preliminary examination of pre-World War II US bonds*. Bower Report No. 253 96 43. The German bonds were actually genuine and the German government was quite happy to pay out on them, so the charges relating to them were dropped, but the defendant still had to face the charges relating to these U.S. bonds.
55. See Bower, P. Splitting Tibetan banknotes. To be published in *The London Papers, Studies in British Paper History* 3. Currently in preparation.
56. There were several security printers involved in the China market during the 1930s and 1940s, when so many banks and warlords were issuing their own currency that it was literally a time to 'print your own money.' The main producers outside China were the American Bank Note Co. (U.S.A), the British American Banknote Company (Canada), Thomas De La Rue Ltd (U.K.), the Security Bank Note Company, later called Security Columbian (U.S.A) and Waterlow and Sons (U.K.). The Chinese security printers were the Bureau of Engraving and Printing (Peking), the Central Printing Factory (Sinkiang), the Commercial Press, the Chung Ha Book Co., Dah Tung Company and Union Publishers and Printers.
57. Private communication with a C.I.A. agent. 1997.
58. Bloom, M. T. 1983. *The Brotherhood of Money*. Ohio: BNR Press. 252.
59. During the war the American Board of Economic Warfare under Vice-President Henry Wallace was certainly involved in a whole range of industrial and economic espionage, including the counterfeiting of currency, an action that would in later years have a major impact on the Chinese economy. One of the most active U.S. officials was the enigmatic Solomon Adler, chief representative of the U.S. Treasury Department in China in the early 1940s. See Yu, Maochun. 1996. *OSS in China: Prelude to Cold War*. New Haven: Yale University Press. 85, 270.
60. It should be noted that some document examiners have a theory that a paper that would not normally fluoresce under ultraviolet light can exhibit strong fluoresence if it has been subjected to some artificial ageing techniques. See Carson, S.L. 1992. Has a sixth copy of the Gettysburg Address been found? *The Manuscript Society News* 13(2): 44. Quoted in Nickell, J. 1996. *Detecting Forgery: The Forensic Investigation of Documents*. Lexington: University Press of Kentucky. 96.
61. Pearson, N. 1997. *Investigation of U.S. Treasury Bonds* PIRA ref J47155.
62. Microscopic analysis by Bob Abbott.
63. Friedberg, R. 1992. *Paper Money of the United States*. 13th ed. Clifton, New Jersey: Coin and Currency Institute. Describes the introduction of the new design of the seal in 1966 and illustrates the old seal with its Latin motto and the new seal with the additional date and wording in English.
64. In 1944 in Hunan province some 60,000 Japanese troops defeated 300,000 Kuomintang soldiers under Tang Engbo, who had been lulled into a false sense of security by the cosy and very profitable trading relationships he had established with the enemy.
65. Eastman, L. 1980. *Facets of an Ambiguous Relationship: Smuggling, puppets and atrocities during the war 1937–45*. 282.

New Zealand Paper Trails: Experimentation with Alternative Fibres in the Nineteenth Century

SYDNEY J. SHEP

Abstract

This paper traces one aspect of the troubled history of paper experimentation in New Zealand in the nineteenth century. Responding to the worldwide paper famine early in the century, and later unable to keep up with local demand, colonial papermakers attempted to develop an industry based on indigenous fibres such as New Zealand flax (*Phormium tenax*) and native tussock grasses (*Carex* spp). Despite their early potential, these experimental papers created problems for papermakers and printers alike, and are now of concern to conservators and collectors. The impact of such colonial papermaking endeavours upon a cultural history of print will be traced by examining the contexts for production of several key books, newspapers and pieces of ephemera. In the process, techniques for and problems with identifying these papers will be discussed, and parameters for developing a critical discourse appropriate to the historian's engagement with nineteenth-century papers will be suggested.

> The utilization of waste materials for paper-making is a subject upon which a great deal has been said and still remains to be said and done. In every country waste vegetable matter which contains fibre in anything like suitable proportions is sure to attract much attention.[1]

On 27 July 1870 Dr James Hector, Director of the Colonial Museum in Wellington, New Zealand, gave evidence to the Joint Committee on Colonial Industries. In answer to the question of whether there would be any use for the 'vegetable productions' of New Zealand, he replied:

> There are many valuable grasses which might be available for paper-making, and to which attention has not yet been directed; and by modifying the machinery, I am inclined to think that the pulp from flax might be converted into a paper of qualities which could be substituted for the lighter kinds of calico and scrim. By restoring the gum to the pulp in the process of manufacture, and submitting it to a high temperature, a waterproof material is obtained.[2]

Although printing first occurred on New Zealand soil in 1830, it was not until 1876 that domestic printing on New Zealand machine-made brown and grey papers was accomplished. During this 46-year period, numerous attempts to develop a local papermaking industry were floated, bolstered by government bonus schemes, debated in the press and in Parliament, interrupted by the Maori wars and encouraged by colonial and international industrial exhibitions. Overseas, the chronic shortage of rags, increased demand for paper, the success of esparto as an alternative fibre, experimentation with various wood pulps and price fluctuations due to trade embargoes, suspected manufacturing combinations or draconian excise regulations all influenced the ways in which the paper industry developed in New Zealand. Central to this development was the impetus given to technical research into indigenous fibres.

It is often said that New Zealand's nineteenth-century economy was based upon four resources: sheep, timber, gold and flax. New Zealand flax, or *Phormium tenax*, dominated early discussions of indigenous fibres, particularly when it was realized that it could be manufactured into rope, rigging, canvas, bags, mats and fine textiles, as well as paper.[3] None of these industries was ever satisfactorily realized in the nineteenth century, but the potential of *Phormium* has remained to haunt the international scene to this day. Initially, *Phormium*'s suitability for paper was recognized by the Scottish essayist John Murray, who as early as 1823 proclaimed this wonder fibre to be the saviour of Britain's papermaking woes. He subsequently wrote three works printed on bleached and unbleached *Phormium* made at the Morton Paper Mills in Yorkshire, from plants grown on his Scottish estate. *An Account of the Phormium Tenax* of 1836 and 1838 became a talisman, and a rare one at that, for budding New Zealand industrial entrepreneurs. Two possible avenues were repeatedly explored: either exporting raw or semi-processed fibre to Britain, or investigating the viability of a domestic papermaking industry extracting the wealth of raw materials at hand.

Throughout the century, however, *Phormium* lived up to its name: *tenax*. Problems with preparing the fibre, an inability to guarantee constant and consistent supply and the economics of extraction and shipping to an overseas manufacturing centre militated against its wholesale adoption in the foreign papermaking industry. On the domestic front, the capital investment required for establishing a paper mill made it virtually prohibitive for the small businessman or colonial consortium. Whereas a complete flax mill cost at most £1,500, a simple papermaking machine could cost between £3,000 and £8,000, and total capital outlay for a paper mill was calculated to be at least £20,000 and closer to £50,000. Labour costs were double those in Britain. Distribution was dependent upon coastal shipping or, in the absence of railways, primitive road networks. Mills could not always be sited close to major ports even though they were close to water power and fibre plantations. The lack of protectionist tariffs meant that local producers were forced to compete with cheap, duty-free, imported paper. Ultimately, since the problem of *Phormium* fibre preparation remained unresolved, entrepreneurs and scientists turned to alternative sources and Australian expertise.

Australia led the way in scientific and industrial research to discover new papermaking materials. It is important to bear in mind that papermaking across the Tasman Sea had a 60-year lead compared to New Zealand. The first mill in Australia was established in 1818 at Botany Bay, Sydney; the next, Collingwood Paper Mills in 1864 at Liverpool, New South Wales; and most famously, Ramsden's Paper Mills in Melbourne, Victoria, in 1868. Although he was not a papermaker himself, Samuel Ramsden placed experimentation at the forefront of his industrial policy. Overseas mills frequently refused to interrupt production for experimental purposes, often with good reason, given the chance of damage to machinery and/or significant disruption to production schedules. Ramsden, however, recognized the need both to develop local resources and to keep abreast of current research. Even before his mill was completed, Ramsden invited the general public to send in specimens of native herbs and grasses whose suitability for paper he could assess.[4]

In this Ramsden was encouraged by several local initiatives. In 1865, the Royal Society of Victoria established a committee to bring together existing research and to investigate new sources of indigenous papermaking fibres. This activity was driven by the increasing demand for and inability to produce enough esparto grass for the British papermaking industry — hence the goal to find alternative sources of fibres — combined with the need to discover antipodean substitutes to make a domestic industry financially viable. The scientific community was also spurred by the Victoria government, which in 1864 allocated £5,000 in start-up incentives to new colonial industries; a £1,500 bonus was to be awarded for the first 10 tons of paper produced weekly, whether wrapping, printing, grocer's or draper's papers.[5] Experiments were carried out on local grasses, reeds and cereals, which could be mixed with rags for white papers or used alone for brown wrappings and newsprint. At the forefront of these investigations was Baron Ferdinand von Mueller, the internationally renowned German botanist who was director of the Melbourne Botanical Gardens from 1865 to 1874.

In his *Report on the Vegetable Products Exhibited in the Intercolonial Exhibition of 1866–67*, von Mueller documented some 30 different Australian fibres prepared as pressed and dried, pure, unbleached pulp linters by his lab assistant, Christian Hoffmann. Pride of place was given to *Phormium tenax*:

> Paper has been placed in the Exhibition from material grown in Victoria. The readiness with which the large richly fibrous leaves can be turned into pulp for a very substantial paper, entitles the plant not alone to our consideration, but also the fact that it may be permanently established with the greatest ease in any swampy ground.[6]

At that time, von Mueller had yet to undertake comprehensive tests to determine the actual pulp percentage content per fibre type; he was certainly oblivious to the difficulties *Phormium* had historically presented to the aspiring New Zealand paper industry and did not at all understand its growth habits. He remained convinced, however, that not only was each of his 30 varieties suitable for manufacture into compressed and dehydrated half-stuff blocks for shipment to overseas mills, but that 'together with the consumption of rags in local factories, the new articles indicated will largely enter into the fabrication of Victorian industry,'[7] since 'the yield from Victorian material is much larger, moreover the supply infinitely vaster, and locally much less expensive and much easier to work.'[8]

Baron von Mueller's sphere of influence in the pursuit of alternative papermaking fibres was extended not only through his copious publications and the trading of published pamphlets and monographs between members of the worldwide scientific fraternity, but also through the increasingly frequent industrial exhibitions which afforded the opportunity to exhibit paper samples in the international arena. His paper collection was showcased at the Paris Universal Exhibition of 1867, then travelled to New Zealand for a special *Phormium* exhibition in 1871 staged by Dr James Hector at the Colonial Museum in Wellington. In 1875, the samples were exhibited in Melbourne in conjunction with 40 additional specimens prepared by von Mueller's successor at the Botanical Gardens, William R. Guilfoyle, then sent to the Philadelphia Centennial Exposition of 1876 and later, the Sydney Exhibition of 1882. These exhibitions were crucial for the exchange of knowledge and technology. The award system and jurors' reports enabled periodic assessment of industrial manufacturing, gave recognition to innovation, and spurred additional investigation.

The von Mueller collection became as internationally famous as a suite of 15 papers produced by Samuel Ramsden which was awarded the silver medal at the 1872 Melbourne Inter-Colonial Exhibition. Ramsden's papers were one of 700 exhibits selected to represent the state of Victoria at the London International Exhibition of 1873. They then went on to win first prize at the Melbourne Inter-Colonial Exhibition of 1875 and travelled to the Philadelphia Centennial Exposition of 1876. The range of papers Ramsden was able to produce is a testimony to his achievement in colonial manufactures: imperial white cartridge, printing paper, printing news paper, coloured printings, bookbinders' pressings, tea cartridge, tea paper, coffee paper, grey royal hand sugar paper, thin grey demy and brown wrapping, both thick and thin. Three additional specimens received considerable attention in the jurors' reports: grey casing made entirely from New Zealand grass, grey casing made entirely from Victoria grass and brown wrapping made entirely from Victoria grass.[9] J. Cosmo Newberry, chairman of the experts' panel for the paper and cardboard class, was most impressed with Ramsden's collection:

> The experts in this division in the exhibition of 1872 regretted that the manufacture of paper from Victorian fibre-yielding plants had not been

> attempted on a practical scale, so that this jury is pleased to be able to record so high an opinion of the excellence of the paper made from these fibre plants, on a commercial scale, at Mr. Ramsden's mills; and they hope that, as it has been shown that this material bleaches well, we shall, before long, see good printing and writing paper made from this source, though it is perhaps scarcely to be looked for at present from mills using the muddy and discoloured Yarra water.[10]

Ramsden began his career intending to produce a wide range of papers, and his sample book is testimony to this. Yet, over the years, he gradually concentrated on brown wrappings and grey newsprint, that is, those papers which did not compete with the export rag market or cheap imported writing and printing papers, those which did not depend on pure water and those which could easily use local, indigenous fibres as substitutes for traditional raw materials. By 1875, William Guilfoyle claimed that, given the wealth of alternative fibres proven experimentally to be fit for papermaking, there was no need to use any rags at all.[11]

Early research into alternative paper fibres was carried out in New Zealand by several key players in the *Phormium* industry. None entered the commercial papermaking arena, but their experiments informed the preliminary feasibility studies of Edward McGlashan, founder of the Woodhaugh Paper Mills in the Leith Valley of Dunedin, who produced the first New Zealand machine-made brown paper in 1876. Throughout this period, Dr James Hector, director of the Colonial Museum in Wellington, took a great interest in von Mueller's fibre experiments in Australia and corresponded with him regularly. Hector participated in the first New Zealand Flax Commission of 1869, whose findings were published in 1870. He soon realized that a full scientific study of the plant, its growing habits and its suitability for different manufactures was essential. This phytological approach, first proposed by von Mueller,[12] was implemented by Hector when he was appointed chairman of the second Flax Commission in 1870. This commission went into greater detail about all aspects of *Phormium*, from its propagation and cultivation to its preparation and manufacture. The commission appointed a network of local and international agents who solicited a wide range of technical expertise, acquired fibre samples from throughout the country and sent samples to manufacturers overseas for testing and assessment. Hector was assisted in this endeavour by the establishment of a fully equipped scientific lab at the Colonial Museum, supervised by William Skey. As chair of the New Zealand Institute, later to become the Royal Society of New Zealand, and director of the Wellington Botanical Gardens, Hector also had direct access to an excellent network of New Zealand–based, like-minded scientific explorers and civic-minded industrialists.

Thomas Kirk, secretary to the Auckland Institute, was one such man. He kept John Murray's book and his ideas about *Phormium* in circulation, taking his copy to society meetings and entering it in various industrial exhibitions, always affirming that 'in strength and tenacity [it] resembles parchment, rather than ordinary paper. There can be no doubt that it is a paper of extraordinary durability.'[13] Unlike some of his New Zealand contemporaries, however, Kirk clearly understood *Phormium*'s limitations which made it uneconomic for the papermaking industry. British papermakers John Evans and Thomas Routledge viewed von Mueller's samples at the Colonial Office in 1867 and reported back to the Association of Paper Manufacturers of Great Britain and Ireland, an organization of which Evans was president. Noting that only six of the fibres were actually suitable for paper, they agreed that *Phormium* was the prime candidate, but quickly pointed out that its price of £35 per ton, compared to a maximum of £6 for esparto, precluded its use in the British papermaking industry.[14]

F.D. Bell and I.A. Featherston toured the manufacturing districts of England in 1870 and reported that:

> The cost of New Zealand flax places it entirely beyond reach of paper makers, who to a large extent depend on the refuse of other trades. Esparto grass from Spain, which, although scarce, can be bought here at £8 a ton, is now extensively used in the manufacture of newspaper and book papers; and although New Zealand flax would be useful for giving it strength as a better class paper, and for producing good papers by itself, yet the price would be such as could never pay the colonists to export. There is a wood pulp imported from Germany, and New Zealand flax or tow might probably pay if reduced to pulp and shipped in blocks at a low freight. Blocks of any size would suit, but they must be pressed free of water, and unbleached. It is difficult to get makers to commit themselves to anticipatory prices, but £18 to £20 is a probable figure. Doubts are however suggested as to the pulp keeping during so long a voyage, and we were advised to recommend that, before shipping to the Home market, parcels should be first sent for experiment to the paper mills at Melbourne.[15]

This position was echoed by Bennett Brothers, fibre brokers in London, who acted as the second Flax Commission's agents to distribute samples to various British manufacturers. In late 1872, they told Hector and Skey that:

> With respect to the sample marked B we cannot at the moment say anything [as] it is in the hands of a manufacturer, but [it is] much too good for paper making. In fact a fibre from New Zealand for paper making would not pay carriage. Germany, Sweden, Switzerland and even England are producing large quantities of fibre from wood shavings, etc. a good fibre only fetches about 20/– per cwt after a cost of 15/– per cwt to produce, without value of material. Bamboo is being imported from Jamaica but is a wretched business. Rags (linen) from China and Japan are selling here at 6/– per cwt (dirty of course).[16]

But Hector did not give up. The following year, he again wrote to Bennett Brothers with the notion that, when reduced to its ultimate filaments, *Phormium* could be used for 'vegetable felting, taking advantage of its wonderful plasticity when wet to form it into a kind of thick tough paper, which by after treatment would be rendered impervious to water.'[17]

For a time, Edward McGlashan also kept *Phormium* alive as a possible papermaking material. When the Otago Provincial Council first announced their paper bonus scheme in 1865, £500 was to be awarded to the person or company who first produced, within 12 months, one ton of paper from *Phormium* or other indigenous fibre. This bonus was far more realistic than that of the Victoria government, which expected newly established colonial papermakers to produce 10 tons of paper per week. The initial New Zealand bonus was not taken up and was frequently revised over the ensuing years. In a letter addressed to the Joint Committee on Colonial Industries, McGlashan affirmed that:

> the manufacture of paper from flax and other indigenous plants ought to be successfully carried out, and to large profit, in New Zealand. The capital, however, required to purchase and erect the necessary plant is considerable. Grocery, printing, and writing paper could all be manufactured to profit, particularly wrapping paper, which requires no bleaching material.[18]

Despite the Scottish mills proclaiming that *Phormium* was impossible to work, McGlashan sent bleached and unbleached half-stuff samples across the Tasman to Ramsden's paper mills for testing. Ramsden's results were encouraging, though, according to McGlashan, 'he did not offer a paying price.'[19] McGlashan still had the successful example of John Murray's book before him, and indeed had himself, at considerable cost, sent fibre to England to be made into paper some years ago. He donated samples of this fibre to the colonial industries commission, and it may have become part of the flax exhibition in 1871, catalogued as 'paper, made in London, 1866.'[20] The paper which eventually won the Otago papermaker a place in New Zealand history on 1 May 1876 was an unsized, improperly calendered brown paper composed of old sacks, rope and tussock grass — no *Phormium* in sight.

As von Mueller did for Australia, Kirk also experimented with native New Zealand plants more suited to the needs and resources of the present industry:

> Doubts having been freely expressed as to whether the Colony possesses a sufficient abundance of raw material for the manufacture of paper to allow of the process being undertaken on a remunerative scale, it may be worth while to call attention to several plants available for the purpose, all of which occur in abundance, and are yearly destroyed to an enormous extent by the process of settlement. Several of them could be cultivated so as to afford a regular supply.[21]

Kirk's identification of 18 different fibres, including *Phormium*, demonstrates a growing range of possible fibres and sources. International trade publications such as *The Paper Makers' Monthly Journal* were keen to communicate such antipodean progress. Founded in 1864, at precisely the moment when the industry was having to accommodate rapid technological change, this journal surveyed the state of the trade worldwide, tracked the growth of alternative fibre experimentation, kept old ideas in circulation and presented innovations and boasted a lively discussion forum in its letters and reports. Kirk's report, for instance, had already been picked up by John R. Jackson, writer for the scientific journal *Nature*, and was subsequently extracted in *The Paper Makers' Monthly Journal.*

Alternative paper fibres had been the subject of international interest from at least the last quarter of the seventeenth century. It was not until the German scientist Dr Jacob Christian Schäffer began to publish his six-volume treatise on vegetable fibres in 1765, complete with specimens, that the diversity of flora possible for papermaking was intensively explored. Schäffer's experiments were followed in quick succession by a number of works printed on paper made from alternative materials, culminating in the landmark research of Matthias Koops, published in 1800 and 1801. Although he went bankrupt in 1804, Koops definitively proved that vegetable fibres such as straw, rather than linen and cotton, could be used to produce paper on a commercial scale.[22] In subsequent years, substances as varied as groundwood, beetroot, cornstalks, mummy wrappings and cow dung were thrust upon the paper stage. In 1851 the Exhibition of the Works of Industry of all Nations, or the Crystal Palace Exhibition, as it became popularly known, brought together the results of international fibre research. Although New Zealand was represented in London with examples of Maori-dressed *Phormium* only, it was the 1865 Dunedin International Exhibition which signalled New Zealand's entrance into the paper-fibre arena. To complement a collection of Indian fibres and Dr Lauder Lindsay's 'various curiosities of paper manufacture,'[23] Dr James Hector submitted specimens of New Zealand trees, shrubs and grasses from the Colonial Museum that were suitable for papermaking. Predictably, *Phormium* received the highest praise, yet the jurors noted a number of fibrous grasses, including *Triticum, Agrostio arunds* and *Danthonea.*

Another of these grasses, *Schoenus pauciflorus*, or snow-grass, was particularly intriguing:

> Many of the grasses of New Zealand are sufficiently fibrous for the manufacture of paper, and the profusion in which they grow on almost every variety of soil, and under every condition of the climate, is an additional reason why efforts should be made to utilize them. One variety of grass in particular claims attention from its resemblance in many important features, to the Esparto or Spanish grass, an article which is now very extensively used in the manufacture of paper in England; this is the 'snow grass,' one

> of the tussocky grasses of the colonists, which grows rank and luxuriant at high elevations and on barren soil in the interior of the Middle [i.e. South] Island.[24]

The jurors remarked on the successful papermaking experiments performed on tussock grass by Edward McGlashan, who had sent samples of tussock to both Ramsden and Thomas Routledge of esparto fame, but recognized that the lack of suitable machinery in the colony was a deterrent to further exploitation. Rivalling *Phormium*, tussock continued in the limelight during the 1879 Sydney International Exhibition and the 1880 Industrial Exhibition in Christchurch. For the Sydney Exhibition, which then travelled to Melbourne, McGlashan entered a sample of paper stock made from 'NZ grass'; the Otago Paper Mills (the firm which bought him out in late September 1876) won first prize for its brown wrapping paper; McGlashan's rival John Walker Bain's Mataura Paper Mill (also producing paper from 1876) won first for its brown and grey wrappings, again made from 'NZ grass'; and the Invercargill Bag Factory won a fourth prize for its bags made from Mataura's brown and grey wrappings.[25] At the Christchurch show, the jurors reported favourably about Mataura's tussock grass paper:

> A sample of brown wrapping-paper, made at the Mataura mills, was shown. This paper which is strong and tough, has been manufactured from the fibre of one of our native tussacs [sic], *Danthonia flavescens*, or broad-leaved oat tussac grass. On our upland sheep runs it grows in great abundance, up to an altitude of 3000 ft, and it is considered to be capable of affording 'an unlimited amount' of fibre material of the manufacture of paper. The manufacture of printing and other papers from linen rags, & c., has yet to be undertaken in New Zealand.[26]

Four years later, George Didsbury, the Government Printer, recalled Mataura's 1879 brown paper in quite different terms. Citing the addition of too much tussock in the furnish, he claimed that the paper was too brittle for wrapping paper and totally unsuited to printing.[27]

The manufacture of printing papers in New Zealand was to remain a vexed issue right up until the 1960s, when the descendants of the Otago and Mataura mills, the New Zealand Paper Mills Limited, were finally able to make white paper suitable for book printing.[28] Almost a century earlier, McGlashan wrote to the colonial secretary asking for modifications to the bonus for printing paper announced by the Committee on Colonial Industries in 1872:

> Neither the Dunedin Mill nor the Mataura Mill have been enabled to attempt the manufacture of printing paper, the necessary machinery for which, so as to make a good saleable paper, not being procurable in the Colony and also from the fact that both mills have been striving to fulfil the conditions for the manufacture of Brown Paper in which they have succeeded, and have been able to turn out paper much superior to the imported article.[29]

One of the conditions of the bonus was that the paper had to be manufactured in New Zealand by machinery permanently established in the colony.[30] McGlashan wanted the Government to pay the bonus up front to the mills so they could invest in new equipment; instead, the deadline was extended to enable more time for the requisite machinery to be shipped out from England. A request in 1880 by James Hanan of Invercargill to encourage the production in the colony of proper machinery for the manufacture of white paper for newspapers similarly fell on deaf ears.[31]

In the mortgagee sale of the Australian Paper Company's works at Liverpool, New South Wales, in 1871, the auction announcement provides a breakdown of principal customers and markets supplied for the mill's 400 tons per annum output: 100 tons of various grey and brown packing papers were sold generally, 100 tons went to the New South Wales Government Printing Office and a combined 160 tons were sold to the region's newspapers. The figures also include 40 tons sold to unidentified New Zealand newspapers.[32] These export figures may not appear overly large, but before the establishment of a New Zealand paper mill, domestic demand for newsprint increasingly put pressure on the printing industry's sources of supply. Between 1860 and 1879, New Zealand's gold-rush period, 181 newspapers were founded, some lasting but one or two issues and in print runs frequently of only 100 or 200 copies per issue.[33] Nonetheless, compared to the 16 newspapers founded by 1851 and 28 by 1858, the increase was exponential. Newspapers were the lifeblood of New Zealand's geographically isolated communities, linking each with the next and to the world at large. Time and again, however, printers ran short of paper, having to abbreviate their publications, substitute whatever was at hand, or stop production altogether. *The Spectator* appeared on red blotting paper for several weeks; early issues of the *Mataura Ensign* and the Dunedin *Herald* were printed on the local mills' experimental papers; and the old *Otago Witness* advertised for donations of paper, then ceased when supplies dried up.

Newspapers also frequently advertised for waste paper. Koops' method of de-inking and thus recycling paper was by now a standard fixture in the papermaking industry. After an audit of the Government Printing Office in Wellington in 1874, the policy of selling waste paper — usually printed public documents and government forms — to local shopkeepers for grocery wrappings was reviewed. The chief clerk of the Audit Office, J.G. Anderson, astutely suggested that the government investigate a pulping machine 'by which the waste can be reduced by a simple process to a form very saleable to paper makers.'[34] This idea does not seem to have been taken further, but waste paper became a valuable commodity. In 1880, for instance, the GPO alone shipped 42 tons to England, where it fetched between £5 9s and £7 9s per ton; 13 tons were sold to local paper mills for

£4 per ton. The following year, only 21 tons were shipped overseas, whereas 22 tons were sold locally. Increasingly too, the government stationery store economized by re-using cancelled forms and substituting cheaper papers for the expensive handmades previously bought.[35] Such cheaper papers were, however, still imported.

Colonial papermakers wanted to manufacture writing and printing paper, but there were challenges aplenty.

> There are many complications in converting a wrapping machine to fine papers, and it is equally difficult to train a wrapping craftsman to make banks and bonds. Nor is it a simple matter to attain within a few months, quality standards of fine papers equal to those of overseas mills which have been making them for half a century.[36]

It must be remembered that neither New Zealand nor Australia had the benefit of progressing slowly from handmade papermaking through to the machine-made era, thereby amassing a skilled workforce and generating any sense of local industrial memory; nor did they have the location or capital to enable regular upgrades of machines and technology in order to keep abreast of overseas developments and compete against foreign imports. Across the Tasman,

> a constant problem Ramsden faced was the securing of the market against overseas competition. The mill increasingly concentrated production on wrappings; the manufacture of printings, both news and fine, becoming more and more difficult by the 1880s. This position had resulted from following the use of new and cheaper raw materials for papermaking in Europe and America and the introduction of more efficient machinery in overseas mills, the machines in Victoria rapidly becoming outmoded.[37]

Furthermore, despite the development of an antipodean industry based in part on indigenous fibres, three additional variables were introduced: the public's resistance to buying locally produced goods; too many local merchants, stationers, and paper brokers all vying to out-price the others in the same import market, even when superior-grade, locally produced brown and grey wrappings could be purchased more cheaply; and the lack of protectionist tariffs to encourage local industry.

Even if colonial papermakers could gain easy access to raw materials, equipment and technology, as long as tariffs favoured imported papers, there was no point trying to compete, retool or recapitalize. Although citizens successfully petitioned the Victoria government in the 1870s so that a 3/– per cwt duty was imposed on imported wrapping paper, it didn't significantly alter the level of imports until the 1890s depression, when duties were doubled; and since printing paper continued to remain duty-free, this emergent industry was crippled.[38] There were also questions debated, most vehemently in 1895, about whether the local taxpayer was supporting an industry which was actually uneconomic. In New Zealand, manufacturing stationers tried to avoid paper duties by ordering larger sizes from the overseas mills, then cutting them down for domestic resale. When the government printer told the colonial secretary that his office would start buying locally produced brown paper and he would try to encourage the post and telegraph office and the railways stores to do likewise, his only negative comment was that people were prejudiced because of the inferior quality of the early papers coming out of the Mataura and Dunedin mills. Yet, had they not gone through this experimental phase and come out the other end as commercially viable brown-paper manufactories, Didsbury's vision of a healthy development for the industry would not have rung true: 'This I think may be taken as an indication of a growing demand for our local productions, and that the public are gradually becoming alive to the fact that an equally good article is obtainable at [our own] doors at prices quite as reasonable as it can be imported for from other places.'[39]

Given the belated development of papermaking 'down under,' local manufacturers experienced a relatively short period of success. They found answers to the fibre question by investigating indigenous resources and made brown and grey papers for a significant wrapping and bag industry. However, the development of woodpulp processes overseas meant that antipodean papermakers soon turned to the importation of pulp until local factories could be established using the considerable timber resources available in both countries: radiata pine for New Zealand and eucalyptus for Australia. In the twentieth century, *Phormium tenax* was used in periods of shortage and depression, particularly during and after the first and second world wars, but both *Phormium* and other indigenous fibres have only taken centre stage again with the hand-papermaking craft revival.

Epilogue

As a book historian and scholar of material culture, I would like to conclude by sharing some thoughts about paper history research in New Zealand and Australia. Several years ago, John Bidwell characterized nineteenth-century machine-made papers as 'regular, reliable, and anonymous.'[40] Perhaps not all mills were able to achieve this desideratum of product standardization, but this description succinctly identifies some of the problems and challenges of working in the paper archive.

The critical tools for identifying and vocabulary for discussing handmade papers have been codified for some time; those for nineteenth-century machine-made papers are still in their infancy. Central to the emerging (or re-emerging) field of history of the book and print culture is the recognition that physical artefacts must be contextualized as well as described. Scholars aim to map the network of relations linking the production, dissemination and preservation of books and print, researching the wider intellectual, social, cultural, political and economic contexts. For nineteenth-century machine-made papers this process is crucial, given that the paper's physical 'signature' — if there is one — is often insufficient to provide

conclusive identification. Extra-textual records thus take on an important dimension and include business archives of those who make, distribute, use and preserve paper (mills, stationers, printers, publishers, shopkeepers, readers, collectors, librarians); contemporary manufacturing records of the paper trade, found in trade journals, correspondence and published accounts; and historical evidence and accounts of the various forces (including geography, weather, shipping patterns and migration of personnel and technology) which can affect the book trade in general.

Although there is no substitute for the experience of handling thousands of sheets to hone one's visual, tactile, aural, gustatory and olfactory perception of paper, artefactual evidence is not enough; at times it is not even extant. I refer, in particular, to brown papers which were the mainstay of New Zealand and Australia's early papermaking industry. Used as broadsheets, newspapers, wrappings and bags, in the street, in the grocery and at the drapers, these papers are ephemeral; they were never meant to be saved, their use frequently implied their destruction and their chemical composition — whether because of fibres, additives or finishing — guaranteed a short shelf life. Such self-consuming artefacts are the researcher's nightmare and are often outside the collecting mandate of most institutions.

Drifting tantalizingly through the New Zealand archive is the mention but not the physical evidence of single sheets: from William Colenso's specimen sheets, exhibited in 1865, of the paper upon which John Murray's *An Account of the Phormium Tenax* was printed, to the 1871 Flax Commission exhibition which included unidentified *Phormium* paper made in London in 1866. Murray's book exists precisely because it is a book, because its subject matter has guaranteed its survival and because the cataloguing conventions of libraries and archives privilege the author and his title, perhaps even the publisher and collector, yet rarely that vehicle of communication, the paper substrate. The survival of single, particularly blank, sheets or discrete mill samples is jeopardized almost from the start; ditto, if they are pieces of ephemera such as broadsheets, household goods such as paper bags or reading material such as newspapers. Such objects are part of our disposable culture. A recent thesis examining the archaeological evidence of nineteenth-century Chinese communities on the Otago gold fields found that, despite the dryness of Otago's climate, paper bags, for instance, were only preserved because they were used as mortar in the walls of buildings.[41]

Where and when brown papers do survive, they suffer further complexities of identification because of the admixture of substances used in the furnish. Without a reference library, including a microphotographic portfolio, of the indigenous fibres used in any one country at any one time, simple visual analysis fails to assist the process of identification. To tell the difference between papers made from any one of von Mueller's one hundred different Australian fibres is perhaps easy; in combination, however, identification is quite a different matter. If we were able to pin down the fibre composition, what would it tell us? In the absence of mill records, a great deal, as we are often left only with the material object. Colonial industry was inherently unstable. With natural disasters, bankruptcies, mergers and takeovers, records of business activity were frequently lost, burnt or trashed. Mountains of account books tracing everyday operations were often used for waste-paper recycling, and if any records were saved, the principles of selection and preservation were often very different from those we use today. It might be possible to track papers from the mill through the records of various middlemen, whether paper brokers, stationers, printers or publishers, but progressively the paper trail becomes thinner and thinner. Tracking the geography of the nineteenth-century book is challenging, the geography of ephemeral papers even more so.

How can we distinguish between different species of the regular, the reliable and the anonymous? What is the repertoire of evidence marshalled in order to identify the unique fingerprints of nineteenth-century machine-made papers? C.R. Elmore suggestively turns to the (albeit frequently subjective) tests and terminology known to nineteenth-century paper dealers and members of the paper trade.[42] In addition to using physical dimensions and visible markings to describe paper, G. Thomas Tanselle enumerates several testing categories which bibliographers can adopt from the quantitative methodologies of industrial paper chemists: performance (substance, strength, permeability and absorbency, formation, smoothness); chemical (fibre and mineral constituents, sizing agents, pH); and optical (colour, gloss, opacity).[43] Tanselle is quick to rule out any destructive or mutilating tests as well as those tests which are impractical for the researcher, such as those requiring access to and knowledgeable use of precision instruments, particularly in the scientific laboratory. This fifth level of engagement with paper, like the sixth, which identifies the individual manufacturer or mill by means of such laboratory tests, reference to specimen books or other research, is clearly beyond Tanselle's ideal bibliographical necessity. Yet it is precisely these tools which the historian of paper, particularly nineteenth-century machine-made papers, requires.

When looking at papers made from indigenous plants, the scientific analysis of fibre is essential. Some of these papers, generally ephemeral brown and grey wrappings and printings, are deteriorating because of the chemical structure of the original fibre as well as their method of preparation and manufacture. Conservation solutions are dependent upon sound identification and assessment; can non-destructive tests be developed for identifying nineteenth-century machine-made papers? If not, are we willing to sacrifice a very small percentage of the original paper to create a reference library available to conservators and researchers alike? As librarians, archivists, bibliographers and book historians become increasingly aware of the importance of paper itself in the communication circuit, it is to be hoped that the evidential needs of the historian of nineteenth-century paper can be met by combining sensitive laboratory analysis with contemporaneous documentation surrounding the

artefact and with the experience of handling the extant artefacts of the paper trail.

Acknowledgements

I would like to acknowledge the assistance of the following people and institutions who facilitated research for this paper: staff at the Alexander Turnbull Library, National Library and National Archives, Wellington, New Zealand; Eamonn Bolger, Archivist, and Valerie Carson, Textile Conservator, Museum of New Zealand / Te Papa Tongarewa, Wellington; David MacDonald, Chief Librarian, and staff, Hocken Library, Dunedin; Brian Hubber, Rare Books Librarian, State Library of Victoria, Melbourne, Victoria, Australia; John Trewick, Librarian, and John Murphy, Laboratory Supervisor and Fibre Analyst, AMCOR Technical Institute and Reference Library, Melbourne; Monika Wells, Von Mueller Correspondence Project, and Jill Thurlow, National Herbarium and Library, Royal Melbourne Botanical Gardens; Frances Wakeman, Frances Wakeman Books, England; Victoria University of Wellington. Participation at the *Looking at Paper* conference was made possible through a research grant from the Marsden Fund, Royal Society of New Zealand.

Notes

AJHR. Appendices to the Journal of the House of Representatives, New Zealand.

NA. National Archives, Wellington, New Zealand.

MU. Archives of the Museum of New Zealand, Wellington, New Zealand.

1. *The Paper Makers' Monthly Journal*. January 30, 1875. 11.
2. AJHR. 1870 F-1. 9.
3. Shep, S.J. 1997. The Paper record: *Phormium tenax* and New Zealand papermaking. *Bulletin of the Bibliographical Society of Australia and New Zealand* 21(3): 135–64.
4. Coote, A.J. 1956. Melbourne Mill 1868–1882. Typescript in A.P.M. (Australian Paper Mills) History Copy File No. 1, Company 345. 6. Melbourne: AMCOR Technical Library.
5. Rawson, J. 1953. A History of the Australian paper making industry 1818–1951. M.A. thesis, University of Melbourne.
12. AJHR. 1869. D-23. 10.
6. von Mueller, F. 1867. *Report on the Vegetable Products Exhibited in the Intercolonial Exhibition of 1866–67*. Melbourne: Blundell & Co. 33
7. von Mueller. 1867. 29.
8. von Mueller. 1867. 27.
9. 1985. *Official Record of the Philadelphia Centennial Exhibition of 1876*. Melbourne: McCarron, Bird & Co. 107.
10. *Philadelphia Centennial Exhibition*. 1985. 366.
11. *Philadelphia Centennial Exhibition*. 1985. 105.
12. von Mueller, F. 1871. On the application of phytology to the industrial purposes of life. *Lectures and Documents bearing on Industrial Researches* 1. Melbourne: Mason, Firth & McCutcheon.
13. Kirk, T. 1870. Remarks on New Zealand flax as a papermaking material. *Transactions and Proceedings of the New Zealand Institute* 3: 48–49.
14. *The Paper Makers' Monthly Journal*. April 30, 1867. 52.
15. AJHR. 1870 D-14A. 2.
16. MU. 94, Box 2, 1029/27.11.1872.
17. MU. James Hector Tissue Letterbook, vol. 3. 19 March 1873. 15–16.
18. AJHR. 1870 F-1. 21.
19. AJHR. 1879 F-1. 21.
20. AJHR. 1871 G-4. 55.
21. Kirk, T. 1873. Notes on indigenous materials for the manufacture of paper. *Transactions and Proceedings of the New Zealand Institute* 6: 55–57.
22. Hunter, D. [1947] 1978. *Papermaking, The History and technique of an ancient craft*. Reprint. New York: Dover. 332.
23. *Official Catalogue of the New Zealand Exhibition*. 1865. Dunedin: Mills, Dick & Co. 72.
24. *New Zealand Exhibition 1865. Reports and Awards of the Jurors*. 1866. Dunedin: for the Commissioners. 124.
25. New Zealand Court. *International Exhibition Sydney 1879. Official Catalogue of Exhibits*. 1879. Sydney: for the Commissioners. 24.
26. *Report of the Industrial Exhibition, Christchurch 1880*. Christchurch: J.T. Smith & Co. 21.
27. NA. IA Misc. Inwards 84/3659. 30 September 1884.
28. Angus, J.H. 1976. *Papermaking Pioneers, A History of New Zealand Paper Mills Limited and its predecessors, 1876–1976*. Mataura: New Zealand Paper Mills Limited.
29. NA. OP16333/12 [IA 77/55]. 23 December 1876.
30. AJHR. 1872. G-16.
31. AJHR. 1880. H-22. 25.
32. *Argus*. 7 January 1871.
33. Traue, J.E. 1985. *New Zealand Studies: A Guide to bibliographic resources*. Wellington: Victoria University Press. 12.
34. AJHR. 1874. H-20. 8.
35. AJHR. 1881. H-10. 3.
36. *Printers' News*. October 1864.
37. Rawson. 1953. 14–15.
38. Rawson. 1953. 15.
39. NA. IA Misc. Inwards 84/3659. 30 September 1884.
40. Bidwell, J. 1992. The Study of paper as evidence, artefact and commodity. In *The Book Encompassed, Studies in twentieth century bibliography*, ed. Peter Davidson. Cambridge: Cambridge University Press. 80.
41. Ritchie, N.A. 1986. Archeology and history of the Chinese in southern New Zealand during the nineteenth century: A Study of acculturation, adaptation and change. PhD thesis, University of Otago.
42. Elmore, C.R. 1979. The Description of nineteenth-century English writing papers. *Bulletin of the Bibliographical Society of Australia and New Zealand* 15: 81–93.
43. Tanselle, G.T. 1971. The Bibliographical description of paper. *Studies in Bibliography* 24: 27–67.

Through the Microscope Lens: Classification of Oriental Paper Technology and Fibres

ANNA-GRETHE RISCHEL

Abstract

The Austrian professor Julius von Wiesner was a pioneer in scientific analysis and identification of fibre materials in central Asian paper nearly 100 years ago. As a botanist, he collected reference material from local plants used for papermaking in order to identify the fibres in paper fragments from the Taklamakan desert. In a study similar to von Wiesner's, reference material consisting of oriental papers of known technology and fibre content was analysed macroscopically and microscopically in order to identify papers of unknown origin. The reference papers proved to be useful in identifying the unknown paper fibres and in revealing information about the papermaking process.

The 1983 Japanese exhibition at the National Museum in Denmark[1] exhibited a wide variety of *washi* samples in *kakemono*, *ukiyo-e*, *shōji* and lanterns. The supply of Japanese paper for restoration normally available at that time in Denmark was limited, expensive and of varying quality. The exhibition therefore inspired me to look for new and better restoration papers in Asia by visiting papermakers' workshops and studying hand papermaking in practice. A number of field trips to papermakers in Nepal, Thailand and Japan in the following years resulted in a collection of 77 papers suitable for restoration. This collection of paper samples of known origin and technology gave me an excellent opportunity to learn more about oriental paper by combining a study of the actual papers with my many field notes, drawings and photographs.

The inner bark from only four or five plants served as the raw material for paper production in all three countries. Therefore, the many small details of traditional papermaking, in preparation of the fibre and formation of the sheet, unchanged for centuries, had to be of importance in order to produce the great variety of papers in Nepal, Thailand and Japan. For example, the handmade papers of *kōzo* fibres produced in Thailand and Japan were different in look and quality. The most influential determinant of paper quality was not obvious: the bast material itself, the preparation of the raw material, the paper mould, the sheet formation, the addition of formation aids or fillers, the final drying process or a combination of several of these factors. Studies in oriental paper history did help with a theoretical understanding of the material and of the technology used, and it inspired me to search for a connection between the look and quality of the paper and the raw materials and technology used.

Non-destructive macroscopic and microscopic analysis showing the connection between the condition of the fibre material and the paper qualities would be a very useful tool in paper conservation, and would help achieve a better understanding of the paper. This better understanding would lead to more appropriate handling, exhibition, storage and conservation of paper objects.

Traditionally, analysis of oriental papers involved the identification of the fibre materials. The Austrian scientist Julius von Wiesner was a pioneer in this field with his 1887 analysis of Arabian paper from the Rainer collection.[2] As a botanist, he used traditional microscopic methods to identify the fibre material and discovered that Arabian rag paper was made of flax fibres and not of cotton, as had been believed for centuries in Europe. His later analysis in 1902 of ancient east Turkestan paper fragments was based on a comparison of the paper fibres with reference material from Asian papermaking plants.[3] He succeeded in identifying the fibres in good condition by using this reference material, but found it impossible to identify many of the materials because of the mechanical treatment of the fibres in the papermaking process.

Microscopic analysis of paper was for many years limited to botanical identification of the fibre material by means of spot tests, fibre morphology and other characteristics. In 1969 the German scientist Marianne Harders-Steinhaüser used technological observations and traces of laid lines and woven texture in her analysis and identification of the geographic provenance of ancient paper fragments.[4] However, it was obvious that much more information could be extracted from the same papers. Might it be possible to identify the technology of papers by observing and identifying the distinctive characteristics of the papers and any traces of the papermaking process, and then comparing these to papers of known origin and technology?

Inspired by Julius von Wiesner's method and later microscopic paper analysis, a pilot project was devised with the aim of writing a detailed systematic description of the fibre material and the actual paper technology used for a reference group of paper specimens. This reference material would then serve as the key for identification of fibre material and technology used in papers of unknown origin and technology.

The following 14 samples of paper from the collection of 77 new oriental papers were chosen as reference materials of paper of known origin and technology:

Sample No. 1 . . . . . Sa SL 32
Moraceae family, Thailand
Sample No. 2 . . . . . *yoshinogami* 93
Moraceae family, Japan
Sample No. 3 . . . . . *misugami* G 118
Moraceae family, Japan
Sample No. 4 . . . . . Sa KT 30
Moraceae family, Thailand

Sample No. 5 . . . . . *kōzo* T 124
Moraceae family, Japan
Sample No. 6 . . . . . lokta T 12
Thymelaeaceae family, Nepal
Sample No. 7 . . . . . *gampi* CLLG
Thymelaeaceae family, Japan
Sample No. 8 . . . . . *mitsumata* CL 123
Thymelaeaceae family, Japan
Sample No. 9 . . . . . local *kōzo* SB 125
Moraceae family, Japan
Sample No. 10 . . . . . lokta L 10
Thymelaeaceae family, Nepal
Sample No. 11 . . . . . local *kōzo* LGB 102
Moraceae family, Japan
Sample No. 12 . . . . . *kōzo mino* 88
Moraceae family, Japan
Sample No. 13 . . . . . *tengujoshi* T 107
Moraceae family, Japan
Sample No. 14 . . . . . *kōzo uda* CL 92
Moraceae family, Japan

The selected reference papers varied in fibre material, preparation, weight, thickness, density of fibres, content and type of fillers and sheet formation aids, paper mould, sheet formation and final drying process. These authentic paper specimens corresponded in principle to Julius von Wiesner's reference material of known Asian papermaking plants, except that the distinctive features characteristic of the various steps of the papermaking process had not yet been analysed and described.

Thirteen samples of eighteenth-century Japanese paper of unknown provenance from the National Museum in Denmark were chosen as test materials for the project. Only minor differences were expected to be found between the Japanese reference material and the eighteenth-century paper samples, because traditional papermaking traditions had continued unchanged for centuries. It ought to be possible to draw sufficient parallels between the known reference material and the old unknown samples for a realistic identification of fibres as well as technology used, in spite of the approximately 120 years of difference. Looking at the paper with the naked eye combined with microscopic examination of the structure and individual fibres was expected to give a more profound understanding of the material and hopefully reveal hidden information of importance to paper conservation and paper history. This non-destructive method of analysis was considered suitable for a limited amount of test material, and would be similar to an analysis of a valuable manuscript or a work of art on paper. The selected samples were therefore considered and treated as single objects of original material and not as test materials in an analysis.

The pilot project consisted of three parts: Part I, analysing and describing the reference material of 14 known paper specimens and looking for a pattern of distinctive features; Part II, a similar analysis and description of the 13 unknown paper samples and experimenting with an identification; and Part III, developing a classification key based on the distinctive features found in Parts I and II.

Part I: Analysis of the 14 known paper samples

Three checklists were prepared: A, B, and C.

Checklist A: Field notes and observations

Checklist A listed 64 statements concerning field notes and observations on the production of the paper: the preparation of the fibre material, the type of mould used, the sheet formation and the final drying process. Every statement was either confirmed or denied and all answers for the 14 samples were collected in a simple database.

1. Preparation of fibre material

A01. Separation of bark layer and twig at collection
A02. Separation of outer bark layer and inner bark layer at collection
A03. Steaming and separation of bark and twig
A04. Rinsing and drying after steaming
A05. Soaking in water of dry bast strips
A06. The outer bark layer is removed manually with a blunt knife
A07. The outer bark layer is removed mechanically by a rasping machine
A08. The bast is boiled in a lye solution made from ashes
A09. The bast is boiled in a calcareous lye
A10. The bast is boiled in a lye solution made from soda
A11. The bast is boiled in soda/calcareous lye
A12. The bast is boiled in soda/caustic soda lye
A13. Cooling in the cooking boiler
A14. Chemical bleaching, followed by rinsing
A15. Short rinsing
A16. Sun/water-bleaching in running water 1–3 days and nights
A17. Snow bleaching
A18. Manual removal in water of coarse fibres and remnants of outer bark layer
A19. Repeated manual rinsing of dry bast mass
A20. Mechanical treatment with wooden mallets
A21. Mechanical treatment in stamping machine
A22. Mechanical treatment in hollander or *naginata*
A23. Mechanical treatment in hollander with chlorine-containing water
A24. Maceration in lined baskets

2. Paper mould

A25. The inner length of the mould/deckle, 33.5–80.0 cm
A26. The inner length of the mould/deckle, 80.1–115.0 cm
A27. The inner length of the mould/deckle, 115.1–158.0 cm
A28. The inner width of the mould/deckle, 16.5–38.8 cm
A29. The inner width of the mould/deckle, 38.9–54.5 cm
A30. The inner width of the mould/deckle, 54.6–66.0 cm
A31. Fixed mat of open woven material
A32. Removable flexible mat of twisted thread and bamboo splints

A33. Removable flexible mat of twisted thread and reed/straw
A34. Fine woven silk combined with the mat
A35. Fine and coarse woven silk combined with the mat
A36. Double bamboo mat
A37. Supporting ribs in the mould
A38. Removable deckle
A39. Hinged deckle
A40. The mould connected to balancing sticks

3. Sheet formation and drying process
A41. Blending of pulp and water with single reed
A42. Blending of pulp and water with double reed
A43. Blending of pulp and water by electric engine
A44. Blending of pulp and water with deckle, wooden paddle or whisk
A45. Adding of filler
A46. Adding of plant mucilage
A47. The pulp is scooped with the mould 1–2 times
A48. The pulp is scooped with the mould 3–5 times
A49. The pulp is poured into a floating mould
A50. The pulp is spread with rhythmic movements of the mould
A51. The pulp is spread by light vibration of the mould
A52. The pulp is spread by rotating hand movements
A53. The pulp flows out and is smoothed by the hands
A54. The pulp residue is thrown back in the vat
A55. Double edge is folded after the sheet formation
A56. The sheet is couched with a flexible removable mat
A57. The sheet is couched directly on the drying board
A58. Thread/bamboo splint is inserted between the sheets of paper
A59. The sheet of paper dries on a fixed mat
A60. Draining of the couched sheets of paper under pressure
A61. Individual smoothing of the sheet of paper with brush on drying board
A62. Individual smoothing of the sheet of paper with brush on heated metal board
A63. Sun drying
A64. Drying in shadow

Checklist B: Macroscopic laboratory observations

Checklist B was prepared, listing 61 statements about the macroscopic examination of the single sheet of paper using the naked eye. Size, surface, look, colour, quality, character and traces of the mould and drying processes were described in a similar way to Checklist A, with confirmation or denial of each statement. Macroscopic photos were used to document the observations.

B01. The length of the sheet, 33.5–58.0 cm
B02. The length of the sheet, 58.1–78.0 cm
B03. The length of the sheet, 78.1–145.0 cm
B04. The width of the sheet, 16.5–23.5 cm
B05. The width of the sheet, 23.6–34.6 cm
B06. The width of the sheet, 34.7–64.0 cm
B07. The sheet has not been trimmed
B08. The width of the sheet is intact
B09. The sheet has been trimmed on all edges
B10. The average thickness of the sheet, 0.022–0.122 mm
B11. The average thickness of the sheet, 0.123–0.196 mm
B12. The average thickness of the sheet, 0.197–0.597 mm
B13. Minimum thickness of the sheet, 0.022–0.120 mm
B14. Minimum thickness of the sheet, 0.121–0.190 mm
B15. Minimum thickness of the sheet, 0.191–0.504 mm
B16. Maximum thickness of the sheet, 0.030–0.129 mm
B17. Maximum thickness of the sheet, 0.130–0.210 mm
B18. Maximum thickness of the sheet, 0.211–0.753 mm
B19. The weight of the sheet, 0–50 g/m^2
B20. The weight of the sheet, 51–100 g/m^2
B21. The weight of the sheet, 101–156 g/m^2
B22. The density of the sheet, 0.15–0.20 g/cm^3
B23. The density of the sheet, 0.21–0.31 g/cm^3
B24. The density of the sheet, 0.32–0.72 g/cm^3
B25. Imprint of coarsely woven material
B26. Imprint of twisted warp threads (chain lines)
B27. Shadow lines from the transverse ribs of the mould
B28. Imprint of the bamboo splints or straw/reed of the mat (laid lines)
B29. Distance between chain lines, 2.6–3.6 cm
B30. Distance between chain lines, 3.7–5.0 cm
B31. Distance between double chain lines, 0.7–2.0 cm
B32. Distance between transverse ribs, 6.5–8.0 cm
B33. Distance between transverse ribs, 8.1–12.5 cm
B34. Bamboo splints or straw/reed per 3 cm, 13–17
B35. Bamboo splints or straw/reed per 3 cm, 18–23
B36. Bamboo splints or straw/reed per 3 cm, 24–30
B37. Opacity[5], 0.20–0.50
B38. Opacity, 0.51–0.80
B39. Opacity, 0.81–1.15
B40. Opacity, 1.16–1.40
B41. Colour reflection[6], 9.33–9.39
B42. Colour reflection, 9.40–9.49
B43. Colour reflection, 9.50–9.51
B44. Glossy surface
B45. Matte paper surface
B46. Smooth paper surface
B47. Rough paper surface
B48. Irregular paper surface
B49. Stiffness/flexibility: stiff
B50. Stiffness/flexibility: pliable
B51. Stiffness/flexibility: soft
B52. Deep rustling sound
B53. High rustling sound
B54. No rustling sound
B55. Homogeneous fibre distribution
B56. Slightly clouded fibre distribution
B57. Irregular fibre distribution
B58. Dominant fibre direction
B59. Random fibre direction
B60. Traces/streaks from brush hairs
B61. Impression of wood structure

Checklist C: Microscopic laboratory observations

Checklist C, listing 64 statements, served as a systematic record of the microscopic analysis, using three different types of instruments. The undisturbed paper structure as well as cross-sections of each sheet were observed using

a scanning electron microscope, which revealed information about the fibre bonding, what was lying between and among the fibres, and the laminates of fibres with different fibre orientation. By adding a drop of water, each sample was separated into its individual fibres, disturbing the original material as little as possible. The morphology of the separated fibres was studied with a polarizing microscope and a differential interference contrast microscope.

C01. Mixture of thin and thicker fibres
C02. A few coarser and unseparated fibres
C03. Average fibre width, 0.011–0.013 mm
C04. Average fibre width, 0.014–0.020 mm
C05. Average fibre width, 0.021–0.026 mm
C06. Minimum fibre width, 0.005–0.006 mm
C07. Minimum fibre width, 0.007–0.008 mm
C08. Minimum fibre width, 0.009–0.010 mm
C09. Maximum fibre width, 0.018–0.029 mm
C10. Maximum fibre width, 0.030–0.039 mm
C11. Maximum fibre width, 0.040–0.043 mm
C12. Average fibre length, 2.0–3.5 mm
C13. Average fibre length, 3.6–5.5 mm
C14. Average fibre length, 5.6–8.9 mm
C15. Minimum fibre length, 1.1–1.9 mm
C16. Minimum fibre length, 2.0–4.0 mm
C17. Minimum fibre length, 4.1–6.7 mm
C18. Maximum fibre length, 3.0–7.0 mm
C19. Maximum fibre length, 7.1–13.0 mm
C20. Maximum fibre length, 13.1–14.5 mm
C21. Varying thickness of cell wall
C22. Fibre ends tapering and pointed
C23. Fibre ends rounded
C24. Fibre ends branched
C25. Smooth surface of fibre ends
C26. Slightly wavy surface of fibre ends
C27. Fibre surface smooth
C28. Fibre surface veined and striated parallel to the long axis of the fibre
C29. Dislocations
C30. Diagonal cross marks
C31. Horizontal cross marks
C32. Short cross marks
C33. Thickening of fibres
C34. Constriction of fibres
C35. Loose primary wall
C36. Folded loose primary wall
C37. Frayed primary wall
C38. Tiny ribbons of primary wall around the fibre
C39. Burst and sporadically missing primary wall
C40. Secondary wall laid open in areas
C41. Weak swelling reaction to chloride/zinc/iodine staining
C42. Strong swelling reaction to chloride/zinc/iodine staining
C43. Fibres connected by amorphous substance
C44. Fibres surrounded by amorphous substance
C45. Sporadic occurrence of amorphous substance
C46. Sporadic pectin reaction to staining in amorphous substance
C47. Pronounced pectin reaction to staining in amorphous substance
C48. Sporadic pectin reaction to staining in fibre wall
C49. Light fibrillation
C50. Heavy fibrillation
C51. Individual cluster crystals of calcium oxalate
C52. Chains of cluster crystals of calcium oxalate
C53. Single prismatic crystals of calcium oxalate
C54. Clusters of prismatic crystals
C55. Individual uncooked starch grains
C56. Clusters of intact starch grains
C57. Individual raphides
C58. Filler particles present
C59. Web of hyphae
C60. Cross-section shows layers with varying fibre direction
C61. Cross-section shows random fibre direction
C62. Cross-section shows a dominant fibre direction
C63. Cross-section shows a central interstice
C64. Fibres smooth on top surface of paper

At the beginning, the microscopic analytical results were a confusing mixture of expected and unexpected details, but after some time, by systematically following Checklists A, B and C, a kind of pattern began to develop.

Photographic documentation, notes of observations, all relevant information from the macroscopic and microscopic laboratory analyses and the field notes were all combined to create an individual description of each paper in the reference samples. The following example demonstrates how the description using the numbered statements of the checklists is combined into a detailed analysis of Sample No. 2, *yoshinogami* 93.

Amount of paper: ½ sheet
Provenance: 295, Kubokaito, Yoshino town in Yoshino county, Nara prefecture, 639-34, Japan
Papermaker: Kazuo Konbu
Visit: 9 September 1988

Checklist A. Field notes and observations for sample no. 2

1. Preparation of fibre material

The preparation of the bast material of *kōzo* strips starts with 24 hours of soaking in running water, followed by draining on a grating of bamboo (A05). The outer dark bark layer is removed manually with a blunt knife (A06) before the bast is boiled for 4 hours in a lye of soda (A10). The boiling lye is stirred at intervals to ensure evenness of cooking, and the bast material is left to cool in the lye solution until the next morning (A13), followed by a short rinsing on the bamboo grating (A15). Next is a sun/water bleaching of the bast strips in cold running water in a big basin in front of the workshop (A16), removing amorphous substances and other soluble products released during the boiling. The bast strips are turned at intervals in order to obtain a homogeneous bleaching.

Remnants of outer bark layer, knots and other coarse inclusions are now carefully removed by hand while the

bast is lying in cold water (A18), followed by a repeated careful manual rinsing of the dried bast (A19). The bast mass is finally pressed together in firm, round balls ready for the mechanical treatment. The wooden hammers in the stamping machine change the rinsed mass to an even pulp of individual fibres in one hour (A21). The pulp is collected in nylon-lined baskets and rinsed and macerated for the last time in running water (A24). At this point, only the pure fibres are left, resembling a white fleecy material.

2. Paper mould

The classic tripartite Japanese mould is used at Kazuo Konbu's workshop. The inner dimensions of the mould do not correspond precisely to the dimensions of the sample, because it is divided into halves. The length of the mould is estimated to be approximately 100 cm (A26). The width of the mould is 24.4 cm (A28). A removable flexible mat of twisted silk threads and bamboo splints forms the bottom of the mould (A32), supported by transverse ribs in the mould (A37). The mat is fixed during the sheet formation by the hinged deckle (A39).

3. Sheet formation and drying process

Fibres and water are mixed in a deep, steel-lined wooden vat to form a homogeneous pulp using a single large reed temporarily hung over the vat (A41). Water and fibres are mixed together by moving the reed to and fro. A portion of viscous plant mucilage is added (A46) (an aqueous extract from the inner bark of *Hydrangea paniculata*, locally called *utsugi nori* or *neri*). It is mixed together with the pulp, immediately changing it to a viscous consistency. The mucilage prevents the fibres from clumping together and sinking in the vat. The draining of water through the woven mat during sheet formation is delayed by the mucilage, giving time for an even spreading of the fibres on the mould.

The pulp is scooped up with the mould once (A47), and spread with light vibration of the mould (A51) in an even layer. The mould is placed on a tilting board over the vat and, using the flexible bamboo mat, the layer of fibres is couched (A56) directly onto the wooden drying board (A57). The board is placed in the sun for final drying of the sheet of paper (A63). The usual procedure of pressing or smoothing the paper with a brush on the drying board was not carried out.

Documentation: 15 colour slides from Kazuo Konbu's workshop.

Checklist B. Macroscopic laboratory observations for sample no. 2

The length of the sheet is 49.5 cm (B01) and the width is 24.4 cm (B05). The width of the sheet is intact (B08), but the length was originally about 100 cm. The average thickness of the sheet is 0.047 mm (B10), minimum thickness is 0.044 mm (B13) and maximum thickness is 0.050 mm (B16). The weight of the sheet is 8 g/m^2 (B19) and the density 0.15 g/cm^3 (B22). There are impressions of twisted threads in the paper in the form of 13 light chain lines (B26) and traces of the supporting ribs in the form of 7 light shadow lines (B27). The distance between the chain lines is about 3 cm (B29), and about 6.5 cm between the shadow lines (B32). The opacity of the thin paper is 0.23 (B 37) compared to the reference measure of 1.27. The colour is warm greyish white with a reflection of 9.44 (B42) compared to the reference measure of 9.41, and the colour is in the dark part of the scale. The paper is glossy (B44) with a smooth surface (B46), without brush marks or an impression of wooden structure. The paper is very soft (B51) and has no rustling sound with quick movement (B54). There is a very even fibre distribution (B55) and a dominant fibre direction parallel to the chain lines (B58).

Documentation: 9 black/white photos, 5 colour slides.

Checklist C. Microscopic laboratory observations for sample no. 2

The fibre mass is a mixture of thin and slightly thicker fibres (C01). The average fibre thickness is 0.020 mm (C03) with a minimum fibre thickness of 0.008 mm (C07) and a maximum fibre thickness of 0.040 mm (C11). The average fibre length is 6.6 mm (C14), and minimum and maximum fibre lengths are 2.7 mm (C16) and 8.8 mm (C26). The fibre ends are tapering and pointed (C22), with a slightly wavy surface (C26). The fibre surface is veined and striated parallel to the long axis of the fibre (C28). Dislocations (C29) and diagonal cross marks occur frequently (C30). Horizontal cross marks have also been observed (C31), as well as thickenings of the fibres (C33).

The primary wall is loose-lying (C35) with folds (C36), frayed (C37), burst and sporadically missing (C39). The secondary wall of the fibre is laid open in areas (C40) and staining with chloride/zinc/iodine causes a strong swelling reaction of the secondary wall (C42). Amorphous substance connects the fibres sporadically (C45) and a sporadic pectin reaction of purple and red colour occurs in the amorphous substance when stained with ruthenium red and toluidine blue (C46). Few fibres show pectin content in the fibre wall when stained with toluidine blue and ruthenium red (C48). Light fibrillation occurs (C49). Individual cluster crystals occur (C51), as well as prismatic crystals (C53). The presence of plant mucilage is revealed by the uncooked starch grains (C55) and raphides from the inner bark of *Hydrangea paniculata* (C57). A web of hyphae is observed (C59) and a cross-section of the paper shows a dominant fibre direction (C62).

Documentation: 11 scanning electron microscope photos, 39 differential interference contrast microscope photos, 4 polarization microscope photos, 2 sheets of fibre drawings.

Part II: Analysis and identification of unknown eighteenth-century Japanese papers

This second part of the project dealt with the analysis of the collection of eighteenth-century paper specimens of unknown origin, following methods analagous to Part I. Early seventeenth- and eighteenth-century references to

Japanese paper production and technology substituted for field notes related to the actual production of the 13 papers. These references with empirical information give some idea of what one might expect to observe and what would be unusual. However, these were less useful than detailed field notes, and this part of the project relied mainly on the identification of fibre materials and paper technology in the unknown papers and a comparison of these with the known papers.

A revised checklist, omitting irrelevant observations from lists A, B and C, was compiled for the macroscopic and microscopic analysis.

Checklist D: Identification of unknown paper

1. Fibre material

C03. Average fibre width, 0.011–0.013 mm
C04. Average fibre width, 0.014–0.020 mm
C05. Average fibre width, 0.021–0.026 mm
C06. Minimum fibre width, 0.005–0.006 mm
C07. Minimum fibre width, 0.007–0.008 mm
C08. Minimum fibre width, 0.009–0.010 mm
C09. Maximum fibre width, 0.018–0.029 mm
C10. Maximum fibre width, 0.030–0.039 mm
C11. Maximum fibre width, 0.040–0.043 mm
C12. Average fibre length, 2.0–3.5 mm
C13. Average fibre length, 3.6–5.5 mm
C14. Average fibre length, 5.6–8.9 mm
C15. Minimum fibre length, 1.1–1.9 mm
C16. Minimum fibre length, 2.0–4.0 mm
C17. Minimum fibre length, 4.1–6.7 mm
C18. Maximum fibre length, 3.0–7.0 mm
C19. Maximum fibre length, 7.1–13.0 mm
C20. Maximum fibre length, 13.1–14.5 mm
C21. Varying thickness of cell wall
C22. Fibre ends tapering and pointed
C23. Fibre ends rounded
C24. Fibre ends branched
C25. Smooth surface of fibre ends
C26. Slightly wavy surface of fibre ends
C27. Fibre surface smooth
C28. Fibre surface veined and striated parallel to the long axis of the fibre
C29. Dislocations
C30. Diagonal cross marks
C31. Horizontal cross marks
C32. Short cross marks
C33. Thickening of fibres
C34. Constriction of fibres
C35. Loose primary wall
C36. Folded loose primary wall
C37. Frayed primary wall
C38. Tiny ribbons of primary wall around the fibre
C41. Weak swelling reaction to chloride/zinc/iodine staining
C42. Strong swelling reaction to chloride/zinc/iodine staining
C51. Individual cluster crystals of calcium oxalate
C52. Chains of cluster crystals of calcium oxalate
C53. Single prismatic crystals of calcium oxalate
C54. Clusters of prismatic crystals

2. Preparation of fibre material

C02. A few coarser and unseparated fibres
C37. Frayed primary wall
C39. Burst and sporadically missing primary wall
C40. Secondary wall laid open in areas
C41. Weak swelling reaction to chloride/zinc/iodine staining
C42. Strong swelling reaction to chloride/zinc/iodine staining
C43. Fibres connected by amorphous substance
C44. Fibres surrounded by amorphous substance
C45. Sporadic occurrence of amorphous substance
C46. Sporadic pectin reaction to staining in amorphous substance
C47. Pronounced pectin reaction to staining in amorphous substance
C48. Sporadic pectin reaction to staining in fibre wall
C49. Light fibrillation
C50. Heavy fibrillation

3. Paper mould

B01. The length of the sheet, 33.5–58.0 cm
B02. The length of the sheet, 58.1–78.0 cm
B03. The length of the sheet, 78.1–145.0 cm
B04. The width of the sheet, 16.5–23.5 cm
B05. The width of the sheet, 23.6–34.6 cm
B06. The width of the sheet, 34.7–64.0 cm
B07. The sheet has not been trimmed
B08. The width of the sheet is intact
B09. The sheet has been trimmed on all edges
B25. Imprint of coarsely woven material
B26. Imprint of chain line of twisted warp thread
B27. Shadow lines from the supporting ribs of the mould
B28. Imprint of laid lines from bamboo splints or straw/reed of the mat
B29. Distance between chain lines, 2.6–3.6 cm
B30. Distance between chain lines, 3.7–5.0 cm
B31. Distance between double chain lines, 0.7–2.0 cm
B32. Distance between shadow lines (transverse ribs) 6.5–8.0 cm
B33. Distance between shadow lines, 8.1–12.5 cm
B34. Bamboo splints or straw/reed per 3 cm, 13–17
B35. Bamboo splints or straw/reed per 3 cm, 18–23
B36. Bamboo splints or straw/reed per 3 cm, 24–30

4. Sheet formation and drying process

C58. Filler particles present
C55. Individual uncooked starch grains
C56. Clusters of intact starch grains
C57. Individual raphides
C60. Cross-section shows layers with varying fibre direction
C61. Cross-section shows a random fibre direction
C62. Cross-section shows a dominant fibre direction
C63. Cross-section shows a central interstice
B55. Homogeneous fibre distribution
B57. Irregular fibre distribution
B58. Dominant fibre direction
B59. Random fibre direction
A55. Double edge is folded after the sheet formation

A58. Thread/bamboo splint is inserted between the sheets of paper
B10. Average thickness of the sheet, 0.022–0.122 mm
B11. Average thickness of the sheet, 0.123–0.196 mm
B12. Average thickness of the sheet, 0.197–0.597 mm
B13. Minimum thickness of the sheet, 0.022–0.120 mm
B14. Minimum thickness of the sheet, 0.121–0.190 mm
B15. Minimum thickness of the sheet, 0.191–0.504 mm
B16. Maximum thickness of the sheet, 0.030–0.129 mm
B17. Maximum thickness of the sheet, 0.130–0.210 mm
B18. Maximum thickness of the sheet, 0.211–0.753 mm
B60. Traces/streaks from brush hairs
B61. Imprint of wood structure
C64. Fibres smooth on top surface of paper

Results

The final identification of the unknown paper specimens by comparison with the reference material of known papers confirmed that the method was useful to some extent, and that information could be derived from the papers about fibre material, paper mould and sheet formation. However, a complete identification of the entire papermaking process from preparation of the fibre material to the final drying process was not possible.

No optical evidence was found in the reference papers to distinguish between the different methods of the initial pulping of the original papermaking material, or the final mechanical treatments of the individual fibres. The degree of fibrillation seemed to be the result of the actual tendency of the fibres to fibrillate and the duration of the mechanical treatment and maceration, rather than being dependent on the method of treatment. Fibres that were more heavily fibrillated than those in the reference papers were observed in the old paper samples, as well as a less perfect distribution of coarse fibres. These types of papers may have been recycled paper, meant for decorative applications.

The identification and description of the unknown paper samples in the pilot project corresponded in many ways to information that appeared later in a handwritten list of Japanese paper samples at the National Museum.[7] Edouard de Bavier, a Swiss silk dealer, had collected the paper samples in 1872, inspired by a similar collection of paper organized by Sir Henry Parkes when Parkes was British ambassador in Tokyo. De Bavier copied the English classification for the samples, referring to the Japanese designations for paper qualities and provenance, and this list confirmed the results of the pilot project identification.

Part III: A Classification key

This part of the pilot project developed a classification key based on distinctive features found in the reference material of oriental papers of known origin.

Classification of fibre material and technology used

1. Microscopic observations

(a) Classification of fibre material

(i) Average fibre length 2.1–4.9 mm; ample occurrence of pectin in the amorphous substance; smooth and pressure-sensitive surface of the fibre: *Thymelaeaceae* family (*mitsumata, gampi,* lokta)

- Presence of druses; fibre ends rounded, pointed and bifurcated; ample pectin in fibre walls; strong swelling with chloride/zinc/iodine stain: *mitsumata,* lokta
- Lack of druses; sporadic or complete lack of pectin in fibre walls: *gampi*
- Sporadic occurrence of loose primary wall; no transverse folds: *mitsumata*

(ii) Average fibre length 6.0–8.9 mm; loose transverse folded primary wall; pointed fibre ends; diagonal and horizontal cross markings and thickenings; varying occurrence of pectin; occurrence of druses; varying occurrence of prismatic crystals: *Moraceae* family (*kōzo*)

- Average fibre length 6.0–8.9 mm; fibre width 0.013–0.020 mm: *kōzo*

(b) Fibre preparation

(i) Lack of prismatic crystals in *Moraceae:* The green inner bark of the *kōzo* bast strips is removed with the outer bark before the cooking process.

(ii) The amount of amorphous substance

- Ample amorphous substance: The rinsing process has been of short duration, and the fibre material most likely originates from a plant of the *Thymelaeaceae* family.
- The fibres are partly combined with amorphous substance: The rinsing process has been careful and stretched over several days, combined with a sun and water bleaching process.
- The fibres form an open network structure, with sporadic occurrence or lack of amorphous substance: Several days of rinsing and maceration followed by a final maceration in water of the pulp in lined baskets have dissolved the original fibre structure.

(iii) The degree of fibrillation

- Light fibrillation of the fibres: The cooking process has weakened and softened the mid-lamellas to such a degree that prolonged hammering/stamping and macerating in a hollander or *naginata* is unnecessary for the complete dissolution of the original fibre structure.
- Heavy fibrillation of the fibres: The cooking process and maceration have not resulted in a sufficient softening and breakdown of the mid-lamellas. A long mechanical treatment was necessary to break down the fibre material into individual fibres. Heavy fibrillation is a characteristic of recycled paper.

(c) Pulp preparation

(i) Occurrence of separate uncooked starch grains: Aqueous extraction of plant mucilage is added to the pulp as a sheet-formation aid.

(ii) Occurrence of needle-shaped crystals (raphides): The plant mucilage is an aqueous extraction of the

inner bark layer of *Hydrangea paniculata*, locally called *utsugi neri* in Japan.

(iii) Fine granular particles among the fibres: Fillers have been added to change the opacity, hygroscopicity and colour.

(iv) Clusters of uncooked starch grains: Finely ground rice has been added to the pulp as a filler.

(d) Sheet formation

(i) Cross-section of the sheet of paper shows one dominant fibre direction: The mould has been moved forwards and backwards with a slight vibration, resulting in a dominant fibre direction; most fibres are settled in the same orientation (*tame-zuki* method).

(ii) Cross-section of the paper shows stratified layers of fibres in that the fibre direction of layers 1, 3 and 5 is the same, and is perpendicular to the fibre direction of layers 2 and 4: The papermaker has spread the pulp in the mould with rhythmic movements forwards and backwards in the two outer and the middle layers, all having the same fibre direction. The mould has been moved from side to side in layers 2 and 4, resulting in a fibre direction perpendicular to layers 1, 3 and 5. Before couching, the coarser fibres still in suspension are thrown back into the vat (*nagashi-zuki* method).

(iii) Cross-section of the sheet of paper shows a random fibre direction: Plant mucilage has not been added as a sheet-formation aid, causing the pulp to drain quickly through the mould.

- The pulp is scooped up once with the mould, which is vibrated slightly during the quick draining process, or
- The mould is floating in water while the pulp is poured into the mould and distributed by quick, whirling movements of the hands, or
- The mould is floating in water while the heavily beaten pulp is poured into the mould, spreading to an even layer.

(iv) Cross-section shows a central interstice with equal numbers of layers on each side: The sheet of paper is a double sheet, formed simultaneously in the mould on two loose mats. These are put together when the fibre distribution and thickness of the sheet are satisfactory. The top mat is replaced in the mould while the double sheet of paper is couched from the bottom mat.

2. Macroscopic observations

(a) Preparation of the pulp

(i) The fibre mass is a mixture of fine fibres, coarser fibres and unseparated fibres: The sorting of the outer bark layer and coarser fibres was done with the wet bark strips.

(ii) Occurrence of larger coherent clumps of new fibres: The fibre mass consists of recycled material, more or less thoroughly dispersed, mixed with new raw bast fibres.

(iii) The fibre mass is a homogeneous mixture of fine fibres with a few single coarser fibres, or with no coarser fibres: The sorting of coarser fibres has been done both from the wet bast strips and from the dried ones, followed by straining of the pulp before the sheet formation. One more sorting of coarser fibres takes place during the sheet formation in the *nagashi-zuki* method, where the sheet formation finishes with the dispersal into the vat of the superfluous coarser fibres.

(b) Sheet formation

(i) Even distribution of the fibres: Plant mucilage has been added to the pulp in order to prevent the fibres from clumping together and to delay the draining. The papermaker controls the distribution of the pulp with various movements of the mould while the fibres settle slowly.

(ii) Cloudy distribution of the fibres and random fibre direction: Plant mucilage has been added to the pulp, but the pulp has not been mixed sufficiently before the distribution of the pulp in the mould.

(iii) Irregular distribution of the fibres and random fibre direction: Plant mucilage has not been added to the pulp.

(iv) The fibres lie in irregular groups where coarser fibres form round patterns: The pulp is poured into a floating mould where the fibres are distributed in swirls by stirring.

(v) The fibres lie in irregular, lightly cloudy groups: The beaten and stirred pulp has been poured into the floating mould with the fibres spreading and settling simultaneously when the mould is lifted up.

(c) Paper mould

(i) Impression of laid lines, chain lines and shadow lines in the sheet of paper: The sheet is formed on a mould with a flexible, removable mat made from bamboo splints or straw, joined together with thread. The mat is supported by cross-ribs in the lower part of the tripartite mould.

(ii) Laid lines with irregular distances: The mat is made from straw or reeds.

(iii) Laid lines with regular distances: The mat is made from bamboo splints.

(iv) Impressions of chain lines and shadow lines only (no laid lines): The mat has been covered by a thin silk material in order to obtain a smooth paper surface.

(v) Impressions of shadow lines only (no laid or chain lines): The impressions of the chain lines cannot be seen through the silk material because of the density of the fibres.

(vi) Impression of a woven fabric pattern in the paper: The mat has been covered by two layers of silk, preventing the mat structure from making an impression in the sheet of paper, or the sheet is formed on a mould with a fixed mat of woven linen fabric.

(vii) The original four edges of the sheet of paper are preserved: The inside measurements of the deckle or mould correspond to the format of the sheet. The width of double sheets must be doubled to calculate the width of the mould.

(viii) All original edges have been trimmed: No information about the precise inside measurement of the deckle/mould and no information about double edges or impressions of separating threads.

(d) Character and look of the paper

(i) A glossy surface, light crackling rattle, low opacity: No filler has been added.

(ii) A lustreless surface, high opacity and weight in proportion to thickness: Filler has been added to the pulp, or a ground has been applied to the paper.

(iii) A porous transparent paper without crackling rattle: Thin *kōzo* paper.

(iv) A non-porous transparent glossy paper, light crackling rattle: Thin *mitsumata*, *gampi* or lokta paper.

(v) Varying fibre distribution, paper thickness and stiffness: Sheet formation was done on a floating mould, followed by drying in the mould without pressing.

(vi) The front of the sheet of paper (the front is the smoothest side, without the impression of the mat or brush marks from the smoothing of the paper before drying) shows an impression of wood grain: The sheet was dried on a board of pine. Drying on boards of pine can result in impressions of wood grain on the front, in contrast to drying on smooth ginkgo boards or steel plates.

(vii) Slightly uneven front surface without woven pattern: The sheet of paper has dried in the mould.

(viii) The back of the sheet of paper shows an impression of chain lines and laid lines, visible in a raking light: The rougher side was in contact with the mat during the sheet formation.

(ix) The back of the sheet shows an impression of brush marks: The sheet has been couched and smoothed on a drying board with a brush.

(x) An impression of wood grain on the front and a lack of brush marks on the back of the sheet: The brush hairs have been covered with a piece of silk in order to avoid brush marks.

(xi) An impression of linen woven fabric: The sheet of paper has dried in a mould with a fixed mat or the mat has been covered by coarse woven silk. The texture of a linen woven mat makes an impression on the back of a sheet of heavy paper, but thin papers will be clearly impressed with the woven pattern of the fixed mat or the silk-covered flexible mat.

This classification system has recently been used in a comparative analysis of central Asian paper of much older origin than the eighteenth-century collection of Japanese paper samples.[8] These central Asian or east Turkestan papers originated in the same area and period as the ancient fragments analysed nearly 100 years ago by Julius von Wiesner. The papers are in most cases well preserved because they were protected for centuries against humidity, light and mechanical damage. However, the mixtures of recycled fibres from hemp, ramie, and linen, and raw fibres from bamboo, rice straw, *kōzo*, *gampi* and lokta, typical of these very early paper manuscripts, are confusing and much more complicated than the eighteenth-century Japanese paper samples. Further observation and studies of the changes that occur between the original botanical bast material and the web of fibres in a finished paper sheet are necessary in order to find distinctive features for hemp, ramie, bamboo, linen and rice straw similar to the description of *kōzo*, *gampi*, *mitsumata* and lokta in the reference material. It is time-consuming but fascinating to look for information in the paper itself in this non-destructive way and hopefully to find new knowledge about the origin, provenance and condition which will be of importance to curators as well as to paper conservators and paper historians.

Notes

1. The principal subjects of the summer exhibition were Japan, Japanese culture, and the uses of paper in everyday Japanese life.
2. The Austrian archduke Rainer's collection in Vienna consisted of 12,500 documents dating from 796 to 1388 and included writing materials of skin/leather, parchment, papyrus and paper. Von Wiesner's examination of Arabian Faiyûm paper from the eighth to ninth centuries was the first scientific analysis of paper.
3. Von Wiesner focussed on two types of local fibres: fibres previously used for woven materials (linen, hemp, ramie, jute, sunn and gambohemp), and raw fibres used for papermaking (bamboo, grasses, rice straw, linen, hemp, ramie, jute, sunn, gambohemp, paper mulberry, mulberry, khoi, *gampi*, *mitsumata* and lokta.)
4. In *Mikroskopische Untersuchung einiger früher Ostasiatischer Tun-Huang Papiere*, Harders-Steinhauser describes fibre lengths and fibre widths, as well as macroscopic observations of watermarks, fibre distribution and fibre orientation.
5. A simple method for measuring opacity using a Barbieri reflection and transmission densitometer was chosen. The portion of the incident light not transmitted through the paper sample is the opacity, and the value is read directly from the instrument. Sample no. 4 (Sa KT 30) was chosen as the reference sample because it was the thickest, with an opacity reading of 1.27.

6. Colour reflectance as measured by the Barbieri densitometer is the ratio of incident light to reflected light. *Kōzo* paper no. 2 from Paper Nao's 1989 sample book was chosen as a reference sample because its colour was in the mid range of all the samples, with a colour reflectance value of 9.41 units.
7. The handwritten list of Japanese paper samples contained information about the name of each paper, its provenance and its use. It was divided into three sections: white papers, treated and decorated papers and oil-treated waterproof papers.
8. These were archaeological paper fragments which were excavated in Lou-lan by Sven Hedin in 1901 and Sir Aurel Stein in 1907. The results of the examination are to be published in Kyoto.

Japanese Decorated and Processed Papers of the Nineteenth Century

PHILIP MEREDITH

Abstract

A great number of handmade papers were produced in Japan during the nineteenth century, many of them decorated or processed for a specific use. This paper is an overview of these decorated and processed papers, their names, the techniques used in their production, how to recognize them and the purposes for which they were used. The paper also refers to Japanese decorated and processed papers acquired in the early nineteenth century by Philipp Franz von Siebold and held in the collection of the National Museum of Ethnology, Leiden.

Nineteenth-century Japan was a culture that relied heavily upon paper, not just for the more obvious uses of documents, letters and printing, but for many other purposes that extended into all aspects of everyday life.

The craft of handmade papermaking had been introduced from China and the Korean peninsula around the beginning of the seventh century; at first paper was used primarily by the temples, the government and the court. During the following twelve centuries the craft of papermaking blossomed and spread throughout most of the country. The earliest papers were made from hemp fibre, but by the beginning of the nineteenth century the most commonly used fibres were *kōzo* (*Brussonetia kajinoki* Sieb.), *gampi* (*Wikstroemia sikokiana* Franch. et Sav.) and *mitsumata* (*Edgeworthia papyrifera* Sieb. et Zucc.). The nineteenth century saw the end of the feudal Edo period and the beginning of industrialization with the Meiji period in 1868. Although industrialization brought the introduction of machine-made paper to Japan, handmade paper continued to be an important product throughout the nineteenth century.

The uses of paper were numerous. In houses, it covered the windows (*shōji*), the walls (*kabe-bari*), ceilings (*tenjō-bari*) and sliding doors (*fusuma*). It was used for the mounting of hanging scrolls (*kakejiku*), folding screens (*byōbu*) and the binding of books and albums. Made into thin, sheer tissue, it was used as a handkerchief or cosmetic paper. Fans, parasols, umbrellas and lanterns were all made of paper. It was used in sheets for clothing (*kamiko*), as a lining to provide warmth, or waterproofed for rainwear (*ama-gappa*). It was also twisted into thread and woven to provide a textile strong enough to withstand washing (*shifu*). Pasted together, it formed a durable laminate, which was sometimes further strengthened with oils, tannins or lacquer and used for boxes, containers, foodware, hats and helmets. Similar objects were also made from paper twisted into string, which was then woven and strengthened in the same way. Heavy paper was treated with oils and embossed or textured to make an imitation-leather paper used for tobacco pouches, wallets and stationery boxes.

Despite the widespread use of paper in Japan, its sometimes ephemeral use and status as a less expensive substitute for other materials in the applied arts has meant that surviving examples of unused papers or everyday paper objects are not numerous. Those that have survived in Japan are often undated or undocumented, which can make it difficult to ascribe them to a specific period. There are, however, some collections preserved in Europe which offer a valuable insight into the variety of papers produced in nineteenth-century Japan. They are important because they reflect the different types of papers available at the time of their acquisition and can sometimes serve as a guide to identifying or dating other papers of an unknown provenance.

The earliest collection of nineteenth-century Japanese papers in Europe is housed in the National Museum of Ethnology, Leiden, in the Netherlands. Other collections are preserved in the Royal Library in The Hague, the Victoria and Albert Museum and Kew Gardens in London, the German Book and Writing Museum in Leipzig, the National Museum of Denmark, Copenhagen, the State Museum Art Library, Berlin, and the Art Gallery and Museum, Glasgow.

The Leiden collection was acquired during the second and third decade of the 1800s. At that time the Dutch were the only westerners permitted to trade with the Japanese. They were confined to the artificial island of Dejima in Nagasaki Harbour and, except for official court journeys to the capital of Edo, were not allowed to travel through the rest of Japan. There seems to have been no active or regular export of Japanese papers to Europe by the Dutch at that time. There is some evidence that Japanese papers had reached Europe in the past, but those had been irregular or perhaps small consignments taken privately without appearing in the official register books, as was permitted. The Leiden papers were obtained by three people, all in the employ of the Dutch East India Company: Jan Cock Blomhoff, Johannes van Overmeer Fischer and Philipp Franz von Siebold.

An item in the Siebold collection of Japanese papers will be used as the basis for this paper: a collection of paper samples bound together in book form. It consists of over 120 samples of paper, plain, decorated and processed. This sample book is of special interest because it can be dated to the years 1823 to 1829, when Siebold was on Dejima. The title plate describes the book as 'A Collection of Japanese Papers — Special Products of the Various Provinces' with the additional note that they were 'Purchased in Osaka.' Osaka and the capital were the two major trading cities during the Edo period (1615–1868). Papers from all over the country were brought to the warehouses of the various provincial governments for resale and distribution. Many of the papers

were processed and decorated by craftspeople in the cities of Edo, Osaka or Kyoto, adapting the already established skills of book and print production and textile dyeing and printing that were peculiar to each location. It is not known whether Siebold ordered and had these papers sent to him at Dejima at some time between 1823 and 1829. We do know, however, that he travelled on the court journey to Edo in 1826, so it is possible that he bought the papers *en route* to the capital, in which case they can be dated more accurately to that year. The sample book is of interest also because the sheets are identified with their names and places of production written in phonetic syllables and are mostly untrimmed, giving an indication of their various sizes.

It is beyond the scope of this paper to describe all of the papers in the sample book, or to describe all of the decorated and processed papers produced in Japan during the nineteenth century. Using some of the decorated and processed papers in the Siebold sample book, however, it is possible to group them and look for clues as to how they were produced. It is hoped that this will serve as an aid to visually identifying and differentiating between other examples of Japanese papers. For the purposes of this paper, the term 'decorated and processed' has been chosen to describe papers that differ from plain papers in that they are embellished with a design or pattern, or have been modified in some way before, during or after formation of the sheet.

As a preliminary means of visually identifying papers, it may be useful first to subdivide them into coloured, decorated and textured groups. There will, of course, be papers that conform to all three categories, but the initial subdivision should help in looking for information on their manufacture. The three groups can be further subdivided by looking for evidence of techniques and methods of production which can provide more information about the papers and help with differentiation and identification.

A note on the names of Japanese papers may be of help. Many end in the suffixes *-kami*, *-gami* or *-shi*, all of which mean paper. The suffixes *-some* or *-zome* mean dyed or coloured, and the suffix *-hiki* or *-biki*, brushed or drawn.

Coloured papers

Papers may be coloured in various ways, using dyes, pigments or loading agents.

Suki-zome. When the fibres are dyed prior to formation or a colouring agent is added to the vat, the process is known as *suki-zome*. The resulting sheets can often be identified by their evenness of colour, which penetrates the whole sheet and is the same front and back. Vat-dyed sheets were often sold in sets of five colours (*goshiki-gami*). Thinner sheets were used for craftwork such as paper flowers. Heavier sheets were used for calligraphy or printing. Vegetable dyestuffs include *beni* (safflower) and *sūo* (sappan) for reds; *shikon* (gromwell) for purple; *kariyasu* (miscanthus), *kihada* (amur cork tree), *kuchi-nashi* (Cape jasmin) and *ukon* (turmeric) for yellows; *kurumi* (walnut), *yamamomo* (myrica) and *yasha* (alder) for browns; and *tade-ai* (Japanese indigo) for blue. Other colorants include *sumi* (carbon ink), *bengara* (red iron oxide) and naturally coloured earths, such as the coloured kaolins used in *maniai-shi*. Papers with a heavy mineral loading, such as *maniai-shi*, were often formed in a mould which included a woven textile (*sha*) placed over the bamboo-splint mat used in traditional moulds; the effect can be seen with transmitted light. The woven textile slowed drainage of the stock through the mould and allowed a more even sheet to be formed.

Vegetable dyes can usually be identified by their transparent colour, which allows the lustre of the fibres to shine through. Mineral fillers fill the spaces between the fibres, resulting in a more matt, opaque effect. Papers were also made whiter, smoother, heavier or more opaque by the addition of calcium carbonate or rice starch, but it is difficult to differentiate between the two by visual means only.

Sukikae-shi. By the nineteenth century, Japan already had a tradition of recycling papers that went back over eight centuries. Recycled papers (*sukikae-shi*) were made from waste paper and documents broken down in water and re-formed. In order to disguise the resulting discolouration from the old sheets and undissolved inks, papermakers would sometimes add some extra colour to the vat. A dark grey recycled paper with a strong addition of *sumi*, known as *minato-gami*, was used for papering the base of interior walls. Lighter grey recycled papers were used for official documents. A very thick recycled paper to be found in the Siebold sample book was produced as the base paper (*shin-gami*) for the covers of printed books. This type of paper was subsequently covered with a coloured paper and sometimes embossed before use, but can occasionally be discovered when a book is disbound or broken. Coarser coloured recycled papers were used for wrapping and packing. Recycled papers can often be recognized by fragments of undissolved paper in the sheet, as well as other inclusions such as hair and thread. Like *maniai-shi*, many *sukikae-shi* were formed on a mould which included a *sha*, to help with even distribution of the sometimes lumpy stock. If the paper is not too thick, this can be detected with transmitted light.

Hiki-zome. When papers are coloured after formation of the sheet by application of a colouring agent with a brush, the process is known as *hiki-zome*. They can be identified by brushstrokes which are sometimes left on the paper, or a puddling of colour from when it was applied too heavily. There is also a tendency for the colour to be stronger on one side of the sheet than on the other. This is most noticeable when the colour is an opaque pigment applied to a sized sheet (*gu-biki*), but more difficult to discern when the colour is a dye applied to a thin, unsized sheet. *Gu-biki* papers were often produced for decorative use, sometimes as the first stage in the production of a decorated paper (see *kara-kami*). *Yakutaishi*, a brownish-red brush-dyed sheet with a

distinctive glossy surface, was used for wrapping medicine. Persimmon tannin (*kaki-shibu*) was brushed onto paper to render it tougher and water-resistant.

Tsuke-zome. Paper was also coloured by dipping the finished sheet into a vat of dye (*tsuke-zome*). This method was most commonly used in the nineteenth century for dyeing paper with indigo. For a truly deep indigo colour this was the only satisfactory method. A vat of fermented indigo dye would be prepared, and each sheet to be dyed was clamped between two wooden sticks along the short edge of the paper in order to keep the sheet straight and allow for easier handling. After removal from the vat, the greenish-grey indigo dye oxidizes and the paper turns blue. A deeper shade was achieved by repeated dippings. A distinctive feature of paper dyed this way is the white border left where the paper was clamped between the two sticks and protected from the dye. Vat-dyed indigo paper was used for the covers of books (again, the white border can sometimes be seen on a disbound book). It was also used as a paper for the copying of Buddhist sutras in gold ink. A pale indigo-blue paper was obtainable in two ways: by adding indigo colour to the vat or pre-colouring the stock (*suki-zome*), or else by breaking down *tsuke-zome* sheets and re-forming them as a kind of *sukikae-shi.*

Decorated papers

Japanese papers may be decorated by a variety of techniques. As with coloured papers, it is possible to look for evidence that identifies the techniques and allows them to be classified.

Brushing

Brushes were used for creating patterns on paper. A wide brush with coarse or separate bristles could create an abstract pattern of parallel lines (*hakeme-biki*). Paper with a grid of horizontal and vertical brushstrokes, usually brown, is known as *chōji-biki.* It takes its name from the colour obtained from cloves, which were originally used in the production of this paper, scenting it as well as decorating it. By the nineteenth century it was used for the covers of books and albums and for papercraft. Paper with a fine grid of brushmarks was used for the borders of paper hanging scrolls. Known as *shike-shi*, or slub-silk paper, it imitated the effect of a plain-weave silk.

Printing

A large number of decorated papers were produced by printing, mostly with woodblocks or stencils.

Kara-kami is one of the oldest varieties of decorated papers. It was first imported to Japan from China during the Heian period (794–1185). It was so much prized as a calligraphy paper that domestic production began, and by the nineteenth century it was used extensively for papering walls, ceilings and the backs of folding screens and sometimes for the borders of paper hanging scrolls. Usually it consists of a sized sheet which is brush-dyed

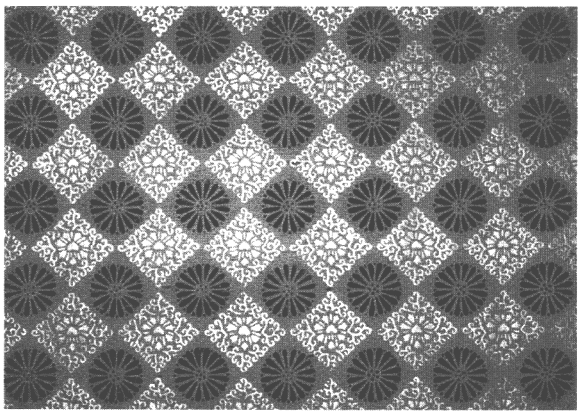


Fig. 1 ***Kara-kami.*** **Block-printed. Siebold sample book, sample number 24. Collection number 1-3060, National Museum of Ethnology, Leiden.**

with an opaque pigment, often shell white. The design is generally printed in mica, which gives a distinctive soft sheen to the image (fig. 1). Sometimes this is reversed, with the ground brushed with mica and the image printed in shell white. Either the shell white or the mica can be tinted with other colours to create an infinite variety of colour combinations. There are numerous designs used for *kara-kami*, many of them based on textile designs from various periods. By the nineteenth century this repertoire had expanded to include the more graphic and dynamic designs of the late Edo period. The printing technique for *kara-kami* differs from that of Japanese woodblock printing in a number of ways. The block is cut from a thick plank of magnolia wood. This is softer than the cherry wood used for woodblock prints, but allows the block to be cut more deeply, thus preventing it from flooding with the generous application of colour used for the printing process. (When it can be detected, the flooding of finely cut shallow depressions in the block with ink or colour is one of the signs that distinguishes a block-printed paper from a stencil-printed paper.) The colour is applied to the block with a sort of cloth-covered tambourine, called a *furui.* Paste and seaweed gel (*funori*) are added to the printing colour. The ratio may be altered to produce an opaque or a semi-translucent mix. This is brushed onto the *furui* and the colour is transferred to the block by patting it on with the *furui.* The paper is lowered onto the block and gently rubbed with the palm of the hand. The sheet can be half peeled back and further colour added to the block, first on one side, then the other, in order to build up the density of colour, if required. When the paper is finally peeled away from the block, there is sometimes a distinctive dragging or movement of the colour (*tarashikomi*), which is a characteristic of *kara-kami.* This gentle method of printing does not leave the 'bite' of the block in the paper as can sometimes be seen in traditional Japanese woodblock printing (see *chiyo-gami*, *e-hōsho*, *e-maki-gami* etc). Some texture in the surface of *kara-kami* can be seen, however, when it has been treated to give it the appearance of a woven textile, perhaps in reference to the origins of some of the patterns. This effect, known as *nuno-me-uchi*, was achieved by stacking damp sheets interleaved with mats of woven horsehair. The stack was beaten or pressed and the

texture of the textile transferred to the paper. During the nineteenth century, *kara-kami* was also produced with stencils, which were made from a laminate of papers brushed with persimmon tannin. To produce a pattern in high relief known as *oki-age*, a thick stencil was used to provide depth and the colour was smeared through the stencil with a spatula. Thinner stencils were used for *kara-kami* where a thick build-up of colour was not required; this variety of stencilled *kara-kami* can sometimes be seen on the backs of folding screens. It was convenient for the mounter to paper the back of the screen first, then have the *kara-kami* printer paint and stencil the surface in two successive operations. Stencil-printed papers can be detected in a number of ways. When the colour is brushed on, it sometimes seeps under the edge of the stencil, bleeding out beyond the limits of the image in a way that is not possible with block-printing (fig. 2). Some designs (a ring, for example) cannot be printed by stencil without the use of 'bridges' to prevent the centre of the stencil from falling away (fig. 3), or the use of a 'double stencil,' in which the ring is divided into four slightly overlapping quarters and printed with two stencils.

Gyōsei-shi is a paper printed in a single colour, often from a white-line block, so that the background appears as coloured and the image is held in reserve (fig. 4). The designs are usually small in scale, depicting auspicious emblems or ornaments and generally printed on smooth white *maniai* paper. The colours are usually the organic blues, reds and yellows used in woodblock printing. This paper was used for book covers and craft work, such as the lining of boxes.

Rikkyū-shi somewhat resembles European paste papers (fig. 5). A well-sized sheet of paper is coated generously with a mixture of colour and rice-flour paste. This is put down onto the printing block and rubbed with the palm of the hand. As the paper is lifted away, the points where the block was in contact with the colour create a rippling, almost three-dimensional effect. Where the pigment did not touch the block, the marks of the brush used to apply the colour can sometimes be seen. White-line blocks were sometimes used for *rikkyū-shi*, but the designs are generally larger in scale than those of *gyōsei-shi*, and are often floral motifs or arabesque patterns. *Rikkyū-shi* was used for the backs of folding screens, the borders of paper hanging scrolls and book covers.

Kinran-shi means gold-brocade paper. It was printed from relief blocks onto paper with an opaque coloured ground. The 'gold' pigment used was an imitation gold alloy, which tarnishes with exposure to the air. It was used for the borders of paper hanging scrolls as a less expensive substitute for genuine gold brocade. Some examples of *kinran-shi* using a stencilled adhesive and metal foil are also known.

Chiyo-gami was produced in the same way as Japanese woodblock prints. It was printed in the larger cities, such

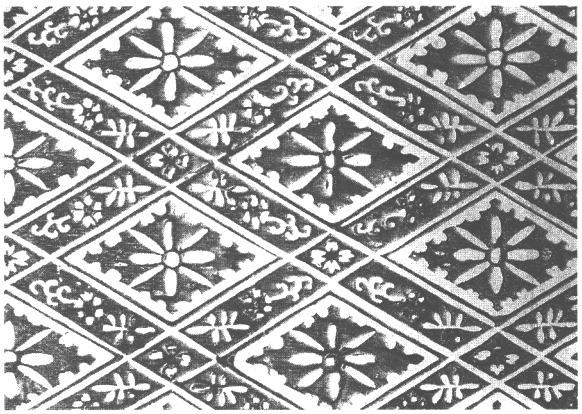


Fig. 2 *Kara-kami*. Block-printed. Private collection.

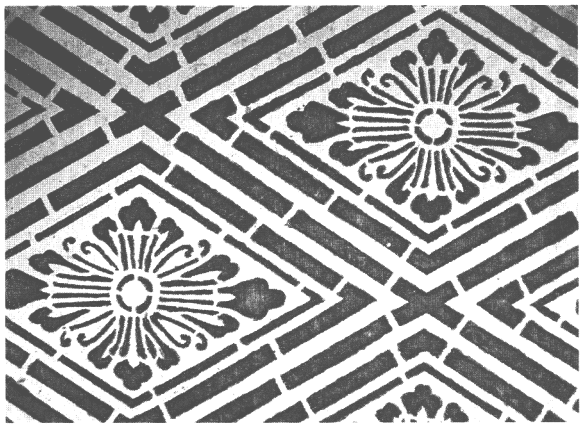


Fig. 3 *Kara-kami*. Stencil-printed. Private collection.

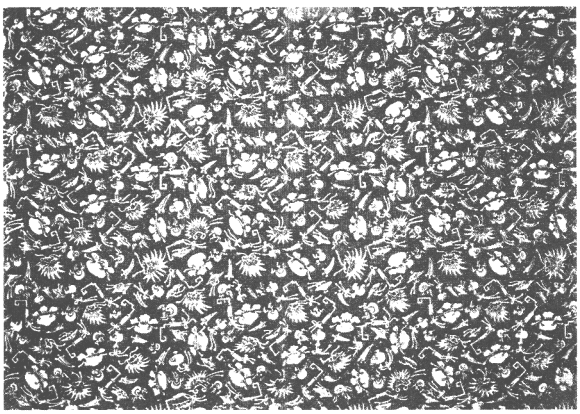


Fig. 4 *Gyōsei-shi*. Block-printed. Siebold collection. Collection number 1-4621, National Museum of Ethnology, Leiden.

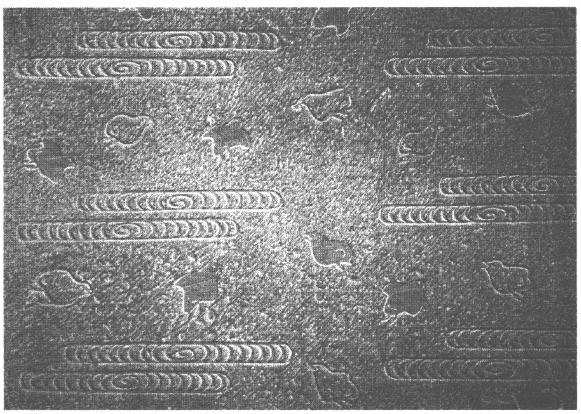


Fig. 5 *Rikkyū-shi*. Block-printed. Siebold sample book, sample number 50. Collection number 1-3060, National Museum of Ethnology, Leiden.

as Kyoto, Edo (Tokyo) and Osaka. The use of hard cherry woodblocks allowed for fine, detailed cutting. Vigorous burnishing of the paper on the block with the baren sometimes results in the 'bite' of the block remaining in the paper, particularly if it is of a heavier weight, such as *hōsho*, which was used for the more expensive varieties. The marks of the baren can sometimes be seen at the back of the sheet and, with thinner papers, the colour often penetrates to the reverse. Sold as a 'toy' paper, it was used to make dolls, line boxes, make decorative wrappings for small items and for other forms of papercraft. Patterns and designs often depict flowers or toys or have some seasonal or literary reference, and cover the entire surface of the sheet (fig. 6). The designs of *chiyo-gami* vary according to their time and place of production, so examples in collections such as Leiden's (which are recorded as having been produced in Osaka) are invaluable when referring to other examples.

E-hōsho and ***e-maki-gami*** (or *e-hangire*) were produced in the same way as *chiyo-gami*. They were both intended for use as a calligraphy paper, so the designs are usually asymmetrical, covering only a part of the sheet and printed in paler colours than *chiyo-gami*, so as not to distract from the script intended to cover them. *E-hōsho* are whole sheets of paper. *E-maki-gami* are half-sheets, cut horizontally and sometimes joined to make a roll, and used as a letter paper.

E-iri-tehon. *Tehon* were calligraphy practice books, and in the early nineteenth century a tall, narrow, accordion-fold format was common. Illustrated varieties, printed like *e-hōsho*, were known as *e-iri-tehon*. The Siebold collection contains an unfolded and unbound sheet with a simple line-block image of a horse and groom printed in black, red and green, which serves to indicate a style popular at that time.

E-sugihara. An unusual calligraphy paper in the Siebold sample book is described as *e-sugihara*. *Sugihara-kami* (also known as *sugiwara-gami* and *suibara-gami*) was popular in the Middle Ages as a rugged calligraphy paper for the warrior classes. The example in the Siebold collection is described as produced in Osaka and is decorated with a group of *rimpa*-style pine trees, printed like *kara-kami*, in mica, but onto an uncoloured sheet.

Mon-tengujo. *Tengujo* is a thin tissue paper. A decorated variety, *mon-tengujo*, was used for making paper lanterns, covering small paper windows and wrapping cosmetics. It was block-printed with shell white, usually in small geometric or floral patterns. The Siebold collection contains a chrysanthemum arabesque design printed in white and a coloured example (*iro-mon-tengujo*) of a spearhead design in green.

Sarasa-gami. *Sarasa* was the name given to painted and printed fine cottons imported from India and Java. Much prized in Edo-period Japan, they were later made domestically, and known as *wa-sarasa*, or Japanese *sarasa*. The

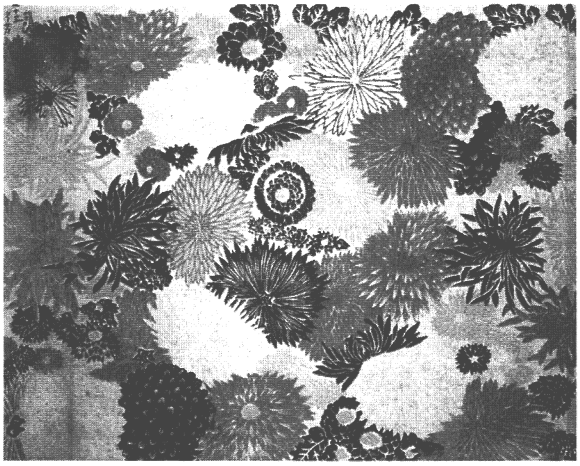


Fig. 6 *Chiyo-gami.* Block-printed. Siebold sample book, sample number 43. Collection number 1-3060, National Museum of Ethnology, Leiden.

Fig. 7 *Sarasa-gami.* Mixed technique. Siebold collection. Collection number 1-4615, National Museum of Ethnology, Leiden.

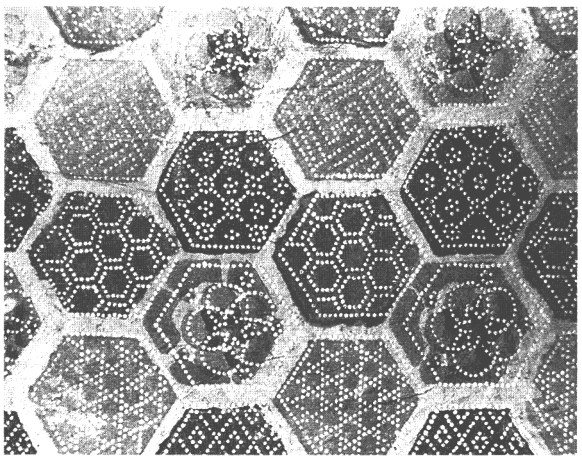


Fig. 8 *Sarasa-gami.* Stencil-printed. Private collection.

Japanese variety was sometimes block-printed, but more often produced with stencils, a technique which had already been developed for the fine paste-resist *ko-mon* textiles favoured by the townspeople. *Sarasa-gami* was popular for craftwork, the borders of paper hanging scrolls and book covers. The motifs are generally based on *sarasa* textiles, both imported and domestic, and it is interesting to note that there is often an attempt to suggest the texture of the cotton graphically, as with the Siebold example, by printing a background of fine ribbed

dots (fig. 7). How this was achieved is uncertain, but perhaps some kind of textile may have been used as a printing surface (it is interesting to compare the effect with the blind-printing *nuno-me-uchi* technique used for some examples of *kara-kami*). The Siebold *sarasa-gami*, which was made in Edo, has a bold design of plum blossoms and maple leaves stencilled in blue and brown. Other *sarasa-gami* can be recognized by the use of stencilled overprinting of fine white dots in shell white (fig. 8). This is perhaps in imitation of the pin-blocks that were used for some of the imported *sarasa* fabrics, or the fine dotted stencils used for *ko-mon* fabrics. As with stencil-printed *kara-kami*, it is also possible to recognize stencil-printed *sarasa-gami* by the use of bridges or double stencils, or the seeping of colour between the stencil and the paper.

Marbling

Suminagashi. Marbled paper was used for calligraphy in Japan from the twelfth century onward and was still popular in the nineteenth century, as the example in the Siebold book shows. It was produced in Echizen, where the technique had been a closely guarded secret for some centuries. It was produced by floating *sumi* and sometimes blue or red colour on the surface of a vat of water, separating each application with oil or resin. The colour was blown about the surface of the water and drawn out with a pine needle or human hair until the desired effect was achieved. A sheet of paper was then lowered onto the surface of the water to transfer the image to the paper. Examples of printed *suminagashi* also exist, produced as a kind of *chiyo-gami*.

Vat-processing

Kumo-gami. Also known as *uchi-gumo*, *uchi-gumori* and *un-shi*, *kumo-gami* (as it is identified in the Siebold book) was also popular as a calligraphy paper from the twelfth century onward. It was produced by first forming a sheet of *tormoko* paper. While still in the mould, a separate stock, prepared from *gampi* paper dyed blue or purple and then broken down, was poured across the sheet. The mould was then agitated to cause the lines of dyed fibres to move across the surface of the paper, producing a distinctive wavy, cloud-like effect.

Matsuba-gami. The Siebold book contains two samples of this paper, one blue and one red (*ao-matsuba* and *aka-matsuba*). Although the name means 'pine-needle paper,' this appears to be a recycled paper which has been decorated by the addition of a scattering of chopped bark. It is similar to other papers known as *sennen-shi*, *sendai-shi* and *sugikawa-gami*, all of which were decorated with fragments or slivers of bark of some kind, and were used for papering walls.

Mon-shōin. *Shōin-shi* are papers used for covering the windows of the *tokonoma*, or formal display alcove, in a traditional Japanese interior. Although plain papers were commonly used, there are examples of decorated varieties. *Mon-shōin* is a watermarked paper, usually produced by sewing a design, cut from paper treated with persimmon tannin, onto the mould, to create a lightly watermarked paper. Watermarked papers were also produced in moulds containing a *sha* upon which the design was painted in lacquer. *Mon-shōin* patterns are generally floral or geometric, as with *mon-tengujo*. The example in the Siebold book is a medium-sized chrysanthemum arabesque.

Textured papers

Momi-gami means 'crumpled paper,' and in the Siebold book is an example identified as *shibu-momi-gami*. It has been treated with persimmon tannin, giving it a distinctive glossy, dark brown surface, and then crumpled by hand to produce a fine network of breaks and creases in the surface of the coating. The paper has also been printed in the same way as *kara-kami,* with a design of small plum blossoms in imitation gold. This paper was used for the borders of hanging scrolls and sometimes referred to as *momi-kara-kami*, to distinguish it from other crumpled papers, such as the thicker variety used for paper clothing. *Shibu-momi-gami* is not the most common form of *momi-kara-kami*. More popular were the papers made with earth colour and shell white mixtures. The base sheet was sized, then given one coating, or sometimes two, in contrasting colours. When dry, the sheet was crumpled or creased to cause some of the pigment to fall away and produce a variety of effects. At this point the textured surface of the paper is apparent, but after lining, the relief texture disappears and all that remains is the craquelure effect in the pigment.

Danshi. By the nineteenth century, *danshi* was a heavy paper with a deeply furrowed surface. It was created by smoothing three or four sheets of newly formed and pressed but undried paper onto a board. The sheets were peeled back at a sharp angle, creating rippled creases. The uppermost sheet was removed and air-dried, not brushed onto a drying board, as was normal for other handmade papers, thus preserving the texture. It was used for calligraphy, formal lists of gifts and formal wrappings. The sample in the Siebold book is identified as *chūtaka-danshi*. *Chūtaka-* refers to the size of the sheet, *chū* meaning medium. *Ōtaka-* and *kotaka-* mean large and small, respectively.

Nuno-me-uchi kara-kami. See *kara-kami*.

Reference List

Coloured papers

suki-zome
sukikae-shi
hiki-zome
tsuke-zome

Decorated papers

brushed *hakeme-biki*
chōji-biki
shike-shi

printed	*kara-kami*	block-printed / stencilled
	gyōsei-shi	block-printed
	rikkyū-shi	block-printed
	kinran-shi	block-printed / stencilled
	chiyo-gami	block-printed
	e-hōsho	block-printed
	e-hangire	block-printed
	e-iri-tehon	block-printed
	e-sugihara	block-printed
	mon-tengujo	block-printed
	sarasa-gami	stencilled / block-printed
marbled	*suminagashi*	marbled / block-printed
vat-processed	*kumo-gami*	
	matsuba-gami	
	mon-shōin	

Textured papers

momi-gami
danshi
kara-kami nuno-me-uchi

This list is by no means exhaustive and is intended only as a suggested guide to looking for evidence that will help to identify decorated and processed papers and the methods of their production. For further information refer to the bibliography. Of special interest are Tindale and Tindale's *The Handmade Papers of Japan*, which contains many tipped-in samples of historical papers, and the Mainichi Newspapers' *Tesukiwashi Taikan*, with over one thousand examples of Japanese handmade paper.

Select Bibliography

All Japan Handmade Washi Association. 1991. *Handbook on the Art of Washi*. Tokyo: Wagami-do.

Barrett, T. 1983. *Japanese Papermaking: Traditions, tools and techniques*. New York and Tokyo: John Weatherhill Inc.

Chambers, A. 1991. *Suminagashi: The Japanese art of marbling*. London: Thames & Hudson.

Herring, A. 1987. *The World of Chiyogami: Hand-printed pattern papers of Japan*. Tokyo, New York and San Francisco: Kodansha International.

Hughes, S. 1978. *Washi: The World of Japanese paper*. Tokyo, New York and San Francisco: Kodansha International.

Japan Paper Academy. 1998. *Washi in the Nineteenth Century*. Kyoto: Japan Paper Academy. (Catalogue of an exhibition of the Bartsch collection of Japanese papers, German Book and Writing Museum, Leipzig. Text in Japanese, German and English; list of exhibits in German.)

Mainichi Newspapers. 1973. *Tesukiwashi Taikan*. Tokyo: Mainichi Newspapers.

Paper Museum, Tokyo. 1994. *Umi wo watatta Edo no washi*. Tokyo: Paper Museum. (Catalogue of an exhibition of the Parkes collection of Japanese papers, Victoria and Albert Museum. Text in Japanese; list of exhibits in English.)

Schmoller, H. 1984. *Mr. Gladstone's Washi: A Survey of reports on the manufacture of paper in Japan, 'The Parkes report of 1871.'* Newton, PA: Bird & Bull Press.

Tindale, T.K., and H.R. Tindale. 1952. *The Handmade Papers of Japan*. Rutland, VT and Tokyo: Charles E. Tuttle Co.

Webber, P., and A. Thompson. 1991. An Introduction to the Parkes Collection of Japanese papers. *The Paper Conservator* 15: 5–16.

Characterization of Western Handmade Decorated Paper: Development of a Standard Terminology

HENK J. PORCK

Abstract

With regard to the use of terms in the field of decorated paper there is much confusion, as a uniform and systematic terminology does not exist. The Belgian-Dutch Society of Students of Bookbinding (Bandengenootschap) decided to tackle this problem, and formed a working group of bookbinding and paper historians for the purpose.

The first objectives of the group were to establish a logical nomenclature and a list of terms with unambiguous meanings. It was decided that the nomenclature should be based on the pattern of the decoration and other directly observable features, rather than on the technique of manufacture. On the other hand, the arrangement of terms — that is, their classification into categories — is based primarily on production technique.

For practical reasons, analysis was confined to western handmade decorated papers produced prior to *circa* 1850. Furthermore, the terminology was not intended to be all-embracing. Despite these limitations, the resulting terms in Dutch and their equivalents in other languages may provide a first step towards an international standard for the description and registration of decorated paper.

The main features of the developed terminology are described. For marbled papers, it proved possible to develop a very detailed terminology, which is presented. In the context of identification methodology, the principle of a new 'fingerprint' technique for identification of the sources of brocade paper is outlined.

Introduction

On studying decorated paper, one finds that it has been used in a multitude of ways. Decorated paper has been associated with bookbinding since the beginning of the sixteenth century, and *circa* 1700 it became a common material for book covers and endpapers. It has been used as a lining material for boxes, cabinets and suitcases, and for various other applications.

The literature of book and paper history provides no unambiguous nomenclature — a serious problem for the description and documentation of the different sorts of decorated paper. The traditional terminology is far from consequent; in some cases terms refer to the technique of decoration, in others, to its pattern or colour. Some terms even refer to the country of origin. A single kind of paper may have several different names and different kinds of paper have sometimes been given the same name.

Several attempts have been made since the 1930s to develop a logical system for classifying and naming the various types of decorated paper. The current proposal originated more than 10 years ago with the Belgian-Dutch Society of Students of Bookbinding (Bandengenootschap). Early in the 1990s a working group of this society was formed to follow up on the idea. Members of the group are Elly Cockx-Indestege, curator of the Royal Library in Brussels; Jan Storm van Leeuwen, curator of bookbindings at the Royal Library in The Hague; and Carina Greven and Henk Porck from the Historical Paper Collection of the Dutch Royal Library.

Full of enthusiasm, we started with the primary objective of working out a logical system for describing the decorated papers used in bookbinding, while also aiming at a set of clear, unambiguous terms for the characterization of these papers. It soon appeared impossible, however, to cover the whole field. For this reason, we have limited our analysis to western handmade decorated papers produced prior to the mid-nineteenth century.

We began by studying primary and secondary literature from the past 150 years. These sources provided a good overview of the existing patterns of decoration, of the techniques of their manufacture and of traditional descriptive nomenclature. On the basis of this overview, and also guided by many practical consultations with present-day craftsmen, we developed our system.

The main categories of our terminology are based on evident technical characteristics of the papers. There are six such categories: plain coloured or monochrome paper, metal paper, marbled paper, paste paper, block-printed paper and relief-printed paper. The subgroups are, however, distinguished on the basis of their visual aspects, their patterns, rather than decoration technique. The technique of manufacture often cannot readily be determined.

Only in the case of marbled papers was it possible to construct a terminology sufficiently detailed that each of the many different marbling patterns found could be classified. The other main types of decorated paper allowed only a more general set of terms.

Although our standard terminology was developed in the first instance for the Dutch language, equivalent terms for English, French, German and Italian are also proposed.[1]

Overview

Decorated paper, for our purposes, was defined as paper that is decorated on one or both sides, with colours in a more or less distinct repeat pattern. This definition was most relevant for the majority of papers in question.

An overview of the six main categories of our classification system follows. The illustrations all reproduce endpapers or loose sheets from the Bookbindings and Historical Paper Collections of the Koninklijke Bibliotheek, the Dutch Royal Library in The Hague. Only the Dutch terms and the equivalent English terms, signalled by *known as*, are given here. In cases

where it is considered useful to provide a literal translation of the Dutch term, the translation is signalled by *meaning*.

Plain coloured or monochrome paper

Effen papier, known as *plain coloured paper* or *monochrome paper*, is not commonly considered decorated paper, but the category proved to be essential to our system. A colorant can be mixed with the pulp during the paper production process; we call these papers *effen gekleurd*, meaning *plain dyed* paper. Alternatively, the colour can be applied by printing or by brushing. Brushed colour will often clearly show the brush strokes. Here we speak of *effen geverfd papier*, meaning *plain painted paper.*

Metal paper

Decorated papers that are evenly covered with a thin layer of gold- or silver-coloured metal foil or paint are called *metaalpapieren*, meaning *metal papers*. The two subgroups are *zilverpapier*, known as *silver paper*, and *goudpapier*, known as *gold paper* or *gilt paper*. These papers can be manufactured with real or imitation silver or gold leaf. With gold papers, the overlapping edges of the individual sheets of gold leaf are sometimes clearly visible. When gold or silver paint is used, the surface is often polished to obtain a metallic effect.

Marbled paper

Marbled paper is commonly produced by means of floating colours on a bath of liquid marbling size in a marbling trough, and by gently laying paper onto the coloured surface so that colour is transferred to the sheet as it is lifted away. These papers are referred to as *bakmarmerpapieren*, meaning *trough-marbled papers*, and known generally as the *common marbled papers*.

Within the group of common marbled papers many types can be differentiated, such as *kiezelmarmerpapieren*, meaning *pebble marbled papers*, and known as *stone marbled papers*. Figure 1 shows one of the many variants of stone marbled paper: *stippenmarmerpapier*, known as *antique spot marbled paper*. Another subgroup is the *getrokken-marmerpapier*, meaning *drawn marbled paper*, a specific subdivision of which is the *kammarmerpapier*, known as *comb-marbled paper*, made by drawing a comb through the colours on the marbling size. Figure 2 shows a variant of comb-marbled paper called *boeketkammarmerpapier*, and known as *peacock comb-marbled paper* or *bouquet*.

Another interesting subgroup is *schaduwmarmerpapieren*, meaning *shadow marbled papers*, and known as *Spanish* or *Greek marbled papers*. The beautiful shaded band structures are produced by a special technique for applying the paper sheet to the coloured surface of the size. A variant called *moiré-schaduwmarmerpapier*, known as *Spanish marbled paper with a moiré effect*, is shown in figure 3.

There is also a group of marbled papers, to be distinguished from the common marbled papers, to which the colours are applied directly: *vlekkenmarmerpapieren*,

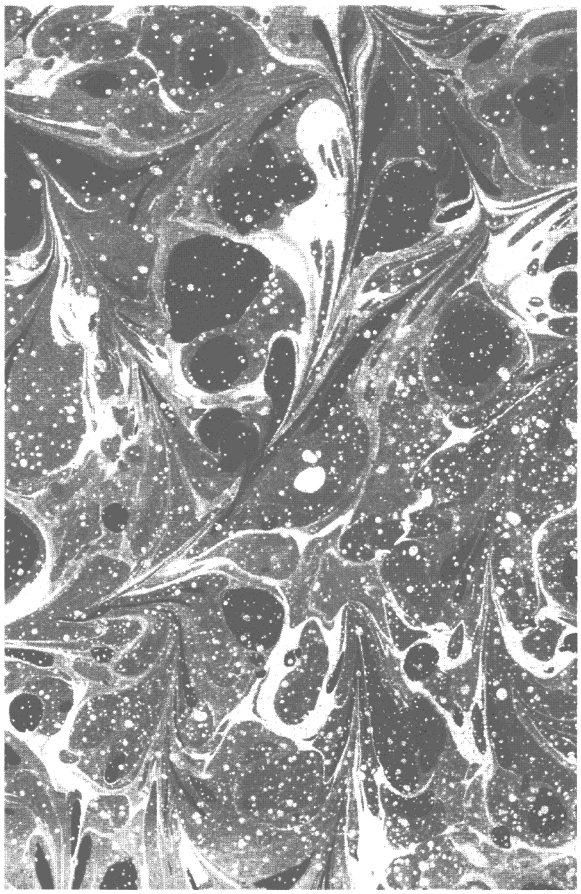


Fig. 1 *Stippenmarmerpapier*/antique spot marbled paper.

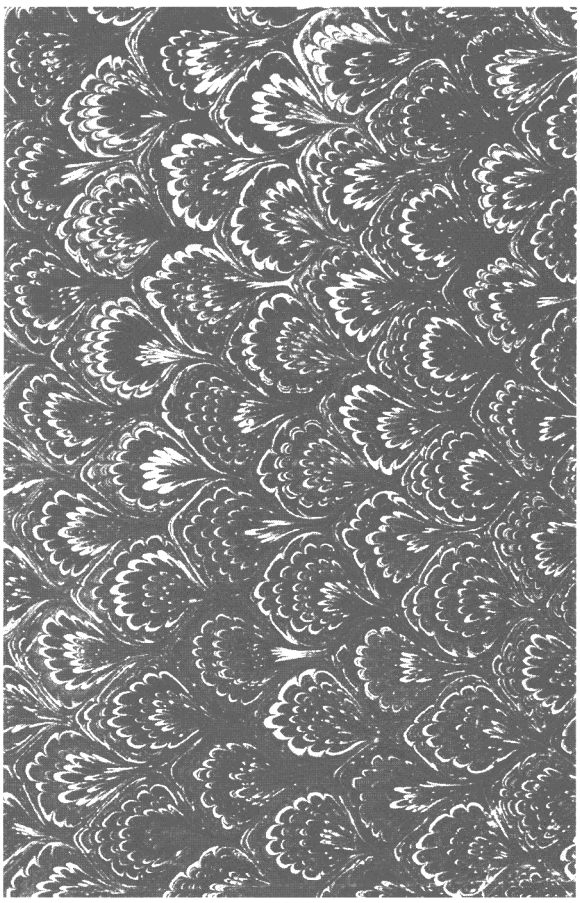


Fig. 2 *Boeketkammarmerpapier*/peacock comb-marbled paper or bouquet.

Fig. 3 *Moiré-schaduwmarmerpapier*/Spanish marbled paper with a moiré effect.

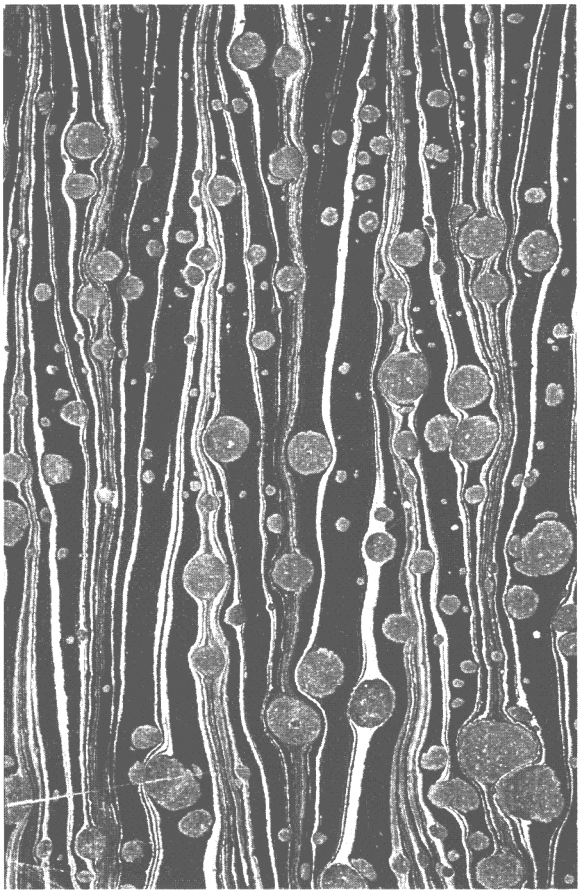


Fig. 4 *Kiezel-streepmarmerpapier*/zebra marbled paper.

meaning *spot marbled papers*. This group includes, for instance, *sprenkelmarmerpapier*, known as *imitation marbled paper* or *sprinkled paper*; *wolkenmarmerpapier*, known as *agate paper*; *agaatmarmerpapier*, known as *Gustav marbled paper*; and *toepmarmerpapier*, known as *daubed paper*.

Often one can distinguish more than one pattern in a marbled paper. Figure 4 shows an example of a combination of a *kiezelmarmering*, known as *stone marbling*, and a *streepmarmering*, meaning *striped marbling*. In our system this combination is called *kiezel-streepmarmerpapier,* or *zebra marbled paper* in English.

Paste paper

Stijfselverfpapieren, known as *paste papers*, constitute another category of decorated papers. Coloured paste is evenly brushed as a single solid colour or in variously coloured patches onto the paper, which is then tooled, while the paste is still wet, with utensils such as brushes, combs, stamps, rollers, fingers and thumbs. This tooling creates the typical paste-paper characteristics, sometimes with intriguing three-dimensional effects (fig. 5).

Paste papers that are rich in ornamentation, like the example shown in figure 6 (see also colour plate 6), are sometimes referred to as *Herrnhut papers*, a term derived from the eighteenth-century Moravian Herrnhuter Gemeinschaft, whose members indeed manufactured this kind of paper. In our opinion, however, the term Herrnhut paper should only be used if there is

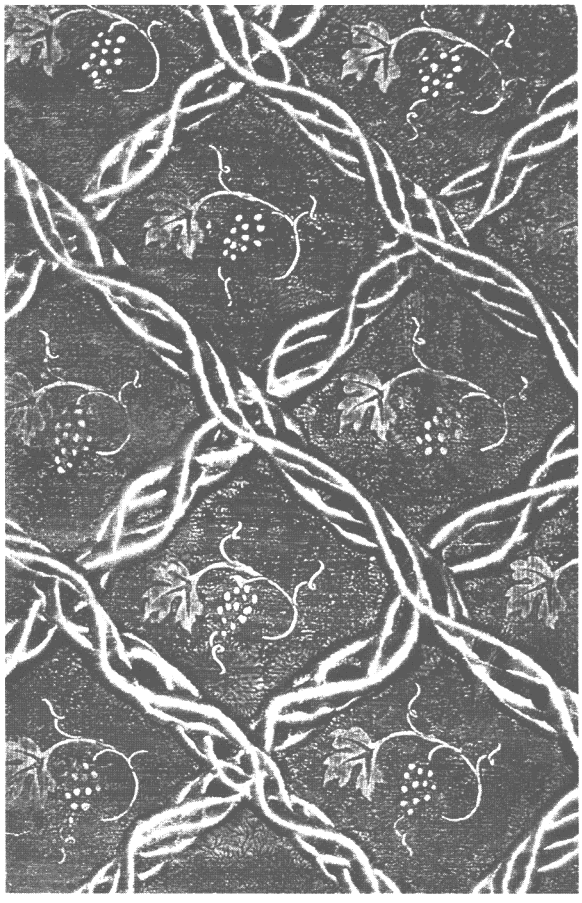


Fig. 5 *Stijfselverfpapier*/paste paper.

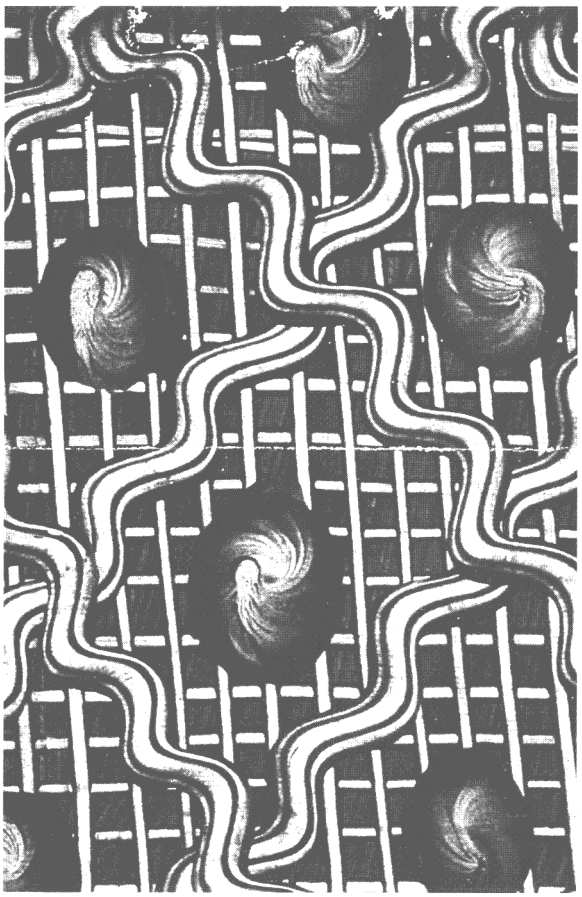


Fig. 6 *Stijfselverfpapier (Herrnhuter papier)*/paste paper (Herrnhut paper).

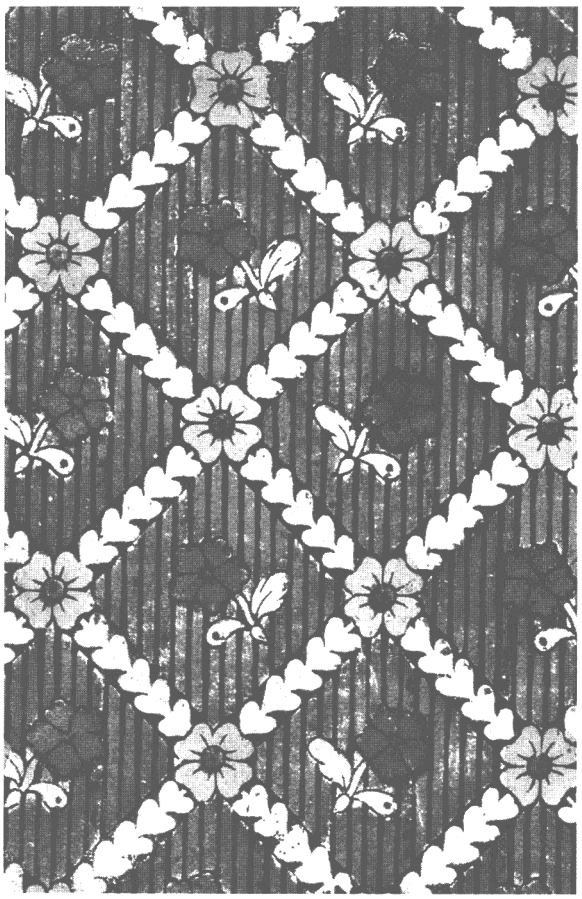


Fig. 7 *Sitspapier*/calico, pattern or chintz paper.

substantial evidence that the paper in question really originated from that religious association.

Block-printed paper

Blokdrukpapier, known as *block-printed paper*, is produced by the printing of inked or painted wood blocks onto paper. In general, a printing block is applied several times in sequence to build up the complete design. A multiple-colour decoration can be obtained by using different printing blocks, by means of stencils or by hand colouring.

When normal, non-metallic block-printing colours are used, the papers are called *sitspapier*, known as *calico paper, pattern paper* or *chintz paper* (fig. 7). The name is derived from the Indian printed cotton fabric known as *sits*, or chintz. Especially in France these papers are often called *papiers dominotiers*, referring to the French *dominotiers* who manufactured it. As in the case of the Herrnhut paste papers, we do not recommend the use of this term unless a real *dominotiers* origin can be proven.

In Germany and France another type of block-printed paper is known, called *bronsvernispapier*, known as *bronze varnished paper* (fig. 8). Varnish mixed with bronze powder was used for printing these papers. They were manufactured only during the first decades of the eighteenth century and are now rather rare.

Relief-printed paper

The final category of decorated paper included in this

Fig. 8 *Bronsvernispapier*/bronze varnished paper.

classification is the *reliëfdrukpapier*, meaning *relief-printed paper.* The characteristic feature of these papers is the relief that is obtained by embossing the paper sheet with a metal plate or cylinder roll into which the decoration has been cut.

In the case of uncoloured, plain coloured or metal paper, these are called *gegaufreerd papier*, meaning *blind-embossed paper.* An interesting subgroup is the paper that is embossed with the grain of a particular type of leather. These have frequently been used to supply books with imitation leather covers.

Another type of relief-printed paper is the *brokaatpapier*, known as *brocade* or *Dutch gilt* or *gold-embossed paper*. Brocade papers are generally considered to be one of the most valuable types of decorated paper. They were made predominantly in the eighteenth century, many originating from the major centres of production in Germany, such as Augsburg and Nürnberg. With these papers the embossing is not blind, but in gold, resulting in either a gold background or a gold-figured design, as shown in figure 9. This figure also illustrates the characteristic relief structure of brocade paper, which allows it to be distinguished from the block-printed bronze varnished papers described above, which are not embossed. In rare cases the decoration of these papers may be silver rather than gold.

As illustrated by figure 10, many brocade papers show additional decoration with patterns of mutually joined patches of colour. The overall colour pattern is produced by means of a fixed set of stencils, one for each colour. In a recent study of eighteenth-century brocade-paper book covers in the collections of the Dutch Royal Library, it was discovered that these colour patterns offer a new way to identify the source of a paper. The patterns depend on the stencil sets used to produce them and they appear to be characteristic of the individual workshops where these papers were made. Using the extended reference collection of well-documented brocade papers in the Royal Library Historical Paper Collection, comparison of colour patterns made it possible to attribute several anonymous brocade papers to various well-known manufacturers. Further details of this promising 'fingerprint' technique are published elsewhere.[2]

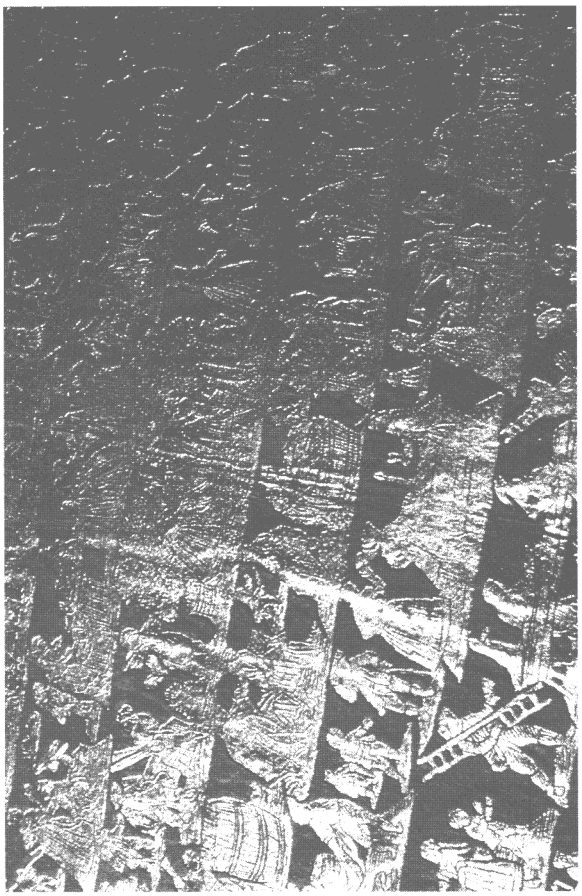


Fig. 9 *Brokaatpapier*/brocade, Dutch gilt or gold-embossed paper.

Fig. 10 *Brokaatpapieren omslag*/brocade paper cover.

Discussion

The nomenclature has been constructed in such a way that terms are applicable to both loose papers and those fixed in and on bookbindings, as well as to the related methods for decorating the edges of a book and non-paper covering materials such as leather.

Only for marbled papers have we been able to construct a detailed terminology, which is based on the various marbling patterns and other visual characteristics of the papers. For the other main categories of decorated paper, only a list of broader terms, indicating the major types, could be worked out. Still, in order to standardize the description of these other papers, which are widely variable in appearance, we have developed a set of general terms, not discussed in the preceding overview, which deal with the structural features of the background,

the type and geometrical arrangement (pattern) of the elements of decoration (ornaments and motifs) and the position of these elements within the overall design.[3]

To date we have worked only with western handmade decorated paper made prior to 1850. Papers of other and more recent origin remain to be studied.

Development of the terminology has been focussed primarily on Dutch-Belgian usage. The equivalent terms proposed for English, French, German and Italian can only, though hopefully, be considered a starting point for discussions concerning the standardization of decorated-paper terminology elsewhere.

Concerted action is necessary to reach the final goal: an internationally accepted standard for the documentation and registration of decorated paper. The International Association of Paper Historians (IPH), which is making much progress in the development of standards and the construction of a database for the registration of watermarks, and of paper in general,[4] might well offer the best setting for such a joint effort.

Looking at paper: evidence and interpretation, the theme of this symposium, is a worthwhile enterprise. But in the case of decorated paper, one is sometimes inclined to forget the evidence and omit the interpretation, and just stick to looking at paper. And why not? Alongside our scientific endeavours, we should also enjoy these papers, as we were meant to, for their beauty and craftsmanship.

Acknowledgements

The present work is the result of close collaboration with Jan Storm van Leeuwen (curator of bookbindings, Koninklijke Bibliotheek, The Hague), Carina Greven (presently manager of the Photographic Archives of the Rijksmuseum, Amsterdam) and Elly Cockx-Indestege (retired curator of the Department of Special Collections, Koninklijke Bibliotheek Albert I, Brussels). The Section of Optical Technology of the Koninklijke Bibliotheek in The Hague is acknowledged for the illustrations.

Notes

1. Cockx-Indestege, E., C. Greven, H. Porck and J. Storm van Leeuwen. 1994. *Sierpapier & marmering: Een terminologie voor het beschrijven van sierpapier en marmering als boekbandversiering*. Den Haag, Brussel. This report has unfortunately sold out, but a photocopy can be ordered by written request to the author.
2. Porck, H. 1998. Identification of brocade paper. In *IPH Yearbook 1998* (in press);
   Porck, H. 2000. Karakterisering van brokaatpapieren omslagen: Het kleurvlekken-patroon als vingerafdruk van de brokaatpapier-maker en het raadsel van de geruite sjablonen. *E Codicibus Impressisque: Opstellen voor Elly Cockx-Indestege ter gelegenheid van haar vijfenzestigste verjaardag (Miscellanea Neerlandica 18, 19, 20)*, Leuven (in press).
3. Cockx-Indestege, Greven, Porck and Storm van Leeuwen. 1994.
4. http://www.paperhistory.org

Looking at Paper: Evidence & Interpretation

PART 2: WORKSHOPS

These workshops provided an opportunity to see and hear how two individuals with a great deal of expertise in the history and making of paper, Peter Bower and Akinori Ōkawa, examine and characterize a variety of antique and contemporary papers. The focus was on learning what methodology they used and how it is applied to specific papers, artworks and documents. Peter Bower's workshop dealt with papers of European or American origin while Akinori Ōkawa's studied Japanese and Chinese papers. They both brought a wide range of papers to examine, often making use of instruments such as the stereobinocular microscope, fibre optic light source and transmitted-light table.

The following transcripts were edited from recordings of the workshop sessions held in the conservation department studios at the Art Gallery of Ontario.

Examining Western Papers: A Workshop with Peter Bower

Introduction

Peter Bower combines actual papermaking expertise with an extraordinary knowledge of the history and analysis of paper. He brought many interesting papers to the workshop and a few slides which reproduced some distinctive features and qualities of specific sheets. Given his recent research on J.M.W. Turner, the Art Gallery of Ontario provided for discussion examples of Turner's work along with a watercolour painting by Thomas Girtin and a chalk drawing by François Boucher. The highlight of the workshop was examining an unpublished drawing by Michelangelo to try and determine whether it was executed on blue paper. We are indebted to Julien Stock from Sotheby's, London, Old Master Painting and Drawing Department, who recently discovered this drawing, for bringing this beautiful work and attending the workshop. Many participants, such as Roy Perkinson and Irene Bruckle, made significant contributions to the discussions and we were very grateful to have them and many others share their expertise and enthusiasm.

Peter Bower: I've brought some examples of a range of papers. I'm sure we'll look at several over the course of this workshop. First, though, we have a real treat — an absolute treat. We are starting with something which might be a blue paper. This is a Michelangelo drawing (fig. 1. See also colour plate 1) and, since he never really worked on blue paper, the important question is, was this ever blue?[1] It definitely has some oddities in it and those of you who are familiar with blue papers might find looking down the microscope useful. I have had a quick look at it. I think this is what is called a music paper. It appears to be laid down — a laminate of two sheets with the chain lines running in one direction in one sheet and in another direction in the other sheet. This is quite common for early music paper; it's called music paper but it was used for all sorts of things. It was laborious to write music out a lot so musicians often worked on laminated papers, which stood up to a lot of handling; they could pass them around among themselves and they would last longer. But a lot of artists drew on them because they were more rigid, and I wonder if this is one of these.

However, I really ought to start this workshop in a very simple way. I am so excited about looking at this drawing that I am forgetting about basic things. As I said in one of my talks, watermarks are a detail that I look for almost immediately. But as useful as they are, there is much more information in the sheet, and the first thing I do with something like this is really look at the fibre — what you can see, quite simply, with magnification. Have a look at the Michelangelo and see what you think. I know what I think it is.

Fig. 1 Michelangelo Buonarroti (1475–1564), *Study of a Mourning Woman*, pen and brown ink on paper with white heightening, 260 mm x 164 mm, Castle Howard, Yorkshire.

What I really like about this field is that it doesn't matter how many pieces of paper you look at, you always see something that you've never seen before. The fibre in this, the inclusion fibre in this, is quite interesting and one would actually have to do proper analysis on it, which we can't do quickly today.

Participant: Would you always start by looking under a microscope?

PB: Oh, yes.

P: Do you have a small portable microscope that you take with you?

PB: Yes. It only does 30 times magnification; it's a cheap viewer.[2]

P: [*looking through the microscope at the Michelangelo drawing*] I'm thinking that there are some very fancy techniques with which one can do topographical imaging

and textural surface analysis, where one could very distinctly see all the various valleys and high points in this sheet. It seems to me there are some very interesting things going on over here, where there is some difference in colour, and there are some places where there is a delamination; one could get a better idea of that or at least map it so it could be analysed. That might be helpful to realize whether this was indeed mounted to be used as a double-mounted sheet or mounted at some later point in order to preserve it.

P: Sometimes you can use a slightly stronger light — for a brief period — to get an idea before the thing comes off the mount.

PB: This laminate is very, very opaque, which makes our examination difficult. People have been experimenting and talking about beta radiographs, but I don't like them. There has been some success now with soft x-rays, but I just don't like radiation. It's as simple as that. It's very laborious and time consuming. We did some trials with soft x-rays at the Tate Gallery on a Turner that they didn't want to take off its backing because it was incredibly fragile. The people at the National Gallery were saying to the Tate photography department, who had never done any soft x-rays, 'Oh, you won't have any chance; it's so difficult hitting the focus right and getting in the right place.' Well, the very first one was absolutely spot on, perfect. But they have never been able to replicate that degree of success since. It's getting harder.

My feeling from having looked at a lot of what I call music papers is that this is one of them. The mills used to do it by double couching or the stationers would do it when someone would come in and say, 'Would you stick all these sheets together for me, I need some music paper.'

P: It was also common restoration practice to laminate sheets and cross-laminate.

PB: And it does appear to be a cross-laminate, doesn't it?

P: The surface is also glossy. In a later conservation treatment they often dried things in a screw press, where the paper gets very burnished on the surface.

P: Exactly. Then one would have to also ask when were music sheets really used. Was that a practice that was common at that time? Because these very special drawings were, of course, so carefully preserved and mounted that I think the option that it might have been a treatment after it was actually done is definitely viable.

PB: It's possible. The only way that one would be able to really tell would be to get it off the board and look at both sheets. It is lifting in one corner. You can see that the other sheet is another off-white paper.

P: How would you necessarily be able to distinguish whether it was mounted later or not?

PB: Primarily, if one can see through it. Normally, if it was a music paper, they would be the same papers. If they are not the same paper, that gives you one indication. The other thing is that there are distinct fashions and styles in the wires, the spacing and everything to do with laid and chain lines with all papers. If you've got particular wire grades, wire thickness, wire weights or patterns of chain lines that are late-eighteenth-century patterns, not early, sixteenth-century patterns, then it is likely somebody has laminated the sheets later on. I doubt if there is a watermark in there; there might be somewhere but it's unlikely.

P: Did he customarily work with what you called music papers?

PB: No, but that doesn't really mean anything.

P: This could have been remounted three or four times before.

PB: Yes.

P: There are some puzzling things in there that I think can't be solved by looking at it and then giving an answer.

P: There is certainly a blue spot here. There is something blueish happening here — more greenish, but that is always a debate. Then there is this incredible fibre mix.

PB: What do you think the black is?

P: The black? I haven't even progressed to that. But there, for example, when you look at this under the microscope there are definitely some very, very intense blue spots there. They are very localized; perhaps we could turn the raking light on also. It is hard to decide which one to choose.

P: When you say black, do you mean black inclusions?

PB: There are some long fibres that look quite black.

P: Definitely — very pronounced, and there are some fibre strands covered by pulp that are thread fragments, too.

PB: Right, and there is definitely a little bit of hemp, that is still slightly brownish, in there as well.

P: Now, is it typical that these music sheets were pasted together like this and then used? Is it likely they might delaminate locally like this?

PB: It is, depending on how well they were glued together.

P: Where was the cross-lamination visible?

PB: Basically it was just in raking light.

P: These lines here, these two, for example, do you see how that just jumps up when the colour changes — that particular one? I was first wondering whether that could be a skinning that is so well mounted you don't see it, and what is underneath is a blue paper. There is also a tiny depression here that's a bit bluer.

PB: It's very difficult. You asked about the laid and chain lines alignment. There are distinct chains going that way up it. If we turn it around, there does appear to be some evidence of chains going in the opposite direction. There's one vaguely visible, running there. But for both of those to show up in this kind of lighting means that it has been subjected to intense pressure at some point. It's likely that intense pressure was applied in either a paper mill or a stationer's where music paper was produced. The presses that they were using were infinitely stronger than the presses that people doing restoration or conservation would be using. That's my feeling.

P: With lamination like that, it is so well adhered due to the strength of these presses, you really don't see any kind of join in the section between the two sheets?

PB: No, you would see it. If we looked at the edge under a microscope you should be able to see it. The other characteristic of these is that they were usually produced so fast that you get areas where they are not glued. They are air pockets that have been pressed out and they do delaminate quite easily.

P: I think pressure is only one parameter by which you can change paper texture, so obviously this was not made very wet when it was mounted because you would see that, but if it was mounted I think all these gloss marks on the surface might have something to do with its later life. They might also indicate some kind of mounting technique. I don't know whether the texture of the cross-directions of the papers could be explained that way.

P: If the paper is made and the initial drying, which you are talking about, has subjected it to greater pressure than what a conservator or a restorer would have used later, then why aren't more papers burnished? I mean, this has a different burnishing than a paper that is dried naturally after production. This has been flattened.

PB: Oh yes, this has been seriously flattened. I think this surface was not produced by a paper mill. I think this paper laminate was probably made by a stationer. The individual sheets had been made and existed for quite a time before they were stuck together, in which case you would get considerable flattening. Some of the stationer's presses were very, very powerful — as powerful as anything in a paper mill.

Julien Stock: What I think is important is that it is heightened with white, which is a very typical characteristic of Michelangelo. Therefore, was that lamination done before the white heightening? Because surely if it wasn't, the white heightening would have cracked or disintegrated.

PB: Well, it has got some cracking in it.

JS: But that could just be age.

PB: Yes.

JS: Let me suggest a few dates — my opinion of course. It's unpublished, as nobody has seen this before. What is interesting are two things. One, it's on a Richardson mount, which makes the mount eighteenth century, and two, it's cut along the bottom edge. This is a drawing by Francesco Salviati [*referring to a book reproduction of a drawing at the Louvre which is a copy of this one*] with 'Michelangelo Buonarotti' written on it, and you can see that the original he worked from was cut. Well, Francesco Salviati died in 1562; therefore it must have been cut before he made this copy. Also, the same figure occurs in reverse in Giulio Clovio's 'The Crucifixion' in *The Farnese Hours*[3] in the Pierpont Morgan Library. So there are a number of *terminus ante quems* one can use to find a date. My dating is second Florentine period. I don't think it is later than 1520 and I think it is more likely 1505. It is difficult, because if you go through the De Tolnay *Corpus*[4] on Michelangelo, that mode of drawing continues right up until 1540.

P: I think lots of the things that you have put your finger on here suggest very strongly that it is a sixteenth-century paper, but of course the harder issue of who drew what's on it requires another set of disciplines and comparative lines of investigation — which you're doing now. Are you familiar with any Michelangelos on blue paper? I've not seen any.

JS: That's why I am here; I have come over to this workshop to let you consider that.

P: So I think, rather like Rembrandt, Michelangelo never used blue paper, and I don't think this is blue paper, at least in two seconds' worth of looking. I could be dead wrong because so often, if you go to the area where the white heightening is present — in this case it is undoubtedly lead carbonate because of the oxidation that has taken place — you often find that some of the colour is preserved there, no matter what happens in the surrounding area. Now, I only looked at one area there very quickly, but I didn't see any of that preserved colour that I associate with a paper that was once blue but is now generally discoloured or darkened or lost its colour. There doesn't appear to be any traces of that colour that is preserved by the presence of rather alkaline material in the media. I don't see that, and for what it is worth, I don't see any halo around it that's often found because of the migration of materials in the paper. Regarding the fibre composition, it doesn't seem to me that it is very unusual with respect to the sort, number and kind of inclusions or extraneous materials. There is

the odd dark fibre, some of which look protein-like.

PB: They could be wool.

P: Yes, they look a lot like wool.

PB: There is some hemp in there and I would say there is also, in the bottom right-hand corner, a piece of straw.

P: But the range of those kinds of inclusion look a lot to me like late-fifteenth- and early-sixteenth-century papers I have seen, both blue and white. For example, at the Gardiner Museum there is a drawing on blue paper that has a very similar range of materials in it, that was probably done around 1470–90.

P: I also think that one has to be very careful in comparing paper qualities with other papers of potentially known dates, especially in the production of coloured paper, because they were used for so many different purposes. I have found that in any given century — say seventeenth-century Italian, which I have seen more of — you could find very high-quality papers next to absolutely coarse, lumpy papers, all of which were used for quick preparatory sketches. So if one just goes by paper texture, you can be easily misguided regarding dates by thinking the coarser paper might be a slightly earlier version. It is not necessarily the case.

PB: I don't think anyone would really think that.

P: I don't think this is a blue paper necessarily; however, I don't think that one should discount that there might be one rare instance where Michelangelo did use it. The whole idea of historical interpretation is difficult because we like to — we are always prone to constructing logical patterns and it doesn't always apply. It can surprise us.

PB: I think that's me that you're talking to, my gang of people. The specialists don't do that — you, the restorers. You're the ones who are open-minded. [*laughter*]

P: If it's not a blue paper, how would you explain that mottled blue effect along the lower left?

P: You mean along the left edge. If it's thinned, if it's not uniformly a laminate, then you may be seeing through it — an optical effect from the board behind or from some repair method. I just had a drawing that was attributed to Michelangelo that turned out to have big lumpy repairs on the back that we couldn't see when it was on the mount. Once it came off, it explained a lot of the things we were seeing on the front. They were quite well done except that they were irregular and they were very different coloured paper and so it changed the optical effect from the front. We were hoping it was an inscription.

P: I thought I saw a single fibre that looked blue.

P: And that looks like very intense tiny blue spots, almost like pigment would look if it wasn't dispersed.

PB: It looks more like a pigment clump.

P: Exactly.

P: It's recessed.

P: It's recessed, which is why we talked about the mounting. There is the possibility that this paper could have been produced by a papermaker who made several different kinds of paper, including blue. In switching colours a little bit of that blue remains; it may be stuck in the vat or stamper throws and would just mix itself into the next batch. This would explain an odd effect like this.

PB: That looks more like, without doing the work on it, smalt than anything else.

One of the wonderful things about something like this and having a group of people like this is that we are going to end up with so many different directions that the research could go in. [*to Julien Stock*] You don't want to hear this, do you?

JS: No, I don't. [*laughter*]

PB: Well, I don't have a problem with this paper at all for the period. It looks like the product of a fairly small, not top-quality mill, given the fibre mixture, particularly the odd bit of straw and other things that appear to be in it.

That type of mill did chuck straw in to just bulk up the amount so they didn't have to make as much pulp. They didn't really bother to cook it or anything, they just chopped it. Also, a lot of smaller mills that were not aiming to produce top-quality papers really didn't bother about cleaning. They didn't bother to clean the system out and only had one vat. If the first 50 sheets of the next batch of paper had odd bits of something else in them, it didn't matter.

There's a paper company in England now, a machine-made paper company, that have actually developed a technique on a Fourdrinier machine where they don't clean the system out. And they make coloured papers that are fantastic, particularly the changeover papers — as they change the vat — which produce a few reels of completely bizarre papers that are one colour at one end and a different colour at the other — and they just sell them. It is quicker and more efficient and they make more money by not cleaning the system out — other than by using pulp.

P: But what you were describing about this paper, you aren't saying is specific to Italian papermakers – that they would be sloppy.

PB: No, there's such a difference in quality. You could get two mills at either end of a valley and at one period in history one is making really good paper and 30 years later, when it's a different generation working and things have changed, you get the other mill producing really

good paper and the first one's gone downhill a bit. It goes up and down. Even great, name papermakers, the quality of their paper varies a lot. After the First World War, for instance, when Whatman had lost a lot of their vat crews who went to fight and didn't come back, their early 1920s paper is dreadful — a lot of it. Then by the end of the '20s it's up again in quality.

P: Why would I be seeing a metallic or graphite-like powder in the tear or creases?

PB: You all are seeing something different; you are all picking up on all sorts of things. I see some things very quickly in a paper and I would come back and look at the thing over and over again and still see more things. Are you talking about this area here?

P: Yes, and my first thought was of different repair techniques throughout the ages, and wondering how it is that in the past they seem to have better techniques for camouflaging repairs. Perhaps they might have rubbed something in there, unless it's just a crease.

P: It would be interesting to systematically examine the surface to see what oddities there are. This is the first level of analysis, and then you can progress beyond that. You could analyse the amount of metals and exposed blue pigment at the bottom and find out what you can gather from that. But before that I think that just scanning the surface carefully is all one can do here.

PB: That's basically what one would do, systematically.

P: And looking under high magnification and different lighting conditions to see whether there might be a clue to what the content of the sheet ...

PB: This is a curious thing; when you are examining anything there are an almost infinite number of possibilities of what you might find. And you could go in lots of different directions. You always have to bear in mind that all this kind of research is, as you all know, constrained by the time available, the cost and also the question that you are being asked. I don't work for an institution, I work for clients, and they want questions — specific questions — answered. And they might not include 'What is this pigment?' even though you might try to say to them, 'Well, to have this, we need to do this because this might — *might* — give us more information.' What they commonly require, basically, is dating and appropriateness and whether or not it is right for what the art historians, the auction house or the specialist need to consider. And if you can, you answer those questions by basically the simplest methods possible because often you don't have unlimited time and you certainly don't have unlimited funds to do it.

My initial look at this Michelangelo suggests to me that there is actually nothing inappropriate about it, though there are some oddities. However, oddity and inappropriateness are not the same thing at all.

JS: What of course is also very interesting from our point of view is that there's a professor in Hamburg who disputes a vast number of Michelangelo drawings. So it would be incredibly useful to have every Michelangelo drawing — all the paper — analysed, because then one could put it all together and confirm that perhaps some of them, certainly in De Tolnay's *Corpus*, a lot of us are right in dismissing.

That would be intriguing. I do paintings and drawings as a specialist, and in the drawing field, although we're thorough, this is unusual for us to try and find out more about the paper. But here I'm worried about it being on blue paper because, when I publish it in a learned journal and say it is the only Michelangelo drawing on blue paper (I am very happy now to hear it's not on blue paper), everybody's going to say, 'But it's not by Michelangelo; you don't know what you're talking about — it doesn't have this-or-that.' And then later, they might say, 'Yes, it is.' But with paintings in the last 10 years, we now, and Christie's, check every signature, so our costs have gone up enormously. If we say signed and dated Jan van Goyen, sixteen-whatever, and you buy the picture and your restorer says, 'But this signature isn't authentic,' we get the picture back and it becomes our picture. And of course the same could happen with a drawing. If we sold a drawing and then it was proven to be an eighteenth-century paper and the drawing ought to be 1520, that's part of the guarantee that you get when you buy from us, so we've got to be careful.

PB: My process on examining this would be to do what I have done here, basically, which is to have a look at it. My next stage would be to suggest that the drawing needs to come off its mount and that we really need to look at the paper, because even though it's a laminate we will actually be able to tell quite a lot just with simple transmitted light, because one thing that really will help is the wire profile. It doesn't matter if there is a watermark, the wire profile, the chain stitches, whether they're twists or double twists — if that's visible it's very helpful. All sorts of things like that will tell us a lot about the time, and to some extent the location, because there are fashions and changes in just that data. If anyone wants a lifetime's work, there should be a database on chain-line twists. You also have to remember that the wire technology was going through changes. In the fifteenth century wire technology changed dramatically and they could get much thinner wires and could stitch them much finer. You get anomalies where, even though this was happening, you get one mill — I'm thinking of a couple of Italian mills — where they immediately go to these really fine wires, incredibly fine, and the mill that's just up the river a bit actually seems to go to the other extreme. They start using even heavier, chunkier wires. It's really odd. However, I think in order to try and answer the question whether the paper is appropriate, is it right for that date, if there is anything wrong with it in that sense, the fibre content is very useful. The actual mould evidence is probably going to tell us more about where it came from, what date, and possibly give us some indication of origin.

Most of Michelangelo's papers were Italian, but not all of them. Some of them come from southern France. (See Appendix 1 for further analysis of this drawing done by Peter Bower later in London.)

P: I wonder, when you have an off-white paper with a few black or blue flecks in there — they may have just thrown in a few blue things of whatever kind — that perhaps it wasn't thought to be any less of a paper. It just shifts the colour in a certain direction ...

PB: It might be that there is a small amount of indigo in there?

P: Yes, I was wondering about that.

PB: But you wouldn't expect the colour to change quite like this paper. That's just my experience of seeing indigo tints that have gone.

P: From a great distance this looks a little bit like certain very off-white papers that have this very strange greenish cast at best. That was not because they made the paper green but because there was just a dusting of blue pigment or whatever they added. It's like when you make a cake and you put a lot of sugar and a pinch of salt.

PB: A lot of papermakers are cooks.

P: Yes, right.

PB: I saw the most amazing thing at a large modern mill, Dickenson's mill in England, when they used to make a writing paper called azure. It was an azure colour and it was Basildon Bond. They had state-of-the-art machinery, but for 25 years a guy called Jack sat up by the top of the hydro-pulper, and he had an armchair and a paper cup and he used to put a little bit more in, like that, to maintain the colour consistency of that paper, which over 25 years was brilliant. When he retired they couldn't make it; they stopped and it was never made after that. Ten years later they produced a blue paper but couldn't get one like the original. Jack would just be looking at thousands of gallons of pulp!

P: Analogous to that, I was talking with one of the research people out at Strathmore a number of years ago and he was telling me about some guy, Charlie or whatever, that worked with him for years and years, and he was better than any of their machinery or anything else for testing the freeness. He couldn't have told you exactly what it was, but he knew when the pulp was ready; he would just reach into the vat and sort of squeeze it and then he'd kick the vat and listen to it.

PB: The other thing is, if you've got a beater roll which is on a bar, you get a piece of wood, which could be an old broom handle, or a piece of tubing, and you put one end of the bar on the end of the roll and you put your thumb on the end of it and you stick your thumb in your ear, and you can hear exactly what's going on as the bars pass over the bedplate bars. You can hear what's going on and it's extraordinary. I used to be a papermaker (that's how I got into this) and yes, you can't explain half of what you are feeling — that it's just ready. It's the sliminess, heat and the warmth in it — things you couldn't measure. I notice even now when I'm going around mills that they have all sorts of incredible measuring equipment, but in fact half of them are cooking. They are still cooking and they feel when it's ready. There's one beautiful mill called Chartham, an old mill in England that makes detail paper. Detail paper is like tracing paper, but it's not quite tracing paper. It's very thin for drawing on and making tracings as well. The mill has laser measuring equipment and all this, but they were having real problems with consistency because that paper is made with incredible heat. Steam is pouring off the forming surface as you're making it and it is very difficult to control, so they were getting problems across the web. They moved the reel up about 30 to 40 feet further away from the end of the machine and they put in a sofa, and two guys sat and worked for 20 minutes at a time; they talked about football and things like that while they watched the paper passing over their heads. Screens displayed all the fine measurements and they'd just punch buttons and things to control it. After 20 minutes they had a break while two other guys did it. I think they had to have six people on to do it, but it saved them a fortune.

P: The sensory thing is just so phenomenal. I was at the Crescent Cardboard place one time; I think it is near Cleveland but I've forgotten where exactly. Crescent Cardboard makes a lot of mat board and various kinds of cardboard in the United States. At the end of the day there we were walking through the factory, or the tail end of the factory, and there was a guy doing something to these piles of cardboard. I said, ' What's he doing over there?' And my guide stopped and said, 'Oh, that's so-and-so, he's the fellow that counts our packages for us.' And I said, 'What do you mean?' He said, 'Well, he counts 25 sheets of cardboard for each package.' I thought, my God, don't you have some other way of doing it? He said they tried other ways of doing it, but in fact — he's actually blind — his tactile sense was so heightened that he can do much better than any machine, with less percentage error than they've ever had. It was fascinating to watch him — like thumbing cards; he could sort of hear — he couldn't tell you what — hear and feel something that was 25, 25, 25 — just amazing!

P: Peter, can you give a brief description of how one might distinguish, in the machine-made papers, between the cylinder mould and the ...

PB: ... and the Fourdrinier sheet? Cylinder-mould sheets are made as sheets or occasionally made as rolls. So we have a problem here. However, they are always narrow, right? There is a particular width. I mean I've never seen a cylinder-mould machine more than about eight feet wide, and if you think of Fourdrinier machines, you've

got enormous widths now. But essentially the main difference is most cylinder-mould papers are watermarked. Cylinder-mould machines are used for two or three kinds of paper. They are used for artists' paper, they're used for security papers, banknotes and bonds and stuff, and they are also used at the bottom end of the market for boards and rubbish like that which wouldn't be watermarked. If you are talking about white papers, they are watermarked but, like a handmade sheet, the watermark is integral to the formation of the sheet — it's on the wire side. On a Fourdrinier machine, if it's got a watermark on it — and after about 1827 you get loads of machine watermarks — the watermark is impressed into the felt side of the sheet. So even if it hasn't got deckle edges, you've got a nice trimmed piece of work, if you are looking at the felt side of the sheet and you can see that's where the watermark is, then it's a Fourdrinier paper. If you are looking at the wire side and that's where the watermark is, then it's a cylinder-mould paper. It's as simple as that. Having said that, distinguishing what is the wire side and what is the felt side is not always easy. That's the basic distinction.

A cylinder mould does have deckles, but only two true deckles, because those are the edges of the cylinder. The deckles on the sheet that cross the cylinder are usually done by either tear wires or deckle straps and they are distinctly different from handmade deckles. They are usually incredibly straight. If you think of contemporary mould-made papers, most of them have actually got torn edges. On the short edge you get a proper deckle and then you've got torn edges. That's as simple as that, but when you have a deckle-strap deckle, the line where the true thickness of the sheet stops is absolutely straight, whereas in a handmade sheet it usually isn't, since the deckle and the mould move slightly even if you're holding tight.

P: The older Fourdrinier paper — do you have deckles along the sides of the machine belt?

PB: The earliest identified machine-made paper that I've ever looked at is 1810, and I've never seen a piece that I could prove was earlier. If anybody can find a sheet of machine-made paper that dates before 1810, please let us know because no one can find any. The only reason I know it was 1810 is because Turner, the artist, actually annotated the sheet 'Elliot's paper.' The paper didn't look like the drawing papers Turner commonly used; it looked like a machine-made paper. Then, as soon as I saw the inscription 'Elliot's paper' I wondered, so I started to really look at it and the wire profile was very different. There's no watermark or anything on it and the formation isn't brilliant. It's very 'juddery.' Elliot's machine was one of the earliest made and the flow of pulp onto the wire was often inconsistent on these. They were still experimenting with the right gauge of wire to make the forming surface and you can see from this paper that it's very coarse — surprisingly coarse. It must have drained really fast. It took ages to get that forming surface right.[5]

Initially they had very, very wild deckles because they were leaving quite a lot of the forming wire and didn't really put an edge on it. Then they put on deckle straps — rolling leather straps. They were usually just trimmed off straight away. It's very unusual because they were cutting them into sheets. They weren't selling them as a reel. The first reels sold were to print newspapers after they had invented the roll-fed press. Everything before that was sold as sheets.

P: When was the roll-fed press?

PB: 1840-something.

P: Peter, have you ever seen any paper that is made as a chain-mould paper?

PB: No, but I'd love to. There are all these marvellous things like Thomas Cobb's wonderful machine, that had individual moulds that were manipulated and shaken about. I'd love to see something that came off that. There's also Ferdinand Leistenscheider's paper. People say that Fourdrinier paper was watermarked from 1827 onwards, but Leistenscheider put a watermark in a sheet in 1813, on his crazy machine that nobody ever talks about. Sheets of this exist and his wonderful portrait heads of Napoleon where it says 'made by Ferdinand by machine' in the watermark. No one knows how he did it.

P: Can you say approximately what was driving the production of machine-made paper between newspaper publication, wallpaper publication and printing publication about 1830?

PB: The customs-duty records in Britain show the amount of paper produced by hand and machine was equal by 1825. Basically it was for printing. How much was for newspapers I can't say because at that stage there was no distinction between the paper for newspapers or the paper for books. It was all just printing paper. You had good-quality ones and lesser-quality ones. Stationers and suppliers like Longman's would buy lots of different grades from the same maker. I've done very little work on the actual economics of it and what was driving it, but essentially printing was *the* force.

P: Printing for journals and newspapers and books. At what period do you think Fourdrinier paper was used as an artist paper?

PB: 1830s — as early as that.

P: As early as that?

PB: Winsor and Newton were selling continuous Colossal drawing paper, four feet wide, which you could buy as long as you liked. It was one of the earliest examples of being able to buy Fourdrinier paper as a roll. I doubt if any artists bought it very long, but they might have bought a hundred feet of it. There are a few examples of Turner working on it.

P: You know it's Fourdrinier because it's so large?

PB: Yes, there's no other way it could be made. It has a very distinct wire and you also get details within the sheet.

The other thing that people were talking about was how to identify Fourdrinier. One thing you see quite commonly — I seem to be coming across it more and more in 1820s, 1830s paper — is the stitch wire, the exact stitching right across the whole sheet. That's literally where the forming wire is joined. You occasionally see papers where everything about them suggests they're handmade, but I cannot imagine that anyone making a wove paper that big is actually going to stitch two together like that when the stitches are identical to the way that they joined machine wires. I think that some of the early Fourdrinier papers have to actually be re-evaluated because some of them were very good papers. They are pure rag and very strong. Some of the mills were obviously producing very good papers, a lot of what gets categorized as handmade artists' papers. For instance, there's a mill — Monckton's mill — and over and over again you hear people saying this is watercolour on Whatman. For various reasons I've been looking at these papers and a lot of them are made by Monckton Mill, which is just up the road from Whatman's. They were made on a Fourdrinier machine, not by hand. This particular mill never made handmade paper.

P: You were able to tell this by the wire side and the felt side?

PB: Yes, and we also found some sheets with watermarks in them, so you could work it out. There were enough characteristics in these 'unidentifiable' sheets to suggest that the fibre mix was identical; the beating structure was the same. You need to really look at how the fibre was beaten; different beatermen had different ways of beating fibre and they would say it's ready when someone else might not think it was ready. Each beater has its own characteristics. We had three beaters going; they were all made at the same time, at the same firm and installed at the same time, yet every single one was different. One you could beat twice as fast in as the others for some reason — just the engineering of it. A beaterman had to know exactly what to do. A thing that people never really consider is that all these things are done by individuals. There's a mill called Tuckenhay in Devon that is closed now, but in its last years it operated three vats, but one of those vatmen was responsible for more than 55% of their output because he could work faster. They treated him *very* well, I'll tell you. If he had a row with his wife or he stayed out too late in the pub the night before, production would decline. However, you can't run a business like that. They closed in 1970.

P: You can't rely on one guy.

PB: You just can't.

P: If there are no other distinguishing marks, one might look at the fibre dispersion in a Fourdrinier sheet. Usually, if there are any kind of irregularities, let's say inclusions of some less-macerated fibre strands, I think there is an inclination to consider that a mark of a handmade sheet, but I have doubts about that.

PB: You do see it in machine-made — early machine-made papers. You also see it in twentieth-century machine-made papers.

P: Right. I was thinking more about those kinds of knots that would be eventually screened out by new technology, knots that have real three-dimensional properties and tight little wads of material ...

PB: You still get those in Fourdrinier papers, but not that often because doctor blades went on these machines quite early. Various people are credited with various inventions with the paper machine, but some of those inventions are actually wrong — they would have been using them ages before the patent. Like Didot's patent for double-faced moulds — that is absolute rubbish. People had double-faced moulds for 20 years before Didot's patent. Didot was always thinking, "I'll put in a patent and try to get some money out of it."

P: Was there a time, a date where there is a very distinct change so handmade and machine-made would actually be very different in terms of screening out these materials?

PB: No, I would think the best-quality handmades were as good as the best quality machine-made papers — they are pretty much the same. We have a real problem here because what we are looking at a lot of the time are wonderful works of art or books and you can't do things to them. If you wanted to tell whether a sheet of paper is made by hand or machine there are all sorts of physically destructive tests that would tell you an awful lot very quickly — but you can't put a Michelangelo through that.

P: Peter, do you find that there is anything valuable in knowing about the introduction of the knotter, and did that diffuse rapidly?

PB: I've never found it, in any particular case, of crucial interest in terms of helping to date anything, but it is interesting to know. Knotters are so different. I know that the first knotters at Hayle Mill were completely different to the ones they were using much later. And those ones, the early ones, are completely different to anything that you see anywhere else around. They do seem, if you look at their papers from the 1820s and 1830s, to be very good papers without any of this stuff. So why did they suddenly change the design? You start seeing knots after that. It does sound very stupid. I think it is absolutely crucial that you not take anything a papermaker says about their own paper seriously; even though they wrote it down in 1820 and it sounds great and it fits your theories, you should ignore it. Most of them lie through their teeth. They

would say, for instance, they were using this and using that and you analyse the papers and no, they weren't. There's a lovely one, Thomas Edmonds, who actually put in his watermark in the 1820s the word *unbleached* because there was a huge problem with bleached papers at this time. I don't know if anybody has read John Murray's book, 1829, on the bad composition of modern paper?[6] It's glorious, a lovely book, but anyway Edmonds did genuinely produce unbleached paper — pure rag, unbleached paper. However, you do get chlorine traces in some batches of it. It is still there. So he was producing unbleached but he was also producing bleached paper and some of these were made on moulds that had the word *unbleached* in the watermark.

P: What about the Unbleached Arnold?

PB: Unbleached Arnold was, as far as I know, always unbleached.

P: And made of rag as they claim?

PB: Yes, as far as I know the Arnold claims are pretty good, actually. I have never come across anything particularly odd that would say not. You mentioned Arches, but with Arches, Van Gelder — with all sorts of mills — it's difficult to evaluate all the papers. What Van Gelder were doing in the 1920s and '30s, I haven't a clue. As conservators you must sometimes come across crazy papers.

P: Oh yes, we get reverse foxing.

PB: A lot of those white spots might be from really filthy felts. Just not bothering to clean the felts properly. You get very weird bacteria, very weird things growing.

P: Yes, it does definitely have a mould-like quality to it.

P: I have a question related to more modern manufacture. Not very much research has been done, in terms of conservation implications, on rosin-sized papers. I do wonder, since in conservation you get early-twentieth-century papers oftentimes used by artists that seem, just by inference at least, to be rosin-sized but behave quite differently from more modern rosin-sized papers. I think that in using organic solvents in a conservation treatment there is a possibility of flushing out rosin size or what might be a natural rosin product. How would one begin to compare or analyse the early or not so early rosin-sized papers with the twentieth-century rosin-sizing procedures with the goal of making a classification system or, at least, getting a better handle on identification?

PB: I think the best person to talk to about that is a member of the BAPH, Barry Watson. If you've got the membership list, write to Barry. Barry has forgotten more than most people have ever known — he is in his eighties and just got married again recently. He's a good man and he's very, very good on early-twentieth-century stuff. To give you some idea — have you heard of Julius Grant?

P: Yes.

PB: Well, when Barry first started in the paper industry, it was as Julius' assistant at Croxley Mill. He's a practical papermaker but he has always had an interest in the analytical side of it as well. He's just got so much information; it's worth talking to him. He won't forgive me for having given his name out, but there you go.

P: Peter, you have been talking about a lot of the visual things that you would use to look at paper. What about the non-visual — how it sounds or feels? Do you rely on those kind of intuitive things?

PB: I think it is there, but you don't rely on it. It gives you indications. You pick a piece of paper up, you feel it, sniff it, tear it, shake it.

P: But you rely more on the visual?

PB: I do all that while I am — well, you can't do it with things like Michelangelo.

P: You aren't recording it.

PB: No, I'm not recording it. How are you going to record what papermakers call 'crackle'? How are you going to record that? Because you know *that* paper is going to crackle, but that is going to crackle too — it's a part-sheet. The same sheet, full-sized, is going to have a completely different tone.

P: Right. It tells you something about the sizing.

PB: No, the crackle tells you much, much more about the internal structure, the bonding and the internal strength of the sheet.

P: Will that tell you anything about handmade versus machine-made?

PB: Not really, except handmades usually crackle better. [*examining a sample paper*] That's a strange paper. Have you heard of Mathias Koops, who went bankrupt — like lots of papermakers? This is some of his paper, but it's a lovely yellow. This is why I mentioned that you should never trust a papermaker. He was making '100% straw' paper. Hmm ... bright yellow, right? It's a dye. He did make straw paper, but that one isn't straw.

P: What is it?

PB: That is linen; it was dyed.

P: To look like straw?

PB: He couldn't make enough of it but he was — so he was faking it.

P: Have you seen the straw paper?

PB: Yes.

P: And what does it look like compared to that?

PB: It actually looks much nicer than that. It's not as yellow. I actually wonder if that has gone darker.

P: Do you know what the dye was?

PB: No, I haven't done the work on it.

P: That's fascinating.

P: What was the appeal of straw paper — the colour?

PB: Oh no, they were desperately trying to find an alternative for rag.

Here is a completely random selection of papers I've acquired. They were just bits and scraps. I once went to a country house because I'd been talking to the owner and he had some old stocks of paper and stuff. He said, 'It's all in the library.' So he goes to the library and there's this big fireplace and in this wicker basket by the fire there's just a pile of old papers which they used to light the fire with! Here's one that proves you should never trust a watermark. There's *Turkey Mill* — you know, the famous Turkey Mill? Rubbish, this little mill was in Wales in the mountains. It's not Turkey Mill in Kent.

P: Let me press you a little further. You say that's not Turkey Mill. How do you know that?

PB: Because it's got *S* and *T* in the mark, which is the makers, 1824. But ...

P: Were they licensed?

PB: No, it was genuinely the name of the mill. They did an awful lot of good business just by the fact that their mill was also called Turkey Mill. There were lots of Turkey Mills in Britain. It's to do with dyeing cloth red; they used to be fulling mills where they actually used to colour cloth with what's called Turkish red.

P: Is all this in your books?

PB: Some of it.

P: When you have a watermark, is there a standard rule of thumb for which side is the wire side? Is it generally right-reading on the felt side or generally ... I know it's both, but I am wondering if it's one way more than half the time ...

PB: I've never done a survey.

P: Or is English paper more often wrong-reading on the felt side?

PB: I would say that during the eighteenth century most English and northern European papers usually read right-way round — the wire would read correctly on the mould, but by about 1810 or 1820, for some reason, in Britain at least, the habit seems to be to reverse on the mould — consistently too. There are one or two mills that obviously didn't do that. You do get double moulds where the sheets have been watermarked twice. One's one way round and one's the other way round. I've actually seen moulds like that. So it doesn't matter which way you hold it up to the light, you read it right.

P: I don't know if you've talked about this sheet already, but when you look at it on the light table it has a different appearance than in normal light. Compared to other sheets, like this one, for example, it has a cool tonality. What can you tell me about it?

PB: In terms of the colour?

P: Yes.

PB: This is a mix of linen and cotton. The rags were also somewhat dirty. They were having real problems by this date. This is a real oddity because it's got the Scottish thistle on it and was actually made to commemorate George the — I can't remember the number — 1821, George IV when he went to Edinburgh.

P: Have you reached the point where you can distinguish between linen and cotton papers very quickly just by handling them a little bit and looking at them a little bit?

PB: I would say so, but people could probably give me one where I wouldn't be able to tell. I think that comes not just from looking at paper but from having been a papermaker and spending a lot time with the fibre in lots of different forms. However, you do get surprises.

People were talking about artists using much older papers earlier. Well, this is a Montgolfier paper, which was very hard to get my hands on because the person who had hundreds and hundreds of sheets of it (from the 1740s) works on it — it's his favourite drawing paper. It's a printing paper and would still print quite nicely probably. It takes graphite beautifully.

P: Could you talk a little bit more about distinguishing the felt and the wire side of the paper?

PB: Right, we need some raking light and an example or two [*setting up lights*].

I don't know how well anyone can actually see this, but the impression of the watermark is in this side of the sheet. That is the wire. Now, having said that, there are occasions when the impression on a handmade sheet is on the other side, but that only happens in a few specific papers. If you are trying to make a really lightweight paper, what usually happens when you've couched it and you put the felt on top, followed by the next sheet, is the couching action for some reason 'pushes' it, but this is

only in very thin sheets. In heavyweight sheets and normal-weight sheets it's not a problem, but in lightweight sheets there can be confusion, especially if it's linen. If they're made of cotton it doesn't happen, but linen behaves very oddly in all sorts of situations. With a really thin sheet of paper there's very little pulp on the mould and the physical wire of the watermark is as thick, if not thicker, than the drained pulp, so when you couch it and put a felt down on it, the watermark will fill in a bit just because of the pressure, but it becomes very difficult to tell which is the wire side and which is the felt side. That happens more with linen than with cotton. Generally it's as simple as that.

P: And if there's no watermark and it's a very thin paper?

PB: Well, if it's a laid paper you are still going to see the laid structure. In a wove sheet you can see the wire profile sometimes. I've found one interesting thing though, with the use of a digital camera, transmitted light and a computer you can actually record the densities of the sheet quite well. Sometimes you can blow it up and what you are seeing is the minute changes in density in the weave.

P: Sometimes I get sheets where the felt impression is so strong on both sides ...

PB: Then you don't have a hope — you can't always see it.

P: Is there a point where the designation countermark becomes meaningless with later papers?

PB: Well, it's difficult to know. You only have a countermark if you've got a watermark. If you've got a watermark in one sheet, it's a countermark, because it's counting it and matching it in the other sheet. Otherwise, most marks today can't be used like that.

P: So it's not simply having a figurative element and some letters?

PB: No, no. There are plenty of papers where you actually have figurative elements and designs in both half-sheets. They are both watermarks.

P: Then which is which?

PB: I don't really use the word countermark. Well, I do, only because other people know what you're talking about, but they're all watermarks really.

P: But in the case where you have two very elaborate figurative things?

PB: I don't know what you would choose. You choose which one you like best!

P: If you have a watermark and it's only a word or letters, then it's just a watermark and not a countermark — if there's no figure there?

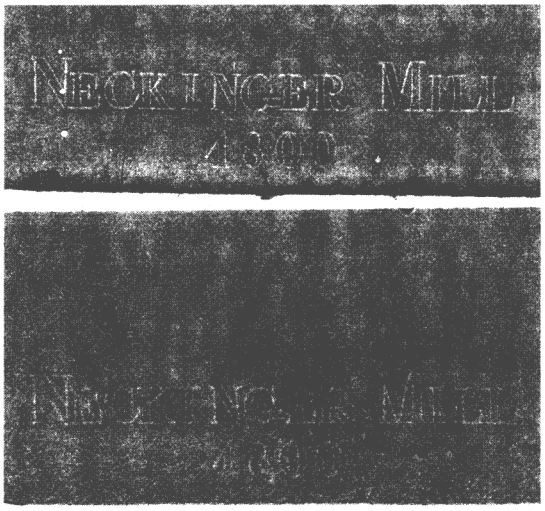


Fig. 2 Watermarks reading *NECKINGER MILL / 1800* from two sheets made by Mathias Koops at Neckinger Mill, Bermondsey, London, showing the typical variation between different watermarks from a pair of moulds and the difference in clarity produced by variation in the vatman's shake.

PB: That's how I do it; that's how a lot of people do it. Do you want to have a look at some other papers?

P: Sure.

P: Peter, are these papers from the same mould with just a different density of pulp? I was wondering why you had the two sheets here.

PB: No, they're variant watermark. They might be off the same mould but, if I remember rightly, they are slightly different lengths and there's a difference in the G in the watermark (fig. 2).

P: Handmade or machine-made?

PB: It's handmade.

P: It could be the same mould but with some differences in the watermark?

PB: These are not the same mould. This is probably the pair.

P: It's interesting, you can see the wire pattern here but not so well here. Is it because of the thickness?

PB: It's just different formation. Every single sheet is going to be different.

P: That watermark is so fuzzy. Why is that?

PB: That's just different formation. The wire is not any different to that wire.

P: When you say different formation ...

PB: It's literally the shake of the vatman and the batch of pulp — everything.

P: You'll probably enjoy this. A while back I collaborated with somebody from school, the Museum of Fine Arts, and she taught papermaking but had never actually had an occasion to make a piece of paper with a watermark on it. Why should she? They're making sculptures and all sorts of things with paper. I had a mould from Lee Macdonald and put a watermark on it and went over and said, 'Let's have some fun; let's make a piece of paper with a watermark on it.' She had some paper pulp handy that was wonderful abaca pulp and we made the sheet and couched it and you could see this huge watermark we'd made of a bull's head. When we pressed it and so forth, the watermark disappeared.

PB: That's abaca for you; it's the fibre.

P: Finally — I am slow at this sort of thing — a light-bulb went on in my head. I asked her, 'What's the crummiest paper pulp you've got? What has the shortest fibre?' She said I didn't want to use that, but I tried it and that pulp produced a beautiful mark.

PB: Right. If you want really fine definition in a watermark, you beat short.

People were just asking about definition of watermarks and fibres [*slide projected for participants*]. This is a watermark and it's a classic example of how you really must beat short; short fibre gives you this definition. This projection is not much bigger than the actual sheet size. It's a huge sheet of paper but the whole thing is, at its thickest — remember watermarks are just pulp-density differences — about one millimetre thick. Here's a close-up showing pulp differences and the incredibly short fibre. One or two of these moulds still exist. You try making a sheet of paper on it. It's appalling! I don't know how they did it. Nobody seems to be able to make watermarks as well as that anymore.

P: What about the ones that they produce in Fabriano today that are sold in all the gift stores there? They also have an extremely short-fibred pulp but there is also something very strange about the surface texture, which makes me think they must have used some kind of additional aid in forming these sheets.

PB: Gin — it changes the surface tension of the water. These are papermakers' tricks. Gin was used in the old days. Gin and beer in Britain was threepence a pint — very, very cheap. But any spirit like that will change the surface tension of the water. It will aid or shift the drainage. It'll allow you to do things that you couldn't do otherwise.

PB: [*another slide projected*] This is Thomas Harry Saunders, who was an extraordinary papermaker. People will have probably heard of Saunders watercolour papers and things. Thomas Harry didn't have any descendants so the company name carried on after his death. At one time he was the biggest papermaker in Britain. He had 19 paper mills up and down the country and he was very proud of what he did. Every time there was a big, international exhibition or something, he'd create some of these outrageous watermark sheets. As far as it's known, there is only one complete set of them anywhere. There's lots of them around but the only complete set belongs to a woman who lives in west London, who inherited them because her grandfather had worked at the mill. He was one of the people who had actually formed these sheets and he'd kept a sheet of each. They're wonderful! If you ever find any, just buy them. They are very collectible and very valuable. But Saunders made them just to say, 'This is how good I am.'

While we are talking about watermarks and things, there is something here which we'll put on the light table. In the lecture yesterday, I talked about photo-filigrane used in fake watermarks ...

P: Are they done with different transitions of wire thickness?

PB: No, with a light-and-shade watermark you carve the mark in very shallow relief in wax on a light box. They used to do it up against a window. You carve a shallow relief, then make a negative and positive mould of it. Under heat and pressure you then force woven wire mesh to take up all those contours, and that becomes your forming surface.

This is a photo-filigrane [*slide shown*] which is rather nice, a very beautiful piece of work. This is not a watermark at all. This is a photograph that they have then made a metal plate from. From the plate they printed gelatin under great heat and pressure into the sheet of paper. That is Woodbury's photo-filigrane process.

P: That would be destroyed then — those plates — in hot water?

PB: Yes, the curious thing is, when they're just made almost any amount of water will take it away. But the really old ones seem more stable. You could get rid of it but it would be much less soluble.

P: The watermark shown in your lecture — made by Warnerke — was that made with enamel paint?

PB: Oh yes, that mould (fig. 3).

P: Was the paper dried in that mould?

PB: No, he couched that off.

P: The raised surface was just painted on?

PB: Yes, instead of using wire.

P: Can you tell us something about this pink paper? [*A sheet from Peter's collection is shown.*]

PB: It was made near the Rhine, southern Bavaria I think. The watermark, *RODER*, you also see spelt *ROEDER*. It's stamper beaten, with all this knotted fibre. This came from a particular source so we know the date of it. It's part of a huge amount of paper that came from one particular place.

These pink papers were used in southern Germany, particularly the areas that had been under French control in the 1790s. At that date they kept birth, marriage and death registers for each tiny little place — their own annual books. Now, the reason that I've got this paper (and a lot more of it) is because the local government had decided to disbind all these books because they took up so much room. In some there would be only one wedding in the whole year, or ten deaths, so what they've done is kept all the pages with written records and discarded all the covers and all the blank sheets of paper that make up the rest of the text block. There used to be three barns that were packed with this discarded material — particularly the book covers. The man doing all the disbinding was lighting his fires with them. There were thousands and thousands in the barns. You could hardly get inside — you had to squeeze between the stacks!

I managed to get quite a lot of blank paper but I couldn't physically carry it all away. These papers were made for all sorts of reasons. It's the kind of paper that one might have seen somebody drawing on with pastel or something like that, given the sheet's colour.

P: That's where I've seen it.

PB: Whatever the papermaker designed his paper for gets obscured once it was distributed out in the world; it ends up all over the place. Somebody sees a batch of it, thinks it's a nice paper, and uses it for any number of purposes.

P: What's the date of it again?

PB: This one, even though it looks older, is probably about 1810.

P: What do you think the colorant is?

PB: It's coloured rags.

P: Coloured with ...?

PB: I don't know. I haven't done any work on it.

P: [*looking at the paper under the microscope*] It is definitely mottled, like mixed fibres.

PB: It's mixed fibres.

P: But pink rags — they must have been collecting them specifically, because ...

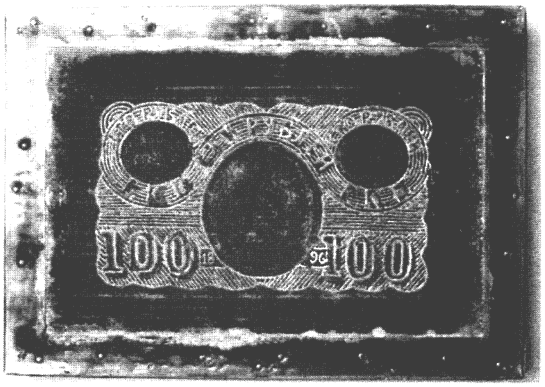


Fig. 3 Mould used by Leon Warnerke for producing forged 100-rouble notes during the 1890s. In this mould the watermark has been produced by building up layers of enamel paint and carving it down, rather than using wire.

PB: You don't need much red rag to produce that pink.

P: It's like a can of white paint and you put one little drop of red in.

P: One of the most amazing sources pertaining to different rag collecting is this manual by Louis Piette,[7] which can be found at the New York Public Library. It has dozens of fabric samples to specify the different classes of rags, at least 15 grades of white, from lace to coarse.

PB: Which year is that book?

P: First half or mid-nineteenth century.

PB: In my Turner exhibition there's a similar book by *Ludwig* Piette.[8]

P: This one contained lots of different colour grades that are all sorted by how much colour they have in them and whether they are printed or dyed. It's very specific.

PB: Piette is amazing. I was looking at a Turner sketchbook and I knew it was a straw paper — almost 100% straw. But who in the 1830s made it? Turner used this in 1839. His sketchbook had a German binding, certainly not an English binding, and I was just racking my brain asking, 'Where on earth is this from?' Then through the post comes a book with the note, 'Thought you might be interested in this.' An 1838 Ludwig Piette book with 187 cereal-straw paper samples! These were actual paper samples from different kinds of cereal straws. It came through the post! Number 99 was the sample match for the Turner sketchbook paper. I put it in the exhibition. They're side by side in the exhibition and it looks like a fantastic piece of research, but it was a lucky coincidence. It's a fantastic book, absolutely wonderful.

P: There were several books actually. One had the fabric samples, one is about the colouring of pulp with dyed samples and there are some others.

PB: In my book he calls himself Ludwig Piette.

The interesting thing is that Turner was actually only a few kilometres away from the mill on one of his journeys when he picked this sketchbook up. That particular journey is fascinating in terms of where he was travelling and, when he was on the Rhine, where he got different papers. He stayed in one place doing these blue paper drawings, and Richard Bocking's mill was located just outside the town. This mill was producing a fantastic rich blue paper. Turner picked up 20 sheets of it.

P: With the blue papers, is the difference in the paler-coloured ones and the much more intensely coloured ones that the paler one is just fibre colour but the other has some dye component in it?

PB: Sometimes it could be but often it isn't. Usually it's just the proportions. But sometimes you get papers where you've got at least two different blue rags, a tiny bit of red, a little bit of yellow, a little bit of brown, a little black, whatever, and that gave the tone. The white rag was the base colour. Other times, you used double-dyed pulp. If you dye in the beater you get a really rich, consistent colour throughout. Sometimes you dye in the vat, or you dye a portion of pulp in a bowl and you don't dry that out before you put it in the vat — you just chuck it in. That colour will leach into all the other colours and you see these wonderful tones where all the white pulp, which is the base pulp, has actually been affected by the dye.

P: In Montgolfier they sometimes took a pigment and mixed it with a dilute solution of starch — cooked starch — and used it as a kind of pudding, if you will, to help disperse the colour in the vat.

P: Can I ask a question about writing papers versus printing papers, with respect to this paper? Would this be a printing paper because it's so soft and it wouldn't hold up well to ...

PB: No, if that was an English paper I know what I'd call it, but it's not; it's a German paper and I don't know what it was actually made for. I think it's a writing paper. In England that would have been called *wedding purple*. Why it was called wedding purple nobody knows, but it must commemorate some story lost in the mist of time. Wedding purple came in all sorts of colours as well. This sheet, believe it or not, was originally purple; you can see the colour has gone soft and gruesome — awful.

This painting is by an artist I'm beginning to do some work on because his bicentenary is coming up (fig. 4. See also colour plate 3). It's Thomas Girtin, who is very interesting. This painting has yellowed considerably, judging by other ones I've seen. I would suggest that the mount is contemporary.

P: Is that a cartridge paper?

PB: This is what's interesting, and I would like to have a proper look at it. Girtin did use cartridge paper but a lot of the papers called cartridge paper certainly weren't cartridge papers. They were just low-grade buff wrappings. They don't have the strength; they never had the strength. Cartridge paper had to have extraordinary strength and it was basically waterproof. You could draw on it, but painting watercolour on cartridge paper was actually very difficult because it would resist taking the paint. However, there are paintings on cartridge papers and you can see holes in the painted wash — little areas where the paint hasn't taken. That's typical of very high-strength — surface strength — cartridges.

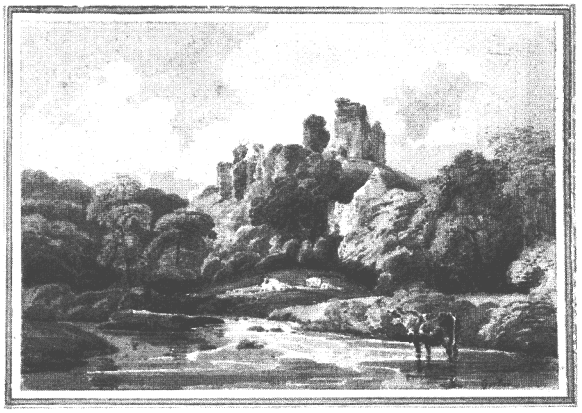


Fig. 4 Thomas Girtin (1777–1802), *Okehampton Castle*, c. 1797, graphite, watercolour and gouache on laid paper, Art Gallery of Ontario, Toronto.[9]

P: Isn't Girtin associated with cartridge paper?

PB: Well, yes, but only to nineteenth- and early-twentieth-century art historians. They say it was all cartridge paper and believe it to be all the same paper, but in fact it's at least 12 and probably 15 different sources. Some of them are cartridge and some of them are not. A lot of the paper is nothing like it. If you look under the microscope at this, you see that this one has actually faded rather badly. The wrapping papers — the flecks that one sees in there are bits of old hemp rope. There are other white papers or off-white papers that Girtin also used which have flecks in them, but they are not the same at all. They are papers that have been chlorine bleached and the lignin parts of the stuff have not bleached the same way as the rest of the rags, so you see these flecks. These ones were intended to be white papers but they didn't end up white.

Let's find some nice flecks. This has had some serious things happen to it over time. Here we are [*looking through the microscope*]. That shows up quite nicely. If anyone wants to have a look, you'll see quite a curious mix of fibres in there. There's a tiny proportion of blue rag in that paper, just a little hint, and a lot of extraneous matter that appears to be hemp. There's a little bit that has a particular sheen on it in a certain light which suggests that it's actually straw, and though the experiments in straw papers were a bit later (the serious experiments were in the early nineteenth century) loads of papermakers from the sixteenth century onwards used to shove straw into the vat. They just bulked it up. It was

cheaper than making pulp; you didn't bother to cook it or anything like that — just chop it up and chuck it in. Obviously people making fine white papers weren't doing that, but a lot of the mid-to-lower-grade papers have some straw.

P: What was the date you said that started?

PB: The fifteenth to sixteenth century. Definitely the sixteenth century, but I am pretty certain it had been done before that. Papermakers will always try to cut as many corners as possible and they still do.

P: I see quite a few bits of straw in a lot of the cheaper — especially the printed papers.

PB: Cheaper printings than these. But a lot of it can be almost anything. There are some wonderful papers made in the eighteenth century which have wool in them — not just wool — but they're wrapping papers that print amazingly well. You could print etchings on them. I know an artist friend of mine does that on old papers and they're gorgeous. They take an impression really well. There was a man called Phillippe Begonin, seventh- or eighth-generation papermaker in Lagat, near Ambert, and he has a wonderful water-powered paper machine, which is crazy! It only produces paper about 24 inches wide. It has no drying cylinders on it. It has an open reel. You just reel the wet paper up on a cage and then you lift the cage off onto a table and you chop it all into sheets; the reel just goes *woomph*, like that, so you've got sheets. He made what's called calendered paper. He made paper to make up into calender rolls to go at the end of a paper machine. So what you're doing is laminating thousands of sheets of paper together like that and then, on a lathe, you turn it so it's a perfect roll and you polish the paper with the end grain of paper. But that paper that he made is 50% wool — old gents' suitings. You go and see it and there's these piles of old suits and things like that. Some of the paper colours were amazing and a lot of printmakers, particularly in the 1960s and '70s, liked Phillippe's paper, but he would never sell it. You know you would actually have to go up into the hills and get it because he would only sell to the calender-roll makers. He couldn't understand why artists would want his paper; 'It's rubbish,' and he would say, 'What do you want this for?' However, it was gorgeous paper. Rauschenberg and all sorts of people worked on his paper. He could have made a fortune with customers like that.

Phillippe married very late in life. When he was about 70 I think his son Christian was 8, and he didn't want him to go into the paper industry. He wanted him to work for the state in the civil service. But Christian used to skive off school and go and work at Richard de Bas, the paper museum down the road. Phillippe is sadly dead now and Christian is making paper.

P: Have you determined if this work by Girtin is a cartridge paper or one of the other papers? (fig. 4)

PB: I think it's a wrapping. The board that it's on is contemporary and it's like other Girtin mounts. If we lift it up, you'll see the board itself is a laminate of a very similar paper. It's lower grade, a very buff colour and it's got a lot of rubbish in it.

P: That shininess that you were referring to, is that straw or is it some other layer on top?

P: It almost looks like graphite, but it's not as grey.

PB: There's one piece on the top right — a buff-colour thing that's glowing gold and looks very like silica, like what you get in the stem of a piece of straw.

P: So some of that glossiness is related to the straw?

PB: And some of it is related to the treatment that this work has had over time. It has obviously been pressed quite a lot at one point.

P: It was a much lighter paper too, originally.

PB: Oh yes, it's gone. A lot of them were almost white — really quite nice. Occasionally you see Girtins in beautiful condition and you know the paper is quite pristine. But it's often got these little flecks in it. Lots of artists wouldn't mind. I love David Cox's remark about working on wrapping paper — Scotch wrapping. Somebody asked him what happens if a fleck gets in the middle of a sky or something like that, and he said, 'I put wings on it and it flies away.' It was a lovely quote. Cox's thing about Scotch wrapping is brilliant because he was at Grosvenor Chater, the paper merchants, and saw this ream of wrapper paper and said, 'Oh God, I'd like some of that.' Well, they ordered him a ream, and a few weeks later he went to collect it and it cost £10, which he didn't have — it was quite a lot of money in those days. The ream weighed 480 pounds — that's heavy. So William Roberts, the amateur painter who was a friend of his, had to be summoned from the other side of London with the money and then the two of them set off down Upper Thames Street with this huge chunk of paper. But he could never get any more because, with those kinds of wrappings, they didn't worry whether one batch was the same colour or anything as a previous batch. They just made it to be used for wrapping. I suppose he got 400 to 500 sheets; it's difficult to know what the actual ream count would have been, and they were big sheets, probably 36 by 24 inches. So you get 500 sheets of that and most of Cox's work was this sort of size. He got a lot of work out of it, but he did eventually run out. He's interesting in terms of how different artists respond to the change in watercolour papers through the beginning of the nineteenth century, when they're becoming more specifically designed for a market. Some artists didn't like them and didn't work on them. There are almost no examples of Cox working on actual watercolour paper. He worked on map papers, printing papers and wrapping papers.

P: What is the colour of that wrapping paper that Cox used?

PB: It was a pale grey, a pale whitish grey. People get confused, though. A lot of people think it is a sort of yellow colour because it goes very yellow in light. In the 1890s a paper company called Dixon's decided to market a range of artists' papers and they produced a David Cox paper. They went to Birmingham and looked at a lot of the ones in the collection there, which have all been badly affected by light, and they thought it was a yellow paper. So they made Dixon's Cox paper, which was a yellowish-buff paper. That's a curious paper because it's made on a machine; it's a Fourdrinier paper but made very, very slowly. It has about 35% peat in it because it's got a fleck, and they got the fleck by just adding peat and a bit of red wool. They stopped making it when the annual demand went down to 16 tons. It wasn't economical to make.

P: Do you know if Girtin or any of the other people who painted on cartridge, where you have that really hard surface, prepared it in any way so that it would take the colour better?

P: It's difficult to see, but you do wonder if it got rubbed with anything.

P: Yes, I was looking for some evidence of it but I'm not sure I'm seeing it. You can see where the colour has run, but other areas look like they're smoother.

PB: Yes, you do wonder whether it's been rubbed like that. There are some Girtins, some Cotmans and one or two other artists who worked on cartridge, where the wash is broken up — the water and the pigment have separated.

He's going to be quite interesting to continue working on. If you look at the back — the board — it's equally flecked and has all sorts of stuff in it. It's obviously been framed up.

P: Did Girtin glaze his skies quite a bit beforehand with a buff tone?

PB: I've never come across one.

P: Are there a lot of forgeries?

PB: No.

P: Since you don't have enough to do, Peter, what you should do is an exhibition about Girtin's papers and so forth and then just tell us all about it so we can come look.

PB: You're joking, but I am working on that. With his bicentenary in 2002, the Tate Gallery is thinking of doing a huge Girtin exhibition. It's actually quite manageable in the sense that his working life was very short. You aren't looking at a huge amount of work and there are big concentrations of his work in just a few places. Okay, there are a lot in private collections and other places as well, but it is feasible in the time available to do something. It's gorgeous work, with so much you could ask about it. Why has the paper colour gone? There are so many different reasons why all this colour could shift like that, particularly when some of the other colour looks fine; it's shifted but not as much as the paper.

Do you know de Wint's work? He worked a lot on Creswick paper, which is a very odd paper. It often is over-cleaned by restorers because it looks, when it was made, as though it had discoloured. That was the sort of tone and quality it had. He worked a lot in indigo, and the skies in so many of de Wint's works have gone red. The combination of this odd paper and the indigo that has changed resulted in these wonderful red skies. Well, there was a woman who came to the Tate doing research into de Wint's red skies. She had to be told that these were actually all blue which, I imagine, meant he didn't have serious psychological problems and things like that. I am very glad it wasn't me that had to tell her.

P: It is interesting and indicates how tricky, how sobering it is to perceive something and clearly understand what it is you are seeing and how you're interpreting it. For instance, there was a scholar of Winslow Homer who regularly showed up at the Museum of Fine Arts in Boston. One day I got into a discussion with him about some of the watercolours we have in our collection, many of which, unfortunately, hung on people's walls for many years, so you can see around the margins that some of the colour is still left there. Well, I just naively said, 'Oh, it's too bad, look at how much colour has changed there.' And he insisted, for many years until he died, that it was the result of some sort of unspecified chemical interaction between the mats and the watercolour pigments that produced that colour, and that what you saw in the middle — the brown colours that I believe were the remnants of indigo — were actually the original colours. It's fascinating, isn't it?

PB: It is a real problem. Kennedy North, who conserved all the Cotmans in Norwich Castle Museum and some of the British Museum ones in the 1920s and '30s, did so much damage to the understanding of Cotman because everyone thinks that those great works — they all know them — look like that. Tragically, he repainted half of them. He took varnishes out, he did this and he did that. Luckily he was so proud of what he'd done that he privately printed a book about exactly what he'd done and he'd also left the Norwich Museum with before-and-after photographs which are — they are all in black and white — very useful. But the problem now is that you get a Cotman in really good condition turning up out of the blue and some people say that it isn't a Cotman because it doesn't look like these ones that Kennedy North had done all this damage to.

P: Calibration of your vision.

PB: Oh, there's one more here to look at [*a watercolour sketch by J.M.W. Turner*]. This is a little blue-paper Turner. It's all right. I am happy to see this Turner sketch on George Steart's blue paper. Not only is it a wonderful paper but he made so many different batches. He experimented non-stop, which is very useful if you are trying to order somebody's work like Turner's. I have been doing so much work on these particular blue papers used by Turner, and they are an absolute nightmare because there are 8,000 of this size — or something like that. They are all one-sixteenth of an Imperial sheet. Bally, Ellen and Steart (George Steart) were the papermakers — near Bath. Nobody has ever heard of them. They made all Turner's blue papers, the famous names for the Meuse, Moselle, Rhine, Petworth, Cowes Castle — all those famous Turner blues. A lot of the grey and buff papers that Turner used were from this maker.

George Steart made such opaque papers that if you hold them up to the light you can't read the watermarks, but they are watermarked. It just says *B E & S* with a date. Luckily he was a constant experimenter with practically every single batch. In the 1829 blue papers there are seven or eight different batches. He kept adding different things to the pulp in the vat. Some of them have lots of different blue rags in there, some have red, little bits of yellow, bits of brown or black and all sorts of things. Others had indigo added to the sheet.

P: Did he ever dye his rags the way Cobb did?

PB: Yes, sometimes he dyed his rags and sometimes he was using coloured rags to start with and sometimes he dyed in the vat, which is different; you get bleed when you do that. What he would do was dye already-made pulp in a side vat and then add it into the white so the white gets tinted as well.

P: How can you tell the difference between him dyeing the rags or just using coloured rags?

PB: If you use coloured rags in the beater, you don't generally get the same bleed of the dye mixed into the white pulp. The white pulp stays quite white. If you dye pulp and just add it into the vat, you've only just dyed it, basically, and all the white gets tinted. That's quite visible under a microscope.

P: I wonder what he used for his dye?

PB: All sorts of things, which included horrible things like quercitron and best Aleppo galls, which is why some of his papers have turned awful colours. In the Turner exhibition at the moment there are two pictures side by side on two different batches of paper. They were done at the same time, but they are from two different batches of Steart's paper; they've had exactly the same exhibition history in the nineteenth century and early twentieth century. In one of them the blue has gone completely — it's a kind of buff colour now — but the other one is fine.

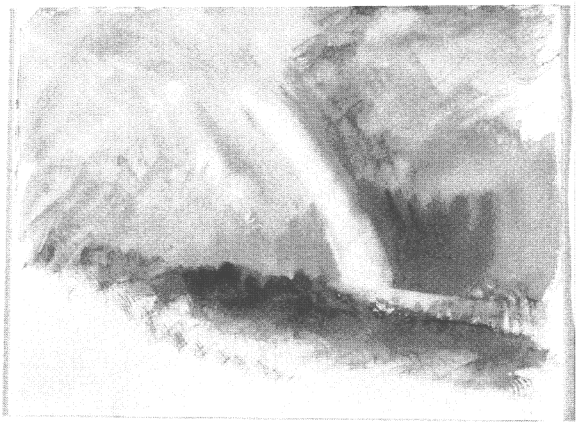


Fig. 5 J.M.W. Turner (1775–1851), *Stormy Landscape with Rainbow*, 1824, watercolour on wove paper, Art Gallery of Ontario, Toronto.[10]

P: [*looking at a Steart paper*] Would you say that colour is pretty good?

PB: That colour is pretty good but some of the Steart ones have turned really crazy colours. A lot of them have just gone.

[*discussing another Turner watercolour sketch*] I have just done all this work on Turner. I have looked at 20,000 of his works at the Tate Gallery and about 6,000 to 8,000 others. Yet here at the Art Gallery of Ontario there are two Turners that exhibit something I have never seen before in his work. It would have been really nice to have been able to write about it in the book, but this is what always happens (fig. 5. See also colour plate 4).

These are Turner sketchbook pages but they still have the attached blank page. There is still a fold. I have never seen that — the two are mounted differently but they've still got their leaf. I've never seen that anywhere, which is really extraordinary. They're both from the same sketchbook, but which sketchbook? I think it is one of the ones that just doesn't exist anymore. I don't think it's from any of the 300-odd sketchbooks that do exist. The kind of examination that one does with this is just common sense. Do these dimensions, the stitch holes, the paper quality — there's no watermarks in these — and the maker — this one looks like a Whatman — match with any existing ones? Could they be assembled to make up a sketchbook? It's quite problematic doing this. In the 1970s Nick Serota [*director of the Tate Gallery, London*] did a comparative study on the Swiss pictures, where he made three new sketchbooks out of all these loose things. Two of them were sketchbooks that are very obvious, but one of them never was. It was actually just wads of paper Turner used — loose sheets.

P: Do you think that these two come from the same book?

PB: Oh yes. The stitch holes and everything are the same — extraordinary. It is beginning to be thought that there have to be about six more Turner sketchbooks that have been broken up completely or broken up over time, and this looks like it comes from one probably from the late 1830s, early 1840s, I would say; the dating of some of

these is getting a bit problematic. I've got a rough idea of a few that have to be looked at now to see whether they are linked to this. I wonder where it came from, because a lot of these came from Mrs. Booth, whom he was living with when he died. She ended up with a lot of stuff. That's going to be a nice piece of research later on.

P: Did he buy his sketchbooks already made up or did he have them made to order?

PB: Both; he bought off-the-shelf sketchbooks a lot. Many of the sketchbooks were not sketchbooks. He used memorandum books, banker's books, ladies' pocket books or anything. He also made some up himself. But early in the 1790s and I suppose to about 1805, he did get sketchbooks made to his specifications. He would get paper and sometimes prepare it with colour and put three or four papers together, different papers, and say, 'Bind this up. I want a big sketchbook, a middle-sized one and a little one.' They were leather-bound. Later he stopped doing that.

P: Peter, did he ever make books of his completed sketches?

PB: There's one called the Grenoble sketchbook from 1802 which is all on Marais French paper, and I don't think it was ever a sketchbook, but it's been known as that. Yes, they were torn or cut sheets that were then mounted up on white paper with a nice little handwritten identification of the site or venue. There's 92 or 94 of them. Ruskin later took them all off, cut the little labels and names out and put them in an envelope. Don't get me onto Ruskin; he's not my favourite human being.

P: Did he work on blocks, the watercolour-paper blocks?

PB: No, they didn't exist at that point. They came a bit later; by the end of his life they existed. His most common approach by the 1820s onwards was to get an Imperial sheet or a Royal sheet and fold it in 4, 8 or 16 panels and stuff it in his pocket and go off drawing. They're lighter than carting sketchbooks around.

P: Did he tear them up as he was drawing or did he tear them up afterwards?

PB: Some of them were kept folded for ages, obviously. Sometimes he would work on them when they were still a complete sheet and then take out the one that he worked up, because he might only work up two or three, or none of them sometimes.

P: Can you tell if he was refolding the configuration?

PB: He didn't always fold it on the same fold, so there are several folds. You can actually work out which order he did it in with some, but other ones you haven't got a hope.

P: Peter, just one question. Those (fig. 5) were bound after he drew them?

PB: No, no. I think this was a sketchbook, but it's difficult to tell until you find the next page.

P: Why then didn't he render on the lower sheet?

PB: There were loads of sketchbooks in the bequest that have got work with blank sheets all over the place. He never worked chronologically through a sketchbook. He'd just open it, work on it, then open it again later and start working from another orientation to the sheet — perhaps upside down. You get situations where, for instance, he'd been working in England in a big sketchbook, and three years later he's going off to the Continent and, 'Oh, there's a lot left in that sketchbook,' which gives the art historians lots to play with.

These disbound sketches are really very interesting to see because it presupposes that the sketchbook was all intact at some point after it left Turner. He certainly didn't use to do things like this. He used to cut them out or tear them out of sketchbooks, but he wouldn't have disbound it in this way. However, where the rest are and which ones they belong to — I've no idea. After having spent 10 years off and on working on Turner, you just appreciate having another bit of the puzzle and keep going.

The reason I want to examine this Turner work again before going back to London is that (this is so common) I hope to find another work where the paper matches this one, with this mark that comes right to the edge. It will have a bit of white on it and a corresponding torn edge.

P: So Turner would have done that afterwards?

PB: He worked on the sheets all joined up and then just tore them up.

This is quite an interesting drawing (fig. 6. See also colour plate 5). We'll turn this [*stereobinocular microscope*] on. You can all have a look. You might want to shift the focus; it is very odd for me because I've only got one eye that works.

This is a very nice, pale buff paper. It seems completely right for the time and place and, given its size, you've got a 50% chance of having a watermark in it. I think it's *papier bulle*, which was a grade of paper; in certain periods of French watermarking you actually get the word *bulle* in the watermark. You get *fin*, meaning fine, and *bulle*. It's hemp and linen and sometimes other inclusions. The other thing that's interesting about this is the mount, where in a raking light you can read the mark, which is 1816. It's quite interesting because, given some of the impression marks in there, you do actually wonder if there's another sheet. It could be a laminate.

P: You've not found a watermark looking at it with raking light?

PB: No.

P: It looks like the hills and valleys of the moon.

PB: It's a chunky sheet.

P: Now this would have been made as a wrapping type of paper?

PB: Yes, though *papier bulle* was used for all sorts of things. Some of it is really well made and some of it is absolute rubbish. The *bulle* categorization was basically because of taxation. You had to make it. There was *fin*, there was *moyen*, and there was *bulle*. *Bulle* was basically a buff colour but they vary; some are almost white.

They are basically a hemp and linen mix, but you do get other coloured fibres in there quite often. Sometimes you wonder whether it's deliberate, the coloured fibres, other times I just think it's accidental because quality control was not hugely important, not for wrapping papers. But once some of those mills realized that there was a market, a better market for their papers, some of them did start to produce better qualities.

Over here are more papers I have brought. They have some interesting characteristics. The whole point of this workshop was trying to show people that there is all sorts of information that you can get out of a sheet without necessarily having watermarks in it.

For instance, the shadows on either side of chain lines — people call that 'antique,' which was a printer's term originally that had nothing to do with paper. Papermakers never call them antique. Those shadows usually suggest a single-face mould, but there are exceptions. This is a blue handmade wove paper (fig. 7) and it's got a very coarse wire which is actually visible — the wove wire. It has shadows, which suggests that it's made on a single-faced mould where the wire forming surface is straight on the strut. However, if you look in this area there are some vertical lines here, and those lines are the support wires that are underneath the forming surface. The reason that you can see some of this stitching, which is where the forming surface is stitched down onto the strut, is because they didn't clean the mould. There's bits of pulp and things that have dried. I used to be a papermaker and that's why I know that if you forgot to clean the mould at the end of the day, the next morning you'd have a terrible job, because there would be all this dried pulp stuck between the wires. You used to give it a scrub and then yell, 'Damn' and carry on working. The reason this is showing up here — there's almost no pulp in these stitches again — is that's where the pulp has dried between the stitch wire and the wire overnight. Things like that happen and it's very useful to see. So what appears at first sight to be a single-faced mould is actually a double-faced mould. It has these shadows because it wasn't sewn down very well and it's actually the mould surface doing that. This is just cheap blue-coloured paper — wrapping paper. No real concern for quality control.

P: So that wouldn't necessarily be pre-1800?

PB: This is 1804. I know where this came from and

Fig. 6 François Boucher (1703–70), *Young Country Girl Dancing*, *c.* 1750, black, red and white chalks and stump on buff laid paper, Art Gallery of Ontario, Toronto.[11]

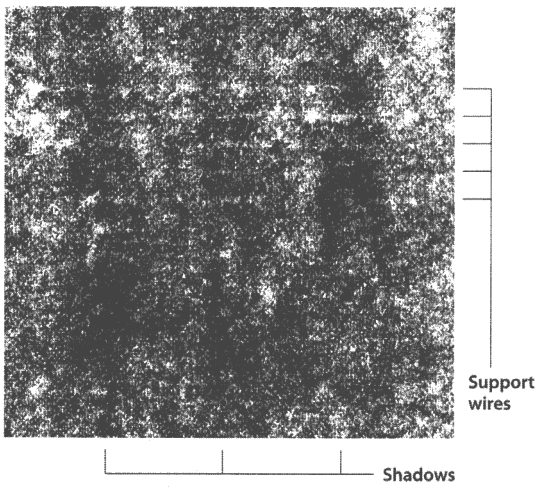


Fig. 7 Transmitted-light image of the wire profile of a paper, showing the structure of the support wires underneath the forming wire.

everything. There are other parts of the sheets which don't show this and have an 1804 watermark — which is quite useful.

P: Have you ever been able to narrow down to a smaller range of time the earliest point in which the double-faced moulds were used? Everything I've read says the last quarter of the eighteenth century.

PB: The earliest double-faced mould evidence I have ever found is 1793. The double-faced laid mould comes in earlier than the double-faced wove, though some people think that it was because of wove paper that the double-facing was invented. I'm not convinced by that. There are laid papers from the 1770s and 1780s that show all the characteristics of being double-faced, but unless you find a sheet where something like this has happened, it's not conclusive. So if anybody finds something like that, I'd like to know. The trouble is that kind of development took place in a high-quality paper mill.

P: Of course, because it was expensive.

PB: It would be a mill where they did clean their moulds properly and things like that.

P: You thought that maybe this sheet we're examining wasn't sewn so well. Would that indicate an early phase of experimenting with how to sew the two pieces together?

PB: It might, or it could just be sloppy workmanship. You have to remember that there were specialist mould-makers but there were also a lot of moulds just knocked up by guys working in the mill. I have to question this whole business of how long does a mould last in use. From having worked with moulds practically, most last an awful lot longer than the experts say they do — the watermark experts.

P: When they changed to the double-faced moulds did they have to change the proportion of water to fibre in their pulp?

PB: Some people might have. They drain completely differently but I wouldn't have thought they would change that much. It's a curiosity of forming a sheet that some papermakers form what's called wet, and some form dry. Which sounds a really odd thing to say, but you dip the mould in and you take the pulp up and you make that judgement of how much you've actually got. Some people seem to get more pulp out of the vat quicker and the sheet drains differently and that causes different shrinkage. When I was making paper and had a business partner, you could tell in a given ream of paper which of the two of us made which sheets, because his sheets shrank differently to mine. If you put the ream together, mine usually shrank slightly more in the long direction than his — and that's just to do with the shake. Also some papermakers are brilliant at making very thin sheets and some are really good at making heavy sheets and there are very few papermakers who can make both well. It's quite interesting.

P: Peter, you said that maybe the 1770s is a possible time for the beginning of double-faced moulds with laid paper. What region of what country?

PB: Oh, I'm looking at France actually. I think a lot of these technical developments occurred in France.

P: From Auvergne? They were certainly known for white paper.

PB: Yes, and Bruges, Montargis, all sorts of places like that. There was a lot going on. A lot of the assignat papers for instance. By the 1790s they had very early shadow watermarking, and they developed effective chlorine bleaching very early. This was because they were desperate; they were churning this paper out because of inflation. Meanwhile the British were making more French money than the French and shipping it over there. This large note is an English fake; the paper is from Haughton Castle Mill. The moulds for that and some of the blocks still exist. That's a printing block for this one — an English woodblock. The genuine ones were metal stereotypes.

Thomas Bewick was asked to engrave some of these and he said he would have 'no part in that disreputable business.' They must have been mad asking him, with his sympathies. Sorry, I've got sidetracked. War and raw material supply problems led the French to do a lot of the serious bleaching research at this time; they just couldn't get enough good rags. So much so, that at one point in the Revolution papermakers were authorized to enter bookshops with troops, so the bookseller could not argue, and they literally trimmed the margins off books just to get the paper to recycle. It was a very difficult time. A lot of French mills closed in the 1790s and then some started up again later. The English were having the same problems with raw materials and they got into bleaching in a big way there. I have always liked James Whatman's remarks about chlorine: he wasn't going to do it because he did some trials and he found that it was injurious to both the paper and the health of the papermaker. This was 200 years earlier than present environmental interests.

[*A Whatman paper is shown.*] I thought people might be interested to see this prepared paper, which was sold like this.

P: What is the date?

PB: Oh, it's a 1794 watermark. But *J Whatman 1794* could have been made in this size; this probably comes from a foolscap. That could have been made any time up to about 1799 with that mark in it. You could buy these.

P: Was it coloured with watercolour?

PB: No, no, this is probably just soot — and water. You get brown soot and black soot depending on what you've been burning and you just put a load of soot in a bucket of water and get a rag and dip it in the bucket and pour it on.

P: Would this have been for drawing?

PB: Yes.

P: Would this have been done by the paper seller?

PB: Yes, some artists did it themselves, obviously. But this was sold as bistre board, or there was bistre paper. You could get it in a variety of different tones.

P: What's the surface like on the bistre paper?

PB: That's a particularly brown version of it. Somebody just gave me a wad of different papers and several of them were prepared like that. One of them had a wonderful ochre watercolour wash over the whole of one side, which is really nice.

[*Another paper is shown.*] This is a paper which I thought people might find interesting, because what I am trying to show you is some oddities, or what appear to be oddities. This is called lined wove. I don't know if you know lined wove. It has chains but no laid lines and it's Italian; northern Italy and southern France in the 1820s and 1830s produced an awful lot of this paper. The Italians actually called it *al inglese*. But why were they making it?

P: It's a wove screen?

PB: It's a wove with these lines on it. But they are not really chain lines, they are just wire.

P: What was the point of putting the wire on there?

PB: You tell me. There are lined woves which are different.

P: It has a watermark. They took the trouble to put a watermark in.

PB: I don't know what they were doing it for. It was just a fashion and there are a lot of fashions in papermaking. One of the interesting ways of looking at paper, even if you don't have a watermark, is to examine the variations in wire thickness and wire profiles, because there were definite fashions. Once the technology was variable enough, people could decide what gauge of wire they would use and, for instance, mills in a particular area would all start to go thin. Consequently, you get much thinner wires.

P: Would you find this kind of laid wove in any particular kinds of publications?

PB: You don't find these in printed books. You find these in bound notebooks usually, or as letter-writing papers, but there's no real evidence as to why they started producing it. The French stuff is usually creamier but a lot of the Italian stuff has been blued like this. This has actually got blue in it to make it appear white — not that successfully.

P: It's very interesting that there could be this mark within a circle — that's so Italian to have everything in a circle within a circle.

PB: [*examining another sheet*] Here are two, a pair of marks on a pair of moulds. They are actually different. This is a true deckle edge in both of them and this edge is torn.

P: So the mark was at the very edge, nothing in the middle?

PB: Generally, English watermarking practice in wove paper was to put the mark on the edge, bottom right usually, but you get bottom left and you also get central along the long edge. You then get people who make your life difficult by putting two marks in the sheet. If you're trying to reassemble things and you think there's only one mark in the sheet and you're ending up with all these extra watermarks — corners and things — you suddenly think it's a double-marked mould and you have to do it all again. They are very nice papers. Use the microscope and have a look because they are really worth it. You see all sorts of wonderful, wonderful things.

Here is a wonderful tracing paper; I love tracing papers like this. Isn't that nice?

P: A nice oiled paper.

PB: Yes, it's oiled — gorgeous.

P: Now, when was this done?

PB: The 1920s. You know John Bidwell gave a paper here about the Fourdrinier brothers and the early machine? Frogmore Mill, in Hertfordshire, was the mill with the first production machine and it's still there; it's still a working mill, now called the British Paper Company. There's a guy who works there (separate company) and he's the only person I've come across in western Europe who still makes oiled papers — still with linseed oil. He makes oiled boards mostly, but he will do thin tracings. It's incredibly dangerous making oiled papers because it can blow up. You get a pile of oiled papers and if the heat builds up too much, *bang!*

I've also brought a random selection of idiocies and some jokes. This is French Revolution money. Assignats are extraordinarily interesting in terms of paper history. They are the first examples of shadow watermarking. This one doesn't have a shadow mark on it. Does this other one? It doesn't have a shadow on it either — they're fake.

Here is a million-dollar bill produced by the right people. It's not a fake. It's produced by the U.S. authorities, but it does say 'non-negotiable' on it. [*laughter*] Yes, it's just a joke. They produced about 300 of these.

Now if people would like to have a look at this cheque written by Sir Walter Scott, tell me what you think about it, anything that strikes you about it. Somebody came to me with that and said, 'Brilliant, I've just bought this cheque.' It cost him £2,000 sterling.

P: Looks like a reproduction.

P: The paper feels wrong.

PB: The paper was made about 1948.

P: Even the ink is wrong.

PB: Yes, none of it's handwritten. The ink is lithographed. But they have actually printed the ink burn on the back as well, so they made a considerable effort. This is not a forgery; this was made as a facsimile by the Royal Bank of Scotland. They own the cheque and they made about 20 of them and they were given away as presents about 30 years ago to various people.

P: They've done that recently too, printed up banknotes from the original printing plates, and we've got some of those plates and the forged banknotes. We're thinking of printing them up. For their centenary they printed up one-guinea notes and gave them out as presents on lovely handmade paper. So in a few years — who knows?

PB: In a few years, yes. These were printed around 1968.

P: And there's nothing marked on them to indicate that they're facsimiles?

PB: No. When people received them they knew that they were just facsimiles. Years and years later they started appearing on the market. What cracked me up about this is the man who bought it is quite intelligent, but it's so easy to see what's wrong with it. Even with the naked eye you can see that it's dot screened. It's just unbelievable.

I was just looking to see what else is here. [another selection] This is a German fake of a British currency note made in the Saschenhausen concentration camp. I am convinced that this is one of the reasons that I got into making paper. My father was in military intelligence and just after the war we were in Austria. At the time I was quite a young child and one of my earliest memories in life is of wet boxes filled with these currency notes sitting on a stone floor. They came out of the lakes in Austria where they'd been dumped. This one didn't come from there but I still have some of the notes they first found.

P: Does it have a watermark?

PB: Oh yes. It's fantastic. They are some of the best forgeries ever done.

P: What's the context of their making?

PB: It was originally someone's brilliant idea to destabilize the British economy by producing vast quantities of this and dropping it on Britain. We thought about doing it to Germany as well. But eventually what happened is that they were producing it to fund intelligence operations and buying goods from neutral countries in sterling. They produced some £5,000 million worth.

P: How much of it was used?

PB: Oh, most of it got out into the market. So many were turning up that by the 1950s the use of all these white bank notes ended. Many more were found in Austrian lakes. There were literally truckloads that had been driven into the lakes. That was it; they changed the banknote design. These are some of the best fakes out — absolutely brilliant. The only thing wrong with this one is that this little bit of watermark here should be slightly further to the right.

[*another selection*] You might find this interesting because this was made not far from here, Domtar, a Canadian paper mill. This is a trial banknote. Have you ever seen a coloured watermark? That's a watermark! Completely new revolution in security papermaking.

P: How do they do it in colour?

PB: Ha, I am not permitted to tell you!

P: But you do know?

PB: I do know how it's done. It's very complicated. They very kindly gave us enough to put in every copy of the journal we produce, just to tip them in, which was very sweet of them. It's curious how I came across this. I ran into a friend of mine that I hadn't seen for about 20 years, in Bristol, and we were talking. He said a very curious thing happened a few days ago. He was in a pub and there was this guy burning blocks of these banknotes and my friend said, 'Can I have some?' Later he gave me a couple of examples and I was looking at them trying to work out where on earth they could have come from. In fact it was this one and it actually says 'Domtar' in here. So I just rang Domtar up and said, 'Is this anything to do with you?' And they said, 'Which one have you got?' [*laughter*] It was this sort of greeny one and they said, 'It was a trial that was no good; it didn't work properly. It was too expensive to produce, so we've now found a slightly different way of doing it.' However, what was this guy doing in England with wads of these? Well, he obviously thought he had had enough of it. Domtar very kindly produced a lot then. There are apparently five governments interested in doing this for their banknotes but the unit cost is high. These are just trial notes. Luminus is the trade name for the process. They're Canadian.

[*another selection*] Oh, I thought you might be interested to contrast this kind of print quality with the printing of those Chinese bonds mentioned in my paper on forgery. If they were genuine, this is what they should look like — this kind of quality in printing. These are all the same period and they were printed by different printers. This is by the American Banknote Company, which produced de la Rue.

P: So you think this is what they would have produced

for the Chinese?

PB: I think the genuine ones were much better quality, but they still had designs with deliberate oddities because the Americans had no intention of ever honouring them.

P: Peter, I'm curious about a period in Whatman paper production where the Turkey Mill or mills may have turned to machine-made paper without making it obvious. I've found out as much as I can from the sources available to me and wondered what more you knew about when they started producing cartridge and if they were intentionally deceptive.

PB: No, I don't think there was any deception involved at all.

P: It's just the way that papermakers chose to market it?

PB: Yes. Hollingsworth moved to machine-made papermaking in 1859.

P: Okay, I thought I had read that they installed a machine around 1848.

PB: They did put a machine in earlier but only went completely over to machine-made in 1859. Balston never put a machine in but in 1859 Balston purchased the rights to the Whatman name. But there's a curiosity; the large Antiquarian and Double Elephant sheets made at Springfield Mill have traditionally always had the Turkey Mill name in them.

P: Oh, they have? Even in that period when Hollingsworth had the right to the Turkey Mill name?

PB: Yes. In the sheets made after 1859 there are other indications where they come from because Balston got all the handmade moulds. They didn't take Turkey Mill off the moulds but what you see in the corner of some sheets is a *B* for Balston. Then it gets even more complicated, because James Newman, the artist colourman, was having paper made for him by Whatman to his specifications. That paper had the Whatman mark and a big copperplate *N*, which means Newman. Winsor and Newton were having the same papers made for them from the same moulds, but they didn't put an initial in the watermark. Those papers were stamped with a griffin, a blind-embossed stamp of a griffin in the corner. The fibre is beaten differently but they have the same function — they're all watercolour papers, but it's their own recipe.

P: Do you have any information on the difference in their recipe for watercolour paper or what they thought made a difference?

PB: There is some documentary evidence, yes. There are 'making-ledgers' describing what kind of rags they were using, what blends of rags, and how they were doing their sizing. If you start analysing them you can see differences. Some you don't have recipes for, but others you do.

P: Are those making-ledgers in the archives of Winsor and Newton?

PB: Oh no, they're not in Winsor and Newton. They're in the Balston family papers, some of which are not accessible to the public; basically, you must persuade John Balston or Keith Balston to let you look at them, since it's family material. There are records in the City Museum in Maidstone and the Kent County Archives as well.

P: Were there any records from the Hollingsworth operation?

PB: The Balstons have got a lot of Hollingsworth material even though there was a co-operative rivalry between the two companies. For instance, when Balston was running out of rags one time, the Hollingsworths shipped a couple of cartloads of rags to him because whatever affected one company affected the other.

P: Because of their shared reputation?

PB: Because the public didn't really distinguish between — the fact that there were two separate companies producing Whatman paper.

P: Okay. Even long after 1859, then, you can find Turkey Mill watermarks on the larger sizes?

PB: On the larger sizes, yes. In the 1930s and 1940s they were still producing Antiquarian with *JAMES WHATMAN / TURKEY MILL / KENT* and a date.

P: Since you find some of the trade catalogues, specifically by the 1890s, talking about the wonders of Turkey Mill paper and Whatman's, that makes sense. Now, I know Cathy Baker did an unpublished master's thesis comparing the Turkey Mill papers and J. Whatman papers from a set of Audubon's *Birds of America*. She found an increasing divergence in Turkey Mill papers in terms of durability and brittleness and discolouration. Have you seen anything in the recipes or the papers that would throw any light on that?

PB: No, but what is very curious is that artists' preferences in paper change inexplicably. If you are looking at the work of watercolour painters in the 1820s, Balston seems to have been the preferred surface, the preferred paper. In the 1830s you get a lot of Hollingsworth, and then in the 1840s you get artists working on both. Whether or not this was due to differences in marketing by the two companies or distinct differences in the papers, I don't know. I've got these papers, but the trouble is you can't really paint on them to find out.

P: To really see what the differences are?

PB: Yes, in some cases the gelatin is gone and in some cases it isn't in bad condition. You're not getting a true picture with old papers. Then, by 1859 Hollingsworth was not making watercolour paper. The machine-made papers that they were making were fine printings — book papers and stationery papers.

P: Cathy Baker noted that was the case when the *Birds of America* was published. So it's much earlier and they were interchangeably using both papers, but she noticed, particularly in the later portfolios, that increasingly discernible difference.

PB: Oh yes, I think there was.

P: They're different in thickness too.

PB: Oh yes, I know that. Of the Imperial printmaking sheets that both companies were making, the Hollingsworth one was always lighter weight, even though they were both called the same weight. The Hollingsworth one was always thinner.

P: Have you ever run across a mention of Whatman in Emperor size, which is larger than the Antiquarian, that I found advertised as well?

PB: The Emperor was never made as a handmade sheet. It's a myth in British papermaking.

P: Well, it's listed in the trade catalogue.

PB: I know, but it's not a handmade size.

P: So it had to come from Hollingsworth?

PB: It's machine-made.

P: That would make sense. I kept trying to figure out if maybe it's a joined sheet.

PB: You could buy from Winsor and Newton, at one point, Quadruple Elephant, which was not one big sheet but a joined sheet.

P: Right, I figured out that, but the Emperor I just couldn't figure out.

PB: The French made Emperor as a size and God knows how they did it.

P: They made it as a handmade?

PB: As a handmade sheet.

P: It's around 50 by 70 inches.

PB: It's like Antiquarian, you need two people to hold the mould and eleven people on the crew. Two vatmen would work together, the pig on the pound, and their job was to take the weight of the mould before couching. One guy, called the bellows man, stood between the two vatmen and operated the counterweight attached to the mould.

P: I can't imagine. It must have been like a circus.

PB: Well, I think Whatman was very clever. When the Antiquarian Society asked him to make it — you know he was going to charge them a lot of money for it anyway — he charged them for making the equipment too, because he said nobody is ever going to want this paper, it's such an expense! Well, they were still making it 200 years later.

P: [*Another paper is examined.*] If you look at a paper like this, what can you discern from observation that would give you some sense of the fibre composition?

PB: Of this?

P: Yes, just using this as an example.

PB: As an example, I think my judgement is based on having been a papermaker and having looked at a lot of paper. This is linen. It's as simple as that.

P: I understand what you are saying. I've made paper and looked at a great deal of paper and I can say I have this intuition that it has linen in it, but I want to know what kind of intuitive things you're using.

PB: I don't know. If I could describe it, I would write it down. It's not just intuition, it's conscious knowledge. I know when this was made, and if you found cotton in there it would shock me rigid, because nobody was using cotton at this date. The French started using cotton; this is French paper, before the English. About 20 years earlier than in England you find cotton coming into the paper.

P: The paper would sound quite different as well?

PB: Yes, the crackle. Obviously a whole sheet is going to have a different crackle to a small one but that's not due to its composition. Crackle is about internal strength, how well it shrank during drying.

P: Well, wouldn't what it's made of make a difference?

PB: It would make a difference because linen will shrink better than cotton.

P: And size?

PB: The size matters too. This paper had gelatin on it, but the gelatin is blah. I've painted on it but it doesn't take well. It's a good drawing paper that takes graphite beautifully.

P: What do you mean it shrinks better? Is it more or less, or is it more even?

PB: When you are beating cotton, linen or any fibre, you can get more water into a linen fibre than you can into a cotton fibre — right inside it — and if you can do that, then, as the sheet dries, it's not just the fibres pulling on each other as the water in the sheet comes out, but also the fibres themselves are losing water and shrinking. They pull incredibly on each other and you get great internal strength. Linen also has an odd characteristic. The thinner the sheet, if it's pure linen, the relatively stronger the surface is going to be. Cotton doesn't work that way. A thick linen sheet doesn't necessarily have a stronger surface. It usually has a slightly weaker surface than a thin linen sheet. It's quite odd. The mechanism — how that happens — I haven't a clue about, but it's a measurable difference.

P: Can you tell beating time, give or take?

PB: Not really, but you can basically say, 'God, they really knocked hell out of that.'

P: And that's translucency as well as ...

PB: Yes, and also shrinkage and strength. The thing is, you have to be very careful when you look at old accounts. I wouldn't trust most of what papermakers say about their own products at all. Really, they are very difficult. There are papermaking accounts which say, 'You start with the roll up and drop it carefully and easily ...' Well, half the time they had some nice old hemp sailcloth, which is tough. It might have been on a ship for 25 years and it's been exposed to salt and water; it's a lovely bleached colour and a wonderful fibre to work with, but to make that properly they bang the roll down hard straight away and the beater's going to really shudder and judder. After about 20 minutes or half an hour maybe, you bring the roll up. You've really knocked the hell out of it right at the beginning and *then* you start carefully after that.

Sometimes papermakers are just in a hurry. There are all sorts of reasons why things happen and sometimes you discover things by accident — they must have discovered some things by accident. I bet the technique I just described was discovered by, 'Oh my God, we've just got to get this pulp made. The boss is coming and ...' Then they would crank it down hard and find that it actually worked very well. It doesn't work well doing that with cotton. It works beautifully with hemp and some of the really coarse linen — thick-grade linens. It halves the beating time and you get a very good quality paper out of it.

You might see long, apparently unbeaten fibre in sheets. These might have come from long chunks of rope which have already been cooked. They might have been boiling for 48 hours before they went in or they might have been rotting for weeks. We used to try that. God, was that nasty, but it makes great paper! The French used to say when the mushrooms are growing on it that's when it's ready, which is true, because you are using biological processes to help you.

Another interesting thing about beating fibre is that for certain fibres you don't actually want sharp bars. People like sharp bars for cotton, but a nice rounded bar is going to produce a much better sheet. Some people grind their bars down and sharpen them up every now and again, but a lot of things are actually better when they're a bit worn — like felts. Papermakers hate new felts, absolutely hate them. They'll go to any lengths not to have to buy new felts. They'd rather buy old ones. If they're about 10 years old, that's great.

P: How long did you make paper and what kinds of paper were you making?

PB: Commercially I made paper for about eight years, I suppose, until I had enough of being a businessman. I just stopped because I wasn't actually making paper anymore. I was having lunch and meetings and other people were making the paper and I just thought it became ridiculous, so I stopped. I still do make occasionally; I make about once a year, but only for me, because I paint and draw. That's it now.

P: Well, that explains your wonderful writing about watercolours.

PB: The fun thing about it is the raw materials you can get your hands on. When Chatham dockyard closed, we got some fantastic nineteenth-century hemp rope — huge-diameter ropes. Then there's Mark Sandiford, who is a wallpaper conservator. He does country houses where they're replacing old wallpaper, and they remove the old linen or hemp backings on the walls, which are rotten. He turns up every six months or so with giant bin bags full of eighteenth-century linen that's come off all the walls. It's in a horrible state but it's perfect for papermaking. You just cook it and wash it — fantastic!

Nobody in his or her right mind would make paper by hand these days. Everybody who does it is in trouble; it's a hand-to-mouth existence, primarily because people won't pay what it's worth. Think of how much a quire of good writing paper cost in 1810 and how long it took people to earn the money to buy it, then look at how long it takes you to earn £2 or £3 to buy one sheet of handmade paper now. It's dirt cheap compared to what it used to be.

P: One of our local art suppliers, who is very involved in paper production when he can be, has said that he can't market it because people are used to smooth, even surfaces and they don't want to work with ...

PB: Yes, it's an educational thing. If the continuity of making had continued, particularly in Europe, and if the art schools hadn't changed how they taught people what they should expect to get in a piece of paper — that it

will do exactly what they want — then the situation would be quite different today. For so much of art history, artists prepared their papers. They didn't expect the paper to be perfect when purchased. They made the paper do what they wanted it to do, which I think is great. After all, it's perfectly possible to resize paper, to recolour it, to change its surface, to prepare it how you like it and a few artists do that, but most will take a piece of paper and that's it.

P: Or they go and get what is available, don't they? They don't even think about it.

P: But they are making handmade paper in Asia and in Nepal.

PB: Oh yes, and they're still making it in Europe. There's a lot of very good European handmade paper but it's hard for the guys making it to actually make a living. One reason being, if people want a ream of something, they expect every sheet to be identical, even though they know every sheet of handmade paper has to have a slight variance in it. Well, Turner never complained about half of the papers that he bought, even though — particularly from the 1820s onward — most were second rate. He was buying seconds, or retree sheets. There are flaws and faults in them, but that's not bad papermaking. It was cheaper and there was nothing really wrong with them; they're still perfectly fine to work on. The very same people who want to work on these nice consistent papers will often enthuse about the lovely variety of old papers. It's crazy.

P: Peter, I don't know if anyone else is interested in this, but I would be really curious to hear you comment on your paper examination chart (Appendix 2) — what you do first, second, third when you have a piece of paper?

PB: It's just a list. Having said that, it is a model that is not necessarily followed. In fact, different objects require different attention, and usually when you find something interesting, you immediately head off in a certain direction. You do come back and complete it all but it isn't necessarily done in this order, but it is the method that should generally be used. It lists the basic headings. You know, people have been talking about nomenclature and structure — they're the kind of headings used — and practically all of those can be subdivided and would be. It is not really a format, though it essentially follows what I'm doing. There is also a select bibliography which you might find of interest (Appendix 3). You probably know half of the stuff, but you might not know some of them.

I notice that eight of the speakers at this conference belong to a very small organization called the British Association of Paper Historians, even though they are coming from lots of different countries. So if anyone wants to join, it's a good organization. We have a member of the BAPH who is trying to compile a papermaking bibliography — a paper history — and he is on 48,000 titles so far.

P: So is this from his bibliography?

PB: No, these are just books that I have actually found quite useful. In among them there are some very useful books which you might not have come across. Joe Nickell and people like that who are forensic investigators use techniques of investigating papers, inks, paints and much more that are very useful.

P: Peter, can you address three terms on your chart: weight, bulk and opacity? Can you then do it abstractly and, if it's appropriate, look at the Girtin (fig. 4) and use those three terms?

PB: *Weight* is literally how much the sheet of paper weighs. It's quite useful information.

P: By that, you mean a full sheet from the mould?

PB: Yes.

P: And the Girtin here is a tiny, little ...

PB: Yes, a tiny, little thing, so some of these evaluations do not apply. *Bulk* is just a personal thing that I use because it's a way I can hold in my head comparisons between papers.

Bulk is related to thickness and weight. You can have a sheet that's twice as thick as another and the thin one actually weighs more than the thick one. It's density or bulk — how bulky the sheet is — and that relates to how wet- or free-beaten the fibre is. Do you know about free-beaten fibre and wet beating in cellulose?

In a beater there are different ways of beating and you beat for different characteristics. If you hydrate the paper, the cellulose, a lot — really fibrillate it, really hydrate it — that's called wet beating. But you can run the same fibre through the same beater and have the roll action slightly different, and it will still bond together and work as a sheet of paper, but the fibres themselves will not take up water in quite the same way.

There are certain papers where you want bulk. With a good printing paper you want a degree of free-beaten fibre in it as well, because it then takes a print impression better. The sophistication, from the late eighteenth century onwards, in beating techniques in order to make paper behave in a particular way is extraordinary, because paper is nothing unless it is used. It's about its use, not about itself.

Some mills used to actually blend different beater loads. They would beat wet in one and not so wet, or a bit drier, in another, and then blend them to get a characteristic in the sheet that they couldn't get any other way. Other mills did it by partial loading of the beater, so the first stuff you put in gets really wet-beaten and then you add more which doesn't have so much beating. It relates to how much pulp there is per cubic millimetre how dense it is.

P: What is the relationship of bulk to free pulp and wet pulp?

PB: With free-beaten pulp you will often end up with a less bulkier sheet because there's less shrinkage during drying. When you've got all the fibres entangled together and those fibres contain a lot of water, they're wet-beaten, and the fibres will shrink as they dry, producing a sheet that is smaller and more compact. If they're free-beaten, those fibres stay as they are. The whole sheet shrinks a bit but the fibres themselves won't. You can get huge differences. If you made a free-beaten sheet on an Imperial mould and a wet-beaten sheet on the same mould and dried them both at the same time in the same weather conditions, you'd probably have a half-inch difference in finished sheet size in each direction.

P: The difference between free and wet is the amount of water or the amount of beating?

PB: It's the amount of water *inside* the fibre — water that you've forced into the fibre or you haven't. Wet beating is what most people do most of the time. Free beating is done for very specific kinds of paper.

P: Why would someone specifically want a sheet with free-beaten pulp?

PB: A portion of free-beaten fibre is found in some printing papers; those papers will give you a better intaglio impression. You get a really fine, crisp mark — better than really wet-beaten. The English had such a problem in trying to make engraving papers in the eighteenth century because they were used to beating very wet, and they also had much slower drying times, which gave the sheets a lot of time to shrink and compact and become tough. Whereas in the Auvergne, say, in France, where they produce wonderful plate papers for printing, they generally continued to use stampers, which gives you a more free-beaten fibre. They had much faster drying times as well. So the sheet hadn't shrunk as much; it was less stable. That actually doesn't matter if you are only putting something through a press once. As soon as people started multiple-coloured printing, the French plate-paper business just went out the window because they couldn't produce a paper that was stable enough if you had to put it through a press more than once.

Opacity is also a function of beating and a function of the fibre and sometimes a function of the mould, which sounds odd. George Steart made wonderful, wonderful papers and was never really recognized until the last few years as a great papermaker, because when you hold his sheets of paper up to the light you can't read the watermarks, the sheets are so opaque and very strong. The little Turner blue paper over there, that's George Steart's paper and you can't really see the marks. I couldn't work out how he got this incredible opacity; how on earth do you do that? It didn't make sense in papermaking terms. And then in the Royal Society of Arts archives, when I was looking for something else and turning over the pages, there were letters from George Steart to the Royal Society of Arts describing precisely how he made his paper. He did it very simply with an ordinary mould that had a very deep deckle. He formed the sheet and it was put to one side; before couching, another mould with handles on the back of it was placed on the back of the wet sheet on the first mould and it was compressed under pressure with a press. Then that was removed, the deckle was removed and it was couched. He got incredible density.

P: What was his goal?

PB: He was making fine watercolour papers, coloured and white. He made a range of 18 colours.

P: What years?

PB: From 1805 until 1832. When he retired, that was it, there was no more. Winsor and Newton went, 'Oh, my God!' and started getting paper made for them. They got James Duffield Harding to design some papers which were then sold as JDH Pure Drawings. And Harding himself worked on them a lot.

P: Do they delaminate?

PB: No, because it is just one thick sheet. You could buy George Steart's things as two-sheet, four-sheet, six-sheet or eight-sheet. It doesn't mean they've got those layers; if you had eight sheets stuck together, that's how thick it would have been. It must have been very time consuming. But he obviously made a lot of money at it, because he built a whole church and almshouses.

P: Opacity and density may be different aspects of the same thing. It's up to you to say it's opaque or dense.

PB: This is a personal thing; it's not designed as a formal thing.

P: Right, it's just to remind yourself.

PB: I do write it down and then sometimes, if it's necessary, you do the measurements. In a perfect world you would do it all — and it would take you six months to do one sheet of paper. [*laughter*] It's like the International Association of Paper Historians standard for watermark recording, which is a joke. Nobody's got the time.

P: Maybe it's useful if you're trying to closely identify one piece of paper.

PB: No, this watermark standard has been designed for producing databases. You'd go mad following it; nobody's got that kind of time.

P: Nobody would pay you to do it.

PB: No.

P: What do you think of scanning for watermarks?

PB: How do mean scanning — in what form?

P: The digital scan to get a watermark or record the translucency.

PB: I have a real problem with what then gets done to them. If you do a scan and then that's it and you can't read it properly because that's how it is in the sheet, that's great. Then save it and keep it. If you want to read it by playing with it a little bit, I think there's a real problem. I have seen some very pretty watermarks scanned which are not accurate, and they are giving you false information. They have been 'tidied up' too much. To read it or to get more information — yes, play with it. However, that isn't what should be kept as such. The watermark recording is the first one before you muck about with it, because, faults and all, whether or not it's cloudy or unclear, that is how it is in the sheet. That is what you should be recording. With scanning you have a real opportunity to get lots of different information, not just the watermark. You have the formation, how good the papermaker was, how well they could beat. All sorts of information is in that scan. When you start mucking about with it, you lose it.

P: I just wanted to ask you about the decorated papers.

PB: The paste papers? They're German paste papers. They came from Germany. They're from Axel Fuchs. Henk Porck was talking about them. These are really quite nice.

P: What date are they?

PB: These are 1790s to about 1820 — southern Germany.

P: [*examining another paper*] This seems very odd; I don't know why. It's just the feel of it — it's kind of crisp, and this marking around the edge ...

PB: Right. This is about 1420, and the funny thing is, this is generally considered to be a German mark — the ox head. However, this is Italian — an Italian version of it, and the paper is stamper beaten.

P: I suppose the paper I've seen of that age is a finer quality than that.

PB: I'm looking for a paper that I brought which was made for the Islamic market. It's a European paper. A lot of paper was made with a wonderful, stone-glazed surface and then sent from Venice and northern Italy to Islamic countries.

P: Did they glaze both sides?

PB: If you polish it on top of a very polished smooth stone, then you get both sides finished at the same time. It's much easier and it halves your working time. They used to do one side partially and then they'd turn it over and do the other, so you'd end up with a fairly consistent sheet.

P: They would be using a starch slurry?

PB: Probably. But sometimes it was just water, and you can see there is no trace of any starch or anything. Usually there is some sort of starch, but quite often there is nothing.

P: That polishing without any starch would protect the paper from bleeding?

PB: Not really, no. One of the odd things it would do is heat the sheet to the point where you get distortion in the size of the sheet. It will spread out and expand, then it will contract again. You can get very odd-shaped sheets by this method.

P: [*examining a paper sample*] What is the fibre content in this?

PB: Linen. This is a paper that was made for Cobden Sanderson, the Dove's Press, by Batchelor's. Now Batchelor's is a very interesting mill. They made for William Morris, and his correspondence is one of the few where you've got a creative person actually writing to the papermaker and talking to him directly about what they want in the paper. Morris designed his own watermarks — a range of four different watermarks for his paper.

Then Mr. Joseph, who ran Batchelor's mill, persuaded Morris to allow him to make and sell this paper to other people; it was sold as Kelmscott paper. And then other people like Cobden Sanderson wanted paper made and they designed their paper very distinctly. If you look at that Sanderson paper, for instance, it has very atypical, very narrow chain lines; the shadow is exactly where he wants it and you've got the watermark in the place. That mould was specially made for that customer to the customer's own specifications. It's really nice to see. All the Morris moulds were supposed to have been destroyed and nobody really knew what had happened to them until I was talking to someone from Cambridge, and they said, 'Oh no, it's all right, we've got them.' How they ended up there I've no idea, but they also ended up with hundreds and hundreds and hundreds of sheets of paper.

A real tragedy occurred at the mill when in 1940, during the war, Batchelor's pulped all their paper stocks for the war effort. There was all this fantastic handmade paper which was of no practical use, so they just mixed it with recycled; they recycled it and mixed it with low-grade paper and produced a lot of paper and then stopped making. They stopped making by hand and they started making stuff called *flong*. Do you know what flong is? It's a paperboard that used to be used in the newspaper industry for casting metal type into stereos.

P: Peter, how expendable were moulds during the latter

part of the eighteenth century? How much time went into making a new mould? What would be the average number of moulds that they would have?

PB: In one mill? A one-vat mill, if they were making a range of 30 or 40 different sizes, would have at least 30 or 40 pairs of moulds. By the end of the eighteenth century, beginning of the nineteenth century, you're occasionally getting people putting in their own watermark. It's when you first start to get names in papers, in Britain anyway, which are not papermakers' names. They are the client's name, and in that case the mould was paid for and owned by the client and was only kept at the mill.

If you had two vats, you could have a lot of moulds. Also, if you were making Large Post writing paper, you wouldn't have just one pair of Large Post moulds. You would have several pairs, and at any given moment one might be damaged or whatever, so if you look through ledgers and daybooks you read, 'So-and-so sent such-and-such a mould to Brewer ...,' who might have been the mouldmaker. Occasionally you find a stock list where once a year moulds might be listed in store or at Brewer's for repairs. Alton Mill in Hampshire in the 1820s had something like 70 or 80 pairs of moulds. But then Whatman, by the end of the nineteenth century, when they had a ten-vat room, a nine-vat room and a four-vat room and a mill down the road with another six vats in it, had thousands and thousands of moulds. If you go to Hodgkinson's Mill in Somerset you'll find that their mould store contains 900 to 1,000 moulds. That's just what's left — a lot have disappeared. They were making for a lot of different clients like Waterlow's, de la Rue, different stationers, different artists' colourmen and others.

P: The mould itself was a valuable enough part of their inventory that you would have it often repaired many times before you would say it's no good anymore.

PB: Yes, indeed. I really do think that the estimates as to how long a mould lasts have been arrived at only by the examination of watermarks in sheets of paper, and are absolutely incorrect. I know from experience that moulds are much, much tougher. In the very early years, until about 1600, the moulds were not as tough and probably didn't last as long, but by the eighteenth century, for instance, they're really tough. I've got eighteenth-century moulds which I've made paper on with no problem at all.

P: The other mess is this business of the pairs of moulds. You have worked with paper. Is it very easy to work from one vat with three moulds?

PB: You could do it. Papermaking by hand is about rhythm, and the best possible rhythm is two people and two moulds — one deckle, two moulds. It's unconscious; it's almost like an act of meditation. You just really go. And sometimes if you're really cooking, time flies by. Other times it's really hard work, so you change positions in order to use a different set of muscles. You swap every 40 minutes, every hour or whatever. The crucial thing about making paper by hand is how you stand, not how you form the sheet. One's health is more important than the paper. You pivot your weight on the vat. I used to stand on my toes, not on my heels, because with your weight like that you can move quite easily and simply. A lot of people think that it's a lot of arm action. It isn't. You hardly use those muscles; it's in the wrists.

When you watch someone like Cyril Finn — he's retired now after making by hand for 45 years — there wasn't any unnecessary movement at all, and he could talk and chat about this and that, and he'd be adding pulp constantly. That's amazing to see; every time you dip a sheet into the vat you change the density, so you have to judge. I used to add pulp after five or six sheets. Someone like Cyril does it after 30, 35 sheets, and he's still getting the consistency. It's absolutely amazing! And he would say, 'It doesn't matter, it's all right.'

P: How did you get into this, Peter? How does one decide they're going to become a papermaker?

PB: Well, I made paper as a child in the Far East and it intrigued me. When I went to art school and didn't like the paper I could buy, I tried to make paper. It was rubbish, absolutely awful stuff. I still keep some of it just to remind me how appalling one's workmanship can be. Later I worked with some other papermakers and then went off and did some completely different things for a few years. When I got very ill I needed something — it sounds crazy — something that was very hard, physical work that also satisfied my interest in history and science. Papermaking, which I had already tried, just fitted the bill. So I went to work with a few papermakers and then set up in business with another guy and started making for artists. I soon realized that the paper was rubbish; it's terrible trying to sell it to people when you actually believe it's awful. That's when I started examining and analysing old papers and collecting them, not learning by the book but just studying what papermakers actually did. How did they get these results and why — because paper is about use. It should do what it's designed for; it doesn't matter how pretty it is. After all, a lot of handmade makers who are working now produce very pretty sheets but they don't function properly. Well, I was studying old papers and people started saying to me, 'You know about old paper, have a look at this drawing,' and it just evolved.

P: Coming back to how many moulds each mill has, go back, for example, to mills established from the middle of the sixteenth century. When they were disbanded in the early seventeenth century they apparently had thousands of moulds purchased by makers around Europe.

PB: But what's the evidence for that? I know they had a lot of moulds, but they wouldn't have had thousands of moulds because there's no point in having thousands of moulds. Is it because the Richel mark appears as a pendant across Europe? Well, none of those moulds

came from Richel's mill. The mark was freely used by many mills.

P: Well, it's not my own research. Apparently the moulds were sold and people just bought the moulds themselves and of course then they carry on making different types of paper.

PB: The only reason that you'd have thousands and thousands of moulds is if you had loads of vats.

P: And lots of mills.

PB: Yes.

P: Apparently there was a chain of mills.

PB: There were only about six.

P: Yes, well, I don't know how big they were.

PB: They would have two or three vats. It's interesting, I love it when people use all these different moulds. Wonderful historical inaccuracies appear like in Churchill's watermark book about Whatman working in Holland because of the *LVG* in the mark. It's just crazy! *LVG* was used by everybody.

P: Could I ask about pairs of moulds? If you decommissioned one of the pair, what's the chance of continuing production with the single and, if you're working to the same size, substituting another?

PB: Oh yes, that was ...

P: Quite common. So to try to trace the twin moulds ...

PB: The twin moulds are the pair that were actually made together at the same time. If a mill had loads of Large Post moulds, Imperial moulds or Royal moulds, they probably didn't even have time to think of keeping the pairs together. It was just, 'Oh, we're making Royal today.' Papermakers used to love making some papers and hate making other papers because of the physical effort involved in making some of them. It's not necessarily the big ones. Imperial — people didn't mind. Imperial's fine, it's a nice tolerable level of exertion depending on your size as a person. Super Royal and Royal are great too. It's things like Medium, which is a printing size, or Demi that are horrible because they're double moulds. They're two sheets. That's a real killer.

A papermaker had to consider the money, too. In Britain you had all these incredibly complex ways of getting paid. You knew how many sheets of a particular size you should make in a day. Now, the maker might ask you to make that plus 50%; then he'd have to pay you a bonus for doing that, a bonus that was both money and beer. Then the beer became money as well rather than beer. It got very complicated. Also, in Britain there were 60 days of the year when papermakers didn't work traditionally.

P: In the summer?

PB: No, throughout the year. I used to note them in my diary and try not to work on those days as a mark of respect. Of course most mills carried on working, but the employees said, 'Yes, we'll work, but you *really* have to pay us.' A very complicated payment system.

P: These 60 days were saints' days or something like that?

PB: Some of them relate to saints' days and some of them — well, there are some wonderful stories. For instance, at Portal's mill they used to have a traditional meeting, a party at one time. They had a man called a bank officer who worked for the Bank of England and would live at the mill to supervise the currency making. They had absolutely riotous parties. I've seen little notes Joseph Portal wrote down a day after one of these parties, '... do not give the rag women gin next year because they threw the bank officer in the pond.' They got absolutely legless and no work was done the following day. Every year there'd be these notes saying they must stop doing this, but then the workers would say, 'No, no.'

There's another lovely story from Portal's of a friend of mine, Gerard Pink — very elderly now, but he started in the industry at that mill before the war. He was 14 years old. He said if he went into the houses of the rag women, they all had the most amazing tablecloths and table linen that they took from the batches of rags. Now when we say rags we think of rubbish, but in fact a lot of the material wasn't. They'd buy up things like bankruptcy stock from shops — drapers or something like that. Gerard had terrible times though, because he was supposed to start off by working in every department. He was destined for management but he started right at the bottom. The first time he ever had to supervise a beat was for banknotes. They were using corset cuttings, which in the 1920s were pink, and they had to bleach them, but they had black elastic in them and you had to make sure that every piece of elastic was out because — you can imagine. Anyway, he didn't, so there's this huge batch of pulp that had black fleck throughout and, since he hadn't bleached it properly, was slightly pink. Well, these days the mill would just make it and sell it for something else, but then things were different. A car arrived with a chauffeur to take Gerard to see old Mr Simmons, who was then the boss of the Portal's family. The chauffeur wouldn't say a word to him. Gerard was terrified. He ended up sitting outside Simmons' office for two hours — they just let him sit there. This was all the punishment he got, because when he entered the office finally, Simmons said, 'How are things going? I just wanted to have a word to see if you were doing all right.' No mention about what he'd done wrong. They just made him sweat for two or three hours.

P: It worked well.

PB: He's a good man.

P: Do you know if the paper merchants or the papermakers were required to register their name with the stationer's company or was there any connection with that?

PB: Not really. It's very difficult. You see, the papermakers didn't want to know. They were very keen on not having any kind of association.

P: Peter, another question about Medium and Demi, as a printing paper, for example. If it was harder to make and there was resistance by the makers, have you tracked percentages of output in mills of that particular paper? We find over in Australia and New Zealand that they substituted writing papers for printing paper quite frequently and I always thought it was because of cost and supply. Perhaps they just didn't have access to and couldn't get enough of the actual printing papers, if production numbers weren't high enough.

PB: Probably, it's possible. It's really problematic because Medium and Demi are the same size basically, but different mills called them one name or the other. Also, if it was a drawing paper it was Demi and a printing was Medium, but they could have both been exactly the same size; there's only a slight difference in sizing. A lot of mills were careful to beat differently for different functions. Other mills didn't; they had a basic way of beating and the only difference is the degree of finish or sizing. That's the only alteration they made.

P: [*showing a sample book of paper*] I wanted to have you look at these 1930s papers — as best I can date them — and see if you know anything about them.

PB: Let's have a look.

P: The first ones are the drawing papers, the Whatman ones, and then you go down to the trace. The catalogue will sometimes tell you the fibre and gelatin size and whatnot, but I am curious when we get down to the Paragon, which is an eggshell bond.

PB: I don't know where the Universal comes from.

P: These were just trade names. This one is their top-of-the-line drawing paper and they made it with a variety of surface finishes and different weights. This particular one has a sort of eggshell surface. I've read that it could have been done with a kind of embossing characteristic. They talk about achieving it simply by not calendering it at the far end of the machine.

PB: This paper is not embossed. This is just felt texture.

P: That's the third way they talk about, the felt texture.

PB: This is just a felt texture, but it's not the forming felt. This has been pressed after. They've used a dry felt.

P: At the far end of the machine?

PB: Yes. And the texture on the other side is different.

P: What's the difference between the two textures? How can you tell it's not the pressing felt?

PB: Because of the weave — hang on, that one has been over metal.

P: And they purposely would make them two-sided?

PB: This is like a forming felt, the first drying felt on the machine, but it isn't because it's too crisp. It looks to my eye like it's been applied at a later stage, down the machine. They sometimes had a second press and they would cover the press in felt or woven linen or something. The French used to put linen finishes in some of their sheets at that point. However, this one has been over a plate.

P: ... which is more traditional. That was considered a lower-quality drawing paper.

PB: Some funny colours, aren't there?

P: There are. There's some lovely tracing papers in here. This was a detail paper that they say was 100% rag and gelatin sized.

P: Is it a Duplex?

PB: It's called Duplex.

P: Yes. It was supposed to be two sides, and they would make the detail papers in different colours to prevent them from looking dirty.

PB: Here are some boards by Mr. Reynolds!

P: He's still there.

PB: Reynolds was amazing. He used to produce London board and Bristol board and all sorts of boards. This is Bristol. Is there a London in this book? No, this is a Superior Bristol. That's a different one, a different maker.

P: No, I don't think there's a London and I don't remember it being listed.

PB: Some of the books you read will say that London board is made from sheets of Whatman, and Bristol board is made from miscellaneous sheets. Absolute rubbish; both of them are miscellaneous.

P: Really?

PB: Yes. If you see Extra Super Fine London board and check the watermarks, it might be three-ply with three watermarks in there — one's Smith, one's Ruse &

Turner and one's Whatman. The Whatman might be the middle one.

P: In looking at those boards, do you actually delaminate them?

PB: No, with enough light you can actually see them. If you've got a six-sheet board, that's a problem, but two- and three-sheet boards are not a problem. Nice surface.

P: That's when they were doing lots of pen-and-ink and they liked it.

PB: Smooth manila, yes. Some fibres are really nice, but manila is not, although you can do some interesting things with it. It's watermarked along the edge: Universal.

P: I don't know what mills they were coming from but all these companies had developed their own brand names.

P: What's the date of the booklet?

P: About 1930, as best as I can tell by looking. The book is not dated but you get an idea of what was being marketed and how.

P: Peter, you listed two books in the suggested reading list by Eric Hebborn, the forger. Have you had much experience ...

PB: In examining his works? Yes.

P: Does he always use the appropriate paper?

PB: No, he plays games and tricks. He leaves clues as well. I looked at a little Crucifixion drawing on a blue paper, which was gorgeous. It was supposed to be 1490s or something like that.

P: What medium?

PB: Chalk, a sort of funny, chalky stuff — very odd, actually. The paper was seventeenth century but on the back there was a tiny little part of a print, a woodblock print, but it was enough to be able to identify it. He did things like that all the time.

He's quite good at matching papers but he doesn't always get it right. A lot of it comes down to tiny details in the paper that have to make him wrong — out of period. Sometimes it could just be the way that the chain twists are done. Perhaps they're a little too tiny. That's really mind-numbing because sometimes you can't see that at all and you have to literally go down every chain line, the twist between every laid line, until you can see it. That's where digital cameras and things are actually quite useful because you can really go in very, very close and then play with it on a computer. You'll actually see subtle differences in density in the pulp, which show you whether it's a twist, double-twist or an over-and-under.

He was just playing games to see whether or not somebody would actually pick up on it. His book, *The Art Forger's Handbook*, is rubbish. It is a joke. If you follow half of what he says, you'll never fool anybody. He's left stages out and also added completely unnecessary bits of technique that you don't need to do. He's a very funny man.

P: The second part of my question is how often do you see fifteenth- or sixteenth-century drawings that are not done on paper close to the date of execution — the age of the paper predating the work by fifty or a hundred years. How common is that for an artist?

PB: Oh, that is much more common than anything else, particularly drawings. You get papers that are 50 years old when the artist works on them — 60 to 100 years, too. It's not that uncommon. The problem is, of course, the other way around. I'm not discussing fakes now. For instance, I looked at two works by Tobias Verhaecht in the Courtauld. They're both on paper made by Jan Kool in 1799 — a couple of hundred years later! They were saying these were attributed to Verhaecht because of the comparisons of the hand and ink with drawings in the British Museum and in Berlin. Well, I looked at those and they are all late-eighteenth-century paper. There aren't any Tobias Verhaecht drawings that I've seen that aren't. So who is this artist? All of this work has been dumped on one Dutch artist who is working 200 years before the actual artist of these drawings, but, strangely, they do look old-fashioned for eighteenth-century art.

P: They're by the same hand?

PB: They're all by the same hand. That's very obvious. But who was he? A mystery. There's been a resounding silence from the Courtauld.

P: I'm sure. Do you think Hebborn was a very good artist?

PB: At his best he could draw beautifully, but most of the time he wasn't at his best. They're not that good once you click on to how Eric draws.

P: I've only seen reproductions.

PB: The photographs actually flatter them.

P: He doesn't look that good to me.

PB: There are one or two, like his Crucifixion drawing. I don't care who did it or when, it's just a really superb drawing and it's now in limbo. It'll turn up in another auction in 30 years' time and somebody might well buy it because the documentation, such as the reports and things by people like me, don't necessarily stay with the work. The works just vanish into limbo. I wouldn't be surprised to see those Cotmans turn up again in 30 or 40 years' time.

There's no point in forging, really. However, it's nice making a living from finding out about it! The thing

about forgery is that most people who do it have a serious lack of imagination. It sounds crazy but they just can't believe that they're going to get caught. They spend ages working out how to do it, how to copy something. They think, 'I'm so clever, I've worked all this out.' However, what they don't realize is that somebody equally or more clever can just work out what they did. They believe everybody's going to be fooled.

P: Peter, I just wanted to thank you for the work you did for me on the Benjamin West drawing.

PB: That was good fun.

P: It was good fun for me, too. At the Brooklyn Museum we found, and I mean found, a drawing in our stacks with no record of acquisition. It was signed and dated 'Benjamin West, 1768.' I started examining it along with my curator and I was just looking for anything that indicated it's not from the period 1768. What I found when I was looking at it in transmitted light was a very unusual pattern in the mould, which is why I kept coming back to Peter and asking about these moulds. I told him it looks like there's additional chain lines that go halfway down. I didn't know what to make of it and nobody else was sure. I started looking at other Benjamin West papers and found one at the National Gallery and one at the Victoria and Albert Museum. It was a known Benjamin West, so I asked Peter to go.

PB: I went to have a look and it was off the same mould and the same lines were there.

P: You thought it had been some type of rewiring that didn't go all the way through — just part way down in a couple of places. Anyway, it was so wonderful that this discovery made the chances of it not being a Benjamin West pretty slim.

PB: It's a very unusual mould; a very unusual paper.

P: This is a question that came up recently when I was looking at a Lucas Cranach print, *St. George Slaying the Dragon*, and it had a fairly prominent crease in it which has given me a lot of trouble. I examined it very, very carefully and there is definitely a portion that is repaired and there's horrible retouching in areas. But the curator said, 'Oh, I just thought that was the crease from hanging the print after it was pulled.' It surprised me because I've never even noticed one of those marks. I've seen pictures of prints hanging and I've talked about back marks, but I've never seen it mentioned, and I was wondering if you could ...

PB: There are a lot of reasons why you can have creases. You can get creases when you're laying the sheets after they've been formed — wonderful creases that usually stay together. After the sheet is dry, if you do one of the finishing processes you can get creases then, particularly if they were then printed on. So you get these wonderful creases where you can actually pull them apart and leave these nice shapes that aren't inked. There are loads of ways creases can happen.

P: So you can't think of any kind of distinctive crease particular to that procedure — a back mark where we can say that's where it was hung after it was sized?

PB: No, I think they vary a lot.

P: The reason that I was pressing you earlier to articulate an appreciation of the importance of paper composition and production is my struggle to do the same on a paper study project at the Library of Congress. I was trying to make a case for better-quality paper, to explain how the linen fibre was such a factor in the quality and durability of the sheet, and how there is an aspect of sizing that was inherent in the fibre and how it was prepared.

PB: It's very difficult. I don't know how you can describe it practically when you know what you're feeling or seeing in a sheet of paper. Many things play a part in that experience, for instance, smell. A classic case in point was an old legal stationer called Hoppy Hopkins. Before Hollingsworth Mill closed, he'd had paper made there. His company had paper made there since the 1850s and they had their own watermarks. Well, the mill was bought by Wiggins Teape, who assured him that they could carry on making this paper for him at their mill in Scotland. Eventually he said, 'I'll take a ton to see how we go.' Hoppy's in his eighties at this point. The lorry arrives with his paper and he climbs up onto the back of the lorry and they open the pallet and get a ream out. They open the ream, get a couple of sheets out and Hoppy tastes it, tears it, shakes it, holds it up to the light and clambers down out of the lorry and says, 'Take it away, I don't want it. It's rubbish.' The driver says, 'I've got to tell the bosses why,' and he says, 'The fibre is wrong, the sizing is wrong, the watermark isn't clear, the internal strength isn't right and the sheet isn't the right size' — it was about 5 mm out in one dimension. That judgement took about two minutes to make. Anyway, they made him another ton. He sent that back. They made him another ton and he sent it back again. Eventually he took half a ton that he wouldn't pay for because he had a customer who needed it.

Wiggins Teape wrote this letter apologizing for the bad quality of this paper and said he wouldn't charge the client. Hoppy wouldn't have paid anyway. They did manage to get him some paper finally, but I think they hated him.

P: What a great story.

Appendix 1

A summary report following a later examination of the drawing *Study of a Mourning Woman*, by Michelangelo Buonarroti (1475–1564).

After the symposium this drawing returned to London, where I recommended that it be removed from its back-

ing so that a proper examination using raking light could take place. The work was removed from its mount by Camilla Baskcombe and underwent a series of examinations at the Tate Gallery paper conservation studios, under both raking and transmitted light, and under various magnifications. A further examination took place at the British Museum, where the paper used for this work was compared to a range of papers used by Michelangelo for other drawings from the collection, to determine if he had ever worked on papers of the type seen in this work. A full description of the work and its examination, co-authored by Camilla Baskcombe, Julien Stock and myself, is currently in preparation.

The whole object proved to be a very complex construction. My initial supposition made at the symposium workshop in Toronto, that the paper in this drawing was music paper, proved to be quite wrong. Although the sheet was a laminate, it was actually a three-ply laminate. On removal from the mount it was discovered that the work had been executed on a very lightweight paper laid down onto a two-ply backing and mounted on a heavier-weight glazed card.

The primary support proved to be a very lightweight, pale greyish-white laid paper, derived from a blend of linen rag, hemp and other fibres, made on a single-faced mould. This paper was laid down onto two further papers. The middle-layer paper was made on a single-face mould with a laid- and chain-line configuration typical of early- to mid-eighteenth-century French manufacture. This sheet is aligned at 90 degrees to the drawing paper, with the chain lines running horizontally. The colour and furnish, a blend of white and blue linen rags, are typical of a wide range of strong blue wrappings available from small provincial mills throughout western Europe during the eighteenth century. The particular blue seen in this sheet suggests either a French or British origin (fig. 8. See also colour plate 2).

The back layer is very similar in tone to the primary support but otherwise a very different paper. The furnish is white linen, poorly beaten, with some hemp and a small portion of pale blue fibres. The ratio of blue fibres to white is typical of a type of very pale blue-white paper, much lighter in tone than most European blue papers and often used for wrapping and as a cover paper, produced by several English papermakers from *c.* 1720 onwards.

The mount is a cream-coloured, heavyweight, three-ply glazed board with a very heavy felt mark still visible under 40 times magnification, despite the very heavy glaze the surface has been given. Three-ply glazed boards of this type were commercially available from most artists' colourmen and some stationers in London from the early years of the eighteenth century onwards. The distinctive type of mount seen in figure 1 is that used by Jonathan Richardson Sr. (1665–1745). The drawing itself carries Richardson's *JR* collector's mark and the verso bears an annotation in Richardson's hand.

Like all artists, Michelangelo worked on a variety of different papers of very different qualities. Some have the most beautiful warm whites; others (though still nominally white paper) have a darker, greyer or yellowish

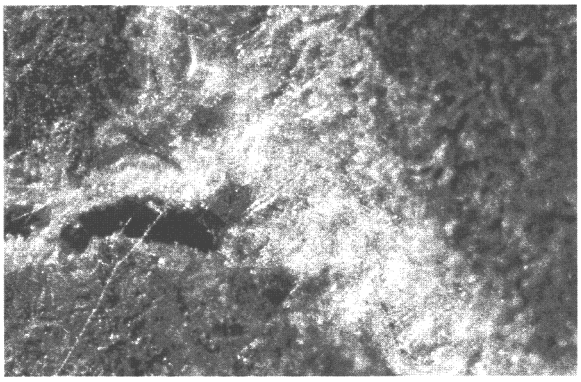


Fig. 8 Detail of the surface of the drawing, showing a tear in the primary support and the blue paper underneath. This was discovered after separation of the papers.

tone. These 'colours' of white derive from a collection of different qualities of rags having come from different sources and variations in the methods used in preparation by different mills. Examination under magnification as low as 4 times reveals that several of these nominally white papers actually contain different proportions of variously coloured fibre, as well as white linen rags and hemp.

The primary support paper in this drawing contains stamper-beaten white linen rag and hemp, and a small proportion of other fibres, including very thin, unbeaten blue and black-brown fibres that are 2 to 5 mm long and 2 mm long hemp shives. This fibre combination and the presence of process dirt are typical of relatively low-grade papers made in small provincial Italian mills. Although hardly discussed in the literature on the history of Italian papermaking, this particular combination of coloured fibres occurs too often in papers from different makers in different parts of Italy to be merely accidental. These papers were obviously produced as a distinct type of paper by several different papermakers from the mid-fifteenth century onwards.

In order to determine if Michelangelo ever worked on this type of paper, the work was examined once again at the British Museum conservation laboratories together with a range of known drawings by Michelangelo from the British Museum's collection. Two of these drawings had, to different degrees, the same distinctive fibre furnish, namely white linen rag, some hemp (probably derived from old sailcloth) and small proportions of various coloured fibres.[12] The hemp was 1 to 3 mm long and the dark brown and black fibre 2 to 5 mm long. The very poorly beaten furnish includes large unbeaten fibre masses and some woody material approximately 5 by 5 mm — very similar to that found in the paper used for *Study of a Mourning Woman*.

The differences between the wire profiles in all three papers are not very significant. This type of paper was obviously being made at many different mills on moulds made by several mouldmakers. Mould construction varied quite considerably between different regions in Italy and indeed throughout Europe, as the papermakers strove to achieve lighter weights, greater stability and better drainage.

A great similarity in the manner of drawing should also be noted between the work under discussion and another drawing in the British Museum's collection.[13]

There is nothing in the fibre furnish or mould construction details visible in the sheet to suggest the paper is out of period.

The apparent 'grey-blueness' of this sheet does not come from the furnish used in the paper, but rather from the blue backing paper, which remains visible through the very thin white paper the drawing has been executed on.

This thin white paper is typical of some of the qualities of paper that Michelangelo liked to work on. The presence of a range of coloured fibres within what is nominally a white paper shows this sheet to be of a very similar type to other papers from a range of different sources used by Michelangelo.

Acknowledgements: I would like to thank Camilla Baskcomb, Rod Tidham and Peirs Townshend (Tate Gallery, London); Heather Norville-Day (British Museum, London); John O'Neill (Art Gallery of Ontario, Toronto); Jane Roberts (Royal Library, Windsor); and Julien Stock (Sotheby's, London) for their assistance and provision of facilities during the examination of this drawing.

Appendix 2
Paper Examination Record

DATA REFERENCE No. _____

Client / Collection Reference: _____
Contact Address / Phone: _____
Client's Reference: _____

Description: _____
Media: _____

Background: _____

Sheet Size: _____
Hand / Mould / Machine: _____
Wove / Laid: _____
Single-Faced / Double-Faced: _____
Chain Line Frequency: _____ in. _____ cm apart
Laid Line Frequency: _____ per in. _____ per cm
Colour: _____
Finish: _____
Weight: _____
Bulk: _____
Opacity: _____
Light Reflection: _____
Formation: _____
Fibre: _____
Fillers: _____
Dyes: _____
Loadings: _____

UV: _____
IR: _____
Photomicrography: _____
SEM: _____
Other: _____

Maker: _____
Mill: _____
Country: _____ Date: _____

Post-mill Preparation: _____
Size: _____
Finish: _____
Colour: _____
Other: _____

Condition: _____

Edges: Deckles Handmade: _____ Cylinder Mould: _____ Torn: _____ Cut: _____

Watermark: _____
Countermark: _____

Appendix 3
Selected Bibliography

(Subjects: F – forgery, P – paper analysis, W – watermarks)

Ash, Nancy. 1986. Watermark research: Rembrandt prints and the development of a watermark archive. *The Paper Conservator* 10: 64–69. (W)

Ash, Nancy, and Shelley Fletcher. 1998. *Watermarks in Rembrandt's Prints*. Washington: National Gallery of Art. (W)

Beadle, Clayton. 1906. The development of watermarking in hand made and machine made papers. *Journal of the Society of Arts*, May: 684–700. (W)

Black, Charles, and Michael Horsnell. 1989. *Counterfeiter: The Story of a master forger*. New York: St. Martins Press. (F)

Bower, Peter. 1990. *Turner's Papers – A Study of the manufacture, selection and use of his drawing papers 1787–1820*. London: Tate Gallery. (P)

———. 1999. *Turner's Later Papers – A Study of the manufacture, selection and use of his drawing papers 1820–1851*. London: Tate Gallery. (P)

———. 1992. Information loss and image distortion resulting from the handling, storage and treatment of sketchbooks and drawings. In *I.P.C. Manchester 1992 Conference Proceedings*. 61–67. (P)

———. 1994. Who made this rubbish? The Historical investigation of particular twentieth century papers. In *Modern Works, Modern Problems, I.P.C. London 1994 Conference Proceedings*. 50–59. (W, P)

———. 1995. Challenge and responsibility: Caring for random collections of paper. *The Paper Conservator* 19: 50–59. (P)

———. 1998. The Disastrous history of paper. In *I.P.C. Conference London 1997 Proceedings*. 1–14. (P)

Bozeman, P. 1989. *Forged Documents: Proceedings of the 1989 Houston conference*. New Castle, DE. (F)

Briquet, C.M. 1966. *Les filigranes: Dictionnaire historique des marques du papier des leur apparition vers 1282 jusqu'en 1600*. 4 vol. New York: Hacker Art Books. (W)

———. 1955. *Opuscula: The Complete works of C.M. Briquet without* Les filigranes. Hilversum: Paper Publications Society. (W)

Browning, B.L. 1977. *Analysis of Paper*. 2d ed. New York: M. Dekker. (P)

Cahill, T.A. 1980. Proton microprobes and particle-induced x-ray analytical systems. *American Review of Nuclear Particle Science* 30: 21–252.

Cahill, T.A., B. Kusko and R.N. Schwab. 1981. Analysis of inks and papers in historical documents through external beam PIXE techniques. *Nuclear Instruments and Records* 181: 205–8.

Churchill, W.A. 1935. *Watermarks in Paper*. Amsterdam: M. Hertzberger. (W)

Clapperton, R.H. 1934. *Paper, An Historical account of its making by hand from the earliest times down to the present day*. Oxford: Shakespeare Head Press. (P)

Collings, T.J., and W.D. Milner. 1979. An examination of early Chinese paper. *Restaurator*: 129–50.

Coremans, P.B. 1949. *Van Meegeren's Faked Vermeers and De Hooghs: A Scientific examination*. Amsterdam: J.M. Menlenhoff. (F)

Denne, Samuel. 1795. Observations on papermaking by the Rev. Samuel Denne, F.A.S. in a letter to Mr. Gough. *Archaeologia* 8. (W)

Eineder, G. 1960. *The Ancient Paper Mills of the Former Austro-Hungarian Empire and Their Watermarks*. Hilversum: Paper Publications Society. (W)

Fenn, John. 1787–1823. A catalogue of the original letters, etc. and a list of the plates and numbers thereon. In *Original Letters Written During the Reigns of Henry VI, Edward IV and Richard III* (known as the Paxton Letters), Vol. 2. London: G.G.J. and J. Robinson. (W)

Fiskaa, H.M., and O.K. Nordstrand. 1978. *Paper and Watermarks in Norway and Denmark*. Amsterdam: Paper Publications Society. (W)

Gaudriault, Raymond. 1995. *Filigranes et autres caractéristiques des papiers fabriques en France aux XVII^e et XVIII^e siècles*. Paris: J. Telford. (W)

Gilreath, J. 1991. *The Judgement of Experts: Essays and documents about the investigation of the forging of the 'Oath of a Freeman.'* Worcester, MA: American Antiquarian Society. (F)

Grant, Julius. 1937. *Books and Documents: Dating, permanence and preservation*. New York: Chemical Pub. Co. (P)

Haselden, R.B. 1935. *Scientific Aids for the Study of Manuscripts*. Oxford: Oxford University Press. (P)

Heawood, E. 1929. Sources of early English paper supply 1. Transactions of the Bibliographical Society. 2d series. 10. In *The Library*. (W)

———. 1930. Sources of early English paper supply 2. Transactions of the Bibliographical Society. 2d series. 10. In *The Library*. (W)

———. 1930. Paper used in England after 1600, part 1. Transactions of the Bibliographical Society. 2d series. 11. In *The Library*. (W)

———. 1931. Paper used in England after 1600, part 2. Transactions of the Bibliographical Society. 2d series. 11. In *The Library*. (W)

———. 1947. Further notes on paper used in England after 1600. Transactions of the Bibliographical Society. 3rd series. 2. In *The Library*. (W)

———. 1928. The position in the sheet of early watermarks. Transactions of the Bibliographical Society. 1st series. 9. In *The Library*. (W)

———. 1950. *Watermarks, Mainly of the 17th and 18th Centuries*. Hilversum: Paper Publications Society. (W)

Hebborn, E. 1993. *Drawn to Trouble: The Forging of an artist*. New York: Random House. (F)

———. 1997. *The Art Forger's Handbook*. Woodstock, NY: Overlook Press. (F)

Hunter, D. 1943. *Papermaking: The History of an ancient craft*. New York: Knopf. (P,W)

Hunter, J. 1859. Specimens of marks used by the early manufacturers of paper, as exhibited in the public archives of England. *Archaeologia* 37. (W)

Labarre, E.J. 1952. *The Briquet Album*. Hilversum: Paper Publications Society. (W)

———. 1956. *The Nostitz Papers*. Hilversum: Paper Publications Society. (W)

———. 1952. *Dictionary and Encyclopaedia of Paper and Paper-making*. 2d ed. Amsterdam: Swets & Zeitlinger. (P)

Lemon, R. 1891. A collection of watermarks by the late

Mr. R. Lemon of the Public Record Office. In Scott, H.T., A. Wright and S.J. Davey. *A Guide to the Collector of Historical Documents, Literary Manuscripts and Autograph Letters, etc.* London: S.J. Davey. (W)

Lindt, J. 1964. *The Paper-Mills of Berne and their Watermarks, 1465–1859*. Hilversum: Paper Publications Society. (W)

Loeber, E. 1952. *Supplement to E.J. Labarre's Dictionary and Encyclopaedia of Paper-making*. Amsterdam: Swets & Zeitlinger. (P)

———. 1992. *International History of Paper and Paper Making*. Microfiche. Lisse, Holland: M.M.F. Publications. (This includes 19,000 watermarks, 7,000 drawings of equipment, 15,000 photographs of equipment, mills, etc. and the *Manuscript* multilingual dictionary of papermaking in 8 languages, 43 volumes. The Loeber Archive is situated in the Municipal Archives, Apeldoorn, Netherlands.) (W, P)

Midoux, E., and A. Matton. 1868. *Etudes sur les filigranes des papiers employes en France aux 14e et 15e siècles*. Paris: Dumoulin. (W)

Mosin, V. 1973. *Anchor Watermarks*. Amsterdam: Paper Publications Society.

Myers, R., and M. Harris. 1996. *Fakes and Frauds: Varieties of deception in print and manuscript*. New Castle, DE: Oak Knoll Press. (F)

Nickell, J. 1996. *Detecting Forgery: Forensic investigation of documents*. Lexington, KY: University Press of Kentucky. (F)

Rendell, K.W. 1994. *Forging History: The Detection of fake letters and documents*. Norman, OK: University of Oklahoma Press. (F)

Roberts, J. 1988. *A Dictionary of Michelangelo's Watermarks*. Milan: Olivetti. (W)

Rosenblum, J. 1998. *Prince of Forgers*. New Castle, DE: Oak Knoll Press. (F)

Sem, J., and J. Mayer. 1945. *Report on Forgery in the Sachsenhausen Concentration Camp*. Central Criminal Office Report no. 495/45. December 15, 1945. (F)

Shorter, A. 1957. *Paper Mills and Paper Makers in England, 1495–1800*. Hilversum: Paper Publications Society. (W)

Simmons, J.S.G. 1965. *Tromonin's Watermarks*. Amsterdam: Paper Publications Society. (W)

———. 1994. *Likachev's Watermarks*. Amsterdam: Paper Publications Society. (W)

Sotheby, S.L. 1845. *Typography of the 15th Century*. London: T. Rodd. (W)

Spector, S. 1987. *Essays in Paper Analysis*. Washington: Folger Shakespeare Library. (P)

Stratis, H. 1998. *The Lithographs of James MacNeill Whistler*. Vol. 2: *Correspondence and Technical Studies*. Chicago: Art Institute of Chicago. (W)

Taylor, W.T. 1991. *Texfake*. Austin, TX: W.T. Taylor. (F)

Tschudin, W.F. 1958. *The Ancient Paper-Mills of Basle and Their Marks*. Hilversum: Paper Publications Society. (W)

Uchastkina, V. 1962. *A History of Russian Hand-Mills and Their Watermarks*. Hilversum: Paper Publications Society. (W)

Valls I Subira, O. 1970. *Paper and Watermarks in Catalonia*. Amsterdam: Paper Publications Society. (W)

Woodward, D. 1996. *Catalogue of Watermarks in Italian Printed Maps ca 1540–1600*. Chicago: L.S. Olschski. (W)

Zonghi, A. 1953. *Zonghi's Watermarks*. Hilversum: Paper Publications Society. (W)

Notes

1. Julien Stock wrote, 'I first discovered the drawing pasted into a scrapbook of Old Master drawings in the library of Castle Howard in Yorkshire, England. It was drawn with a pen in two shades of brown ink with white heightening. The white has been used to correct, as brown ink cross-hatching is drawn over its surface. It is adhered overall to a Jonathan Richardson Sr. (1665–1745) mount with his collector's mark in the lower right, JR. The drawing was cut in the sixteenth century by approximately 35 mm along the bottom edge. For a work of this importance to be pasted into a scrapbook of drawings of mediocre quality is a mystery. There was no attribution either on the mount or the page from which it was taken. When it lost its identity nobody knows. Of particular interest is a red chalk drawing discovered by Paul Joannides in the Louvre, and attributed by him to Francesco Salviati (1510–1563), that copies this work even down to the loss of the bottom edge. [see P. Joannides 1988 article, 'Salviati et Michelangelo,' in *Franscesco Salviati o la Bella Maniera*.] I would propose that this drawing is an important addition to Michelangelo's oeuvre. Likely drawn in the 1490s, it is probably a copy after a figure in a now destroyed fresco by one of the great masters of the trecento or quattrocento.'
2. Lamagny illuminated pocket microscope, model 7520.
3. Clovio, Giulio [1498–1578]. 1976. *The Farnese Hours: The Pierpoint Morgan Library, New York*. New York: G. Braziller.
4. De Tolnay, C. 1975. *Corpus dei Disegni di Michelangelo*. Novara: Instituto Geografico de Agostini. 3.
5. Richard Elliot and his descendants operated Chesham Bois Mill, Buckinghamshire, from 1799 until the 1850s. In 1807 he was granted a license to erect a Fourdrinier machine, which was properly operational by 1810. On his death in 1816 the mill was worked by his wife and son as Sarah Elliot & Co., before passing to their son, also called Richard. Elliot's paper is illustrated in Bower, P. 1990. *Turner's Papers: A Study of the manufacture, selection and use of his drawing papers*. London: Tate Gallery. 124.
6. Murray, J. 1829. *Practical Remarks on Modern Paper, with an Introductory Account of its Former Substitutes*. Edinburgh: W. Blackwood.
7. Piette, L. 1853. *Essais sur la coloration des pâtes a papier et sur la fabrication directe de papiers de tenure d'après un nouveau procède*. Paris: L.A. Mathias.
8. Piette, L. 1838. *Die Fabrikation des Papieres aus Stroh und vielen andern Substanzen im Grossen*. Coln: Dumont-Schauberg.
9. Gift of W.B. Dalton, Stanford, Connecticut, and the United Kingdom, 1959.
10. Purchased by the Art Gallery of Ontario as an anonymous gift in 1998.
11. Purchased as a gift from the Salamander Foundation and the Marina Gelber Fund, with a grant from the Department of Canadian Heritage on the recommendation of the Canadian Cultural Review Board under the terms of the Canadian Cultural Property Act, 1998.
12. Michelangelo Buonarotti, *Head of a Bearded Man Turned Slightly to the Left*. Charcoal on laid paper, BM 1895, 9-15-511. In Tolnay. *Corpus 220, Drawings by*

Michelangelo. Ex cat. London, 1975, no. 65, and also *Nude Male Figure from Behind, turned to Right*. Black chalk on laid paper, BM 1859, 6-25-567. In Tolnay. *Corpus 208, Drawings by Michelangelo*. Ex cat. London, 1975, no. 104.

13. Michelangelo Buonarotti, *A Philosopher*. Pen and ink on laid paper, BM 9-15-498.

Examining Oriental Papers: A Workshop with Akinori Ōkawa

Introduction

Akinori Ōkawa is an expert in the manufacture of oriental papers, and he brought numerous examples of Japanese, Chinese and Korean papers with him. Some of these papers dated back to the eighth century. He showed participants how to analyse the fibre content of these papers. As well, he characterized the papers by appearance, sound and tactile qualities. Many of the participants were very knowledgeable about oriental papers and we are grateful to them for sharing their experience.

John O'Neill: It is my pleasure to introduce Mr. Akinori Ōkawa, who is the technical manager at the Paper Research Centre in Kōchi, Japan. He has developed the ability to analyse and reproduce exactly many varieties of early Japanese and other Asian papers. Since 1979, through workshops with conservators in Japan and in consultation with art institutions around the world, he has researched and been able to assist in the identification and treatment of over 1,000 works on Japanese and other eastern papers. He will be translated by Deirdre Tanaka and assisted by Kayoko Moriki. Mr. Ōkawa.

Akinori Ōkawa: Good day, everybody.

There are three handouts. This is the first. On the first page there are instructions for preparing the dyeing solution that I will be using today. On the next page there is a chart which indicates the colours that the fibres will turn when exposed to the dyeing solution. (See Appendix)

There was a question about what the GP and SP and KP stand for. GP stands for ground pulp. GP will turn yellow to yellowish orange.

Participant: Does ground pulp mean wood pulp?

AO: In Japanese when you say pulp it always refers to wood. You wouldn't say *kōzo* or *gampi* pulp. So ground pulp is wood. SP is sulphite pulp. And KP stands for kraft pulp. And AP stands for caustic soda — pulp that has been treated with caustic soda.

The C dyeing solution is fairly standard. Has everyone heard of this? It is the C stain from TAPPI.

P: Where you talk about unbleached and bleached pulp, do you mean sun-bleached or chemically bleached?

AO: This information is taken from TAPPI. The bleached and unbleached refers to chemical bleaching.

On the third page there are samples of various papers made from *kōzo*, *gampi*, bamboo, *ine* (fibres from the rice stalk), *mitsumata* and *seitan* (a Chinese paper). These sample papers are made from 100% of these fibres. And of the six here, the bottom two are not Japanese fibres. They are bamboo and *seitan* and are Chinese fibres.

And on the last page I took drawings from a botanical dictionary indicating what each of the plants looks like. The names on this page are the Latin and the Japanese. The English names, starting from the top left, are *kōzo*, *mitsumata*, *gampi* and *kajinoki*. *Kōzo* is a plant that has been found in Japan from time immemorial; it is a uniquely Japanese plant. And *kajinoki* is a plant found typically in Thailand, Taiwan and southern parts of China. *Kajinoki* is in fact a different plant from *kōzo* but in Japan now this is often used interchangeably with *kōzo*. The name *mitsumata* comes from the word *mitsu*, which means three, as the branches of the plant are divided in three. Then there is rice and *seitan*. And on the bottom row are two types of vegetable mucilage used for viscosity in the water. On the left is *noriutsugi* and on the right, *tororo-aoi*, the most commonly used, particularly for *kōzo*, which has very long, sinewy fibres. And *noriutsugi* was used more in ancient times for scooping up *gampi* or *mitsumata*. It is preferred for these two fibres. It is not used exclusively for these fibres, but as a general rule it is.

P: Is paper made from the rice plant?

AO: The fibres of the rice plant are used but they are fairly short, so they are used in combination with other fibres. In China, rice fibres are commonly used in papermaking. There was an explanation of the use of rice fibres in Chinese papermaking in one of the papers given the other day. They talked about bamboo but perhaps not this Chinese *senshi* paper. This is the kind of paper that would have rice fibre in it. About 70% would be rice-straw fibres and the remaining 30% would be *seitan*. Later on we will have a chance to actually look at the fibres.

Another brochure that was handed out is an introduction to the place where I work. Our new facilities were built four years ago. In this facility I work in the second section, which is the technical department, and we focus on making paper. My work, strictly speaking, is not to do with examining old documents or dealing with restoration, but in my work with various fibres it became a part of it. Situations would occur in which a company that sells paper would present a paper to the papermaker and would ask them to make something exactly like this. But the papermaker presented with the paper wouldn't know exactly what fibres, what the content was, how it was put together. So they would bring these papers to us and we would examine and determine the content. And so what we would do is identify the fibres, whether they were rayon, whether they were wood pulp and then we would actually count the number of fibres, determine the

relative measurements and then give this information to the papermaker. And this is something that we do on a daily basis at my work. And so, initially in dealing with these various forms of paper, we became fairly well known. And then Mr. Masuda of the Tokyo National Research Institute of Cultural Properties contacted us and inquired whether we were interested in dealing with old paper as well. And that would be about 20 years ago now. The rest is history, and over time we have now basically established ourselves to the point where any national treasure in Japan, the paper is brought to us for analysis and examination.

On the second page, just for your information, there is a photomicrograph of a portion of Lou-lan inscriptions from the third and fourth century, found on the Silk Road at a place called Lou-lan. It is a Chinese paper made from hemp and it is kept in a Swedish museum. And the third item on your chair is some material on Kōchi prefecture, which I hope will encourage you to visit sometime.

Basically there are three main materials in Japanese handmade *washi: kōzo, mitsumata* and *gampi*. Each one of the fibres is a different shape and length. And so the final product made from them will also look different.

P: The colour difference is very clear.

AO: The colour difference is related to the difference in fibres. There is perhaps also some effect from the way in which it was processed, the way it was made. Particularly in the very beginning, when you are making the raw material and what portion of the bark you use — that would affect the colour as well.

P: In that case, if the colour is slightly characteristic, is *mitsumata* slightly pinkish — more pink than the other two, or is that too general?

AO: Probably that pinkish hue is more to do with this particular piece of paper.

This is a typical *kōzo* paper. *Gampi* has this typical high-pitched sound. And *mitsumata* is probably somewhere in between *kōzo* and *gampi*. I believe you are quite aware of all this. However, I believe that your connections with *washi* are based predominantly on *washi* that is currently made where *kōzo* and *gampi* are easily identified. However, in our case, we are often requested to look at papers which are much older, that will often be 1,000 years old. The methods of papermaking were different in those days and often the fibres have been cut so short, which is not a method that we would use now. And after the paper is made, it is treated in a way that we wouldn't consider doing these days. They made the paper and then they wet it again and pounded it.

This is a picture that I bought at an antique shop last year in Toronto. This is from a book published in 1763 in Europe indicating that they also used a stamper in Europe to pound the paper. And this picture shows how the paper is placed on top of a rock and pounded. The rock is also used for polishing the surface of the paper.

P: I understand that they pounded the surface of the paper afterwards — after it was made, after it was formed.

AO: Yes. This is a paper that was made in Japan in 1226. The question is, can you identify this paper by touching it? And this paper was made in 1267, around the same time. In Europe they would stamp the paper once it was dry, in a dry state. But this particular one was stamped when it was dampened.

P: Redamped?

AO: Yes, redamped, basically. First you have wet paper, then it would be coloured and after this dried. Following this it would be wet again and then pounded.

This will clarify what we are talking about. Here you have the original paper complete and dried. Here you have the same piece of paper dyed and then the final process of wetting and stamping. This is made of *kōzo*, as you can probably tell, but by the final stage, once it has been stamped, it almost sounds like *gampi*; it has this high kind of sound to it. So when you are looking at very old papers you cannot determine immediately if it is *gampi*, even when it has this sound and is very smooth.

The technique used to produce this very unique *kōzo* paper is something that is not used in modern times. We were requested to analyse old paper like this, and in the process we discovered that the density of this paper is completely different from any other paper we had encountered. And so we created our own version as part of the experiment. This is the original *kōzo* paper, and then it is dyed. And then this dyed paper is dampened, and then it is beaten to create this effect. Through the beating it becomes much more dense and compact and is about half the thickness of the original paper.

P: Was this beaten in a large or small stack?

AO: It doesn't really matter how many. You can put 10 together and beat them or you can put 100 together and beat them.

P: This sample — is that *shibu* on the outside?

AO: No, it's very, very different. That one is dyed with *kihada*, a natural yellow dye derived from the inner bark of the *kihada* tree, but it has no kind of coating or processing. It is strictly from the beating that you get that texture.

P: It's very, very slick, though, that one.

AO: Yes. There are many things in Japan that are dyed with *kihada*, because *kihada* also protects the paper from insects. I will explain the beating process a little more. The purpose was to create a smooth surface which would be easy to write on and to prevent the ink from bleeding. The papers that I have been passing around are Buddhist prayers. They could be written quite leisurely, without being concerned that the ink would spread. This

technique is very ancient. It came to Japan from Korea, probably along with the actual papermaking techniques. The oldest record of this beaten paper is from 738; there is a record of 180 pieces of purple-dyed beaten paper. And after that date there are many examples. In Japanese this paper is called *uchigami*. The *uchigami*, the beaten paper, should not be used as a backing paper because it expands.

P: Right.

AO: Present-day papermaking methods do not include *uchigami*, this beaten method. As a rule now, paper is calendered or else some kind of chemical sizing agent is added to the paper to prevent bleeding of ink on the paper. And the technique involves — the paper has gone through all the processes and at the very end it is dried, and once it is dry, you wet it again and then you pile up these damp sheets of paper. And when we reproduce beaten paper for specific requests, we pile up the paper and cover it with plastic to make sure that the moisture spreads evenly among the paper. And then we put a layer of leather underneath and a layer of leather on top. And we start by hitting it very gently at first. We use a wooden mallet that is about 10 cm in diameter. You could use a metal hammer, but the difficulty with metal hammers is that there would be more force from the edges and it could possibly damage the paper and it would actually be quite difficult to get it even. So in the beginning you would beat it quite lightly because the water content is just over 30%. And then after you beat it a bit you spread it out and let it come in contact with the air a bit and then bring it back together again and beat it again. Sometimes the sheets stick to one another, so you have to every now and then separate them. As you are doing this, gradually the paper will start to dry more, and as it gets drier you can start hitting it even harder.

And this is *aizome*, indigo-dyed *kōzo* paper, and this is what it looks like after it has been beaten. So the problem then is often identifying papers; once you've produced this beaten paper, if you only saw this paper you would see that it has a lustre like *gampi*. It is very shiny and dense and so you would assume it would be *gampi*. Unless you took a fibre you probably would not be able to identify what it was accurately. So if you beat the paper, what exactly happens to it? As you can see when the paper is beaten, it has a very smooth surface and the ink does not bleed on the paper. We do an absorbability test called the Klemm absorbability test, which shows the degree to which the paper will absorb water. We cut it into a 15 mm strip across and put it into the water. Normally this test is done for 10 minutes, but we do it for just 5 minutes. And in this particular experiment, I have paper that is a hemp and *gampi* mixture in both beaten and unbeaten sheets. You put the end of this strip of paper into water and you measure how high the water is absorbed. In the case of the unbeaten *gampi* and hemp material it rose 88 mm, and after if it was beaten it rose to only 22 mm. In other papers it would be, as a general rule, a third; that is, the beaten paper would be a third of the unbeaten.

P: So those papers have no sizing?

AO: No, no sizing.

P: Is it dyed on both sides of the sheet?

AO: What you would do basically is that you would produce the white piece of paper and dip it in dye and then beat it.

P: One side is more evenly coloured than the other side; that is why I was asking.

AO: The reason why the colour is on one side and not the other was a problem created during the drying stage. So basically this would be dyed with a brush, probably brushed-on colour.

P: On one sample that is going around — in raking light there are lots of little shiny flecks on the surface. What are those? Have these papers been treated with size?

AO: No. Sizing was not a technique that was used in the early papers and the pounding was basically their way of solving the problem of the ink bleeding on the paper. Very few present-day papers are sized, but those that are use animal glue or alum on the surface to prevent bleeding. These particular ones that we made experimentally at the centre are not sized.

Now I would like to talk a little bit about present-day paper and the various ways one can look at it and analyse it. Then we will dye some of the fibres and look at them under the microscope. The first we are going to look at is *tesuki washi* — handmade *washi*. You can tell that it is made by hand because of the deckle edges. But presently even machines can produce this deckle edge. Even though they are not very expensive or very nice machine-made papers, they still have this edge. The majority of these machine-made papers are made from raw materials that come from Thailand.

This is called *Echizen hōshoshi* — a very famous type of *washi*. It is often used for *ukioyo-e*. There is no sizing. It is dried on a bed of gingko board, which gives it that surface.

P: Why is *hōshoshi* so thick?

AO: This very thick *hōshoshi* is from Fukuiken, a province in Japan, and I am not too familiar with it. I am not quite sure why *hōshoshi* is so thick; I have always thought it was too thick. Apparently it didn't used to be so thick.

P: I have been working on some Surimono *ukioyo-e* on *hōshoshi*, and I know it is a more expensive paper, but I presumed it was just because it comes from a certain region and it's a rare paper. Yashima Gakeite — he is the same time as Hiroshige.

AO: *Hōshoshi* was not really for woodblock printing.

The local lords used it. It was very special paper for the *shōguns*. They made it very thick because only the most powerful and wealthy were supposed to use it.

P: These were private commissions, woodblock prints as opposed to the *nishiki-e* (a kind of *ukioyo-e* print).

AO: You had to be wealthy to use *hōshoshi*; even now you have to be wealthy to use *hōshoshi*. But now of course there are all kinds of *hōshoshi*. You can get cheap ones that have wood pulp in them. But that might answer your question of why it is so thick. It would be like anything connected with the wealthy: the thicker it is, the more luxurious it is.

The kinds of papers that are made in large quantities are used for calligraphy and they are called *gasenshi,* but they have all been trimmed at the edges. These are all Japanese and all the edges have been cut off, but when it is made the deckle edge has a folded-over effect like this (fig. 1). During the Edo period, from 1602–1867, there are also many papers that reproduced this folded-over effect. But even though they folded it over this way, the assumption was that before you actually sold the paper the edges would be cut off.

P: Is it always one side that is folded over?

AO: It doesn't seem to matter which side it is folded in on. It is probably the personal habits of the person making the paper.

The paper that is made for calligraphy tends to be fairly weak paper. The reason that the edges are folded over is because when the paper is still wet and it is pulled off the drying bed it tends to tear very easily. This is *tesuki* paper which also has the folded edge and is made for *shōjigami* — the sliding lattice doors. In general, paper made for *shōjigami* is *kōzo*, at least the good ones.

P: Can I ask a question about a print? I don't see any lines, any chain or laid lines.

AO: Because it was produced with a wire mesh, not a traditional bamboo or reed screen.

P: I understand that, but a wire mesh also leaves an imprint. You observe this in western papers.

AO: Basically it is a combination of materials and of mesh. Normally *mitsumata* would be made on a traditional bamboo or reed screen, and in these cases it would show. When you put *mitsumata* on a wire mesh then — *mitsumata* fibres are not as small as European fibres, so the mesh would make less of an imprint on it.

And in the Edo period there was a kind of paper made that had a crepe effect. Unfortunately I do not have a sample. It is made in the following way. You start with — you scoop up the paper and you pile it all up wet and then you press it and then you pull it off one by one onto different boards. If it is thin, they will often do maybe three together. Then they are pulled off all at once. And

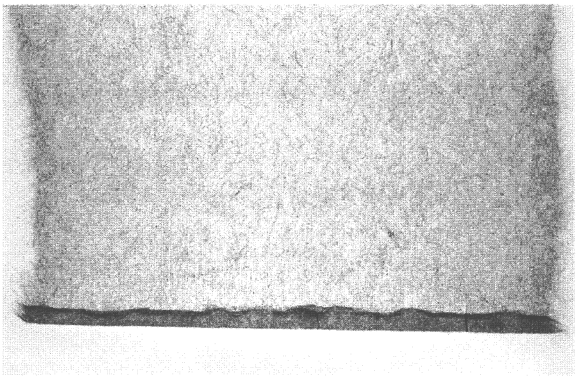


Fig.1 Example of a Japanese paper showing folded-over deckle edge.

then you hang it up to dry and that will give you wrinkles on the surface, that is, a crepe-like effect. Now in Japan this type of paper, called *danshi,* is used to make envelopes, and these envelopes are used when you give someone money.

This particular paper was made on a *kaya* (screen). *Kaya* is a Japanese reed. The laid lines on paper made on a *kaya* screen are more widely spaced and rough. Each piece of *kaya* is about 20 cm long. The individual pieces of *kaya* are connected with a small piece of bamboo — in the hollow centre, like putting two straws together. You can see where it is connected with the bamboo pieces if you would like to pass this around (fig. 2). You can see that the marks from the threads [chain lines] are an equal width across the sheet. And you will also notice that this paper has been dried on a pine drying board and the pattern of the wood grain can be seen on the paper.

This particular paper is made instead on a bamboo screen (fig. 3). The stitching on a bamboo screen is much more closely spaced together. The reason for this is that individual pieces of bamboo tend to be short and need to be connected more often. The bamboo needs these very narrow widths every now and then to connect it. The *kaya* doesn't need that.

P: Is *udagami* made on a *kaya* or bamboo screen?

AO: The answer is that it could be either, depending on the maker. This particular sample of *udagami* here was made on a *kaya su*. Very thick paper like this would require a fairly firm brush, a brush made of the tips of rice stalks, which forms a firm, solid brush. Very fine, delicate papers like *gampi* and *tengujō* (a kind of *kōzo*) would be brushed with a brush made from horsehair.

P: Does it matter which side of the paper is brushed onto the board or is it immaterial?

AO: It depends on the papermakers. Some would make the paper and then flip it over onto the drying board; so then this would be the side that would be brushed.

P: So that would be opposite the mould side.

AO: That's right. And then it would be peeled off. And then the others would start the opposite way. It depends

on the papermaker. This particular paper uses *kaya* or reeds for the screen for scooping up and you can see the pattern is fairly clear; it is fairly rough. In older papers made on a *kaya* screen the surface of the paper next to the *kaya* screen would then be the one that is placed on the board. And the surface of the paper that is used for writing is the side that was not in direct contact with the *kaya* screen. Probably between 60% and 70% of the paper was made and used in that way. This is *mitsumata* paper made on a *kaya* screen. It could be made on either depending on the maker. This particular sample of *udagami* was made on a *kaya su*.

Back to the brushing issue. To help paper stick to the drying board it is brushed, and you can see lines left by the brush. This particular piece of *kōzo* paper that was shown was brushed with a brush made from very strong rice straw or possibly hemp palm, which is also a very firm, wiry kind of material. And then for more delicate papers, such as this *tengujōshi* — it is very thin and not very strong, so the hair from the mane of a horse is used for brushing this particular paper. And in Japan there is a very fine *gampi* paper called *torinoko;* in this case they will use hair from a deer for making a brush to brush it on the drying board.

P: Aren't those hairs hollow on the inside — they take up a lot of water? The deer hair?

AO: In Kōchi prefecture we don't use deer hair so I am not really sure. A friend of mine in Ōmi in Shiga prefecture makes Ōmi *torinoko* and they use deer, but it is very near Kyoto.

P: Do you have *torinoko* paper here?

AO: Slightly thick *gampi* becomes *torinoko* as well. This is thin. And this is so thin that you can't see any imprint left from the *su* at all. And the reason for that is a silk gauze has been placed on top of the bamboo *su*. I bought this near the Seine in Paris. This type of paper was exported to Europe sometime after 1888. And even though I might try and look for this type of paper in Japan, it would be very difficult to find, but if I go to Paris I can pick it up for 5 or 10 francs. We look at it and right away we know it is Japanese paper; it is often used for etchings and lithographs. I have heard that this particular paper is very famous because, after the First World War, when the treaty was drawn up at Versailles they used this particular type of paper. It is called *kyokushi* paper.

It is a handmade paper from *mitsumata* in the European style, using a wire screen. The Japanese government continues to make this paper for official paper purposes, such as giving someone an award or a special edict. It is made by *tame-zuki*, which is the type of paper where you just put everything into the vat and just pull it up once, basically the European style of papermaking, and this is continued to this day by the government.

Kyokushi paper is dried in a rather unique method in that it is dried in a frame. It is stretched across in a frame rather than on a drying bed. Most Japanese handmade papers are dried on a wooden or metal drying bed, but this one is dried in a frame and after it dries it is calendered. This paper became famous because it was used at Versailles; the French people decided that they had to mimic something similar to it to keep up with this

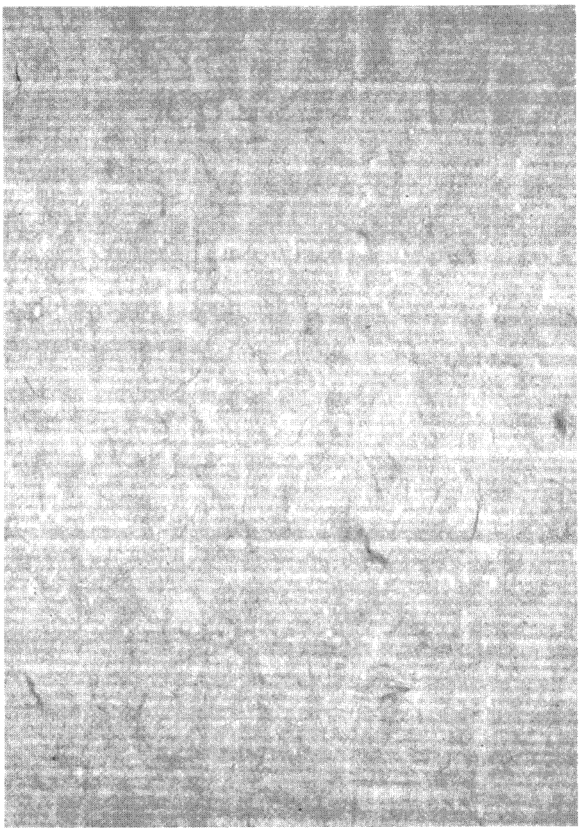


Fig. 2 Japanese paper made on a *kaya* screen.

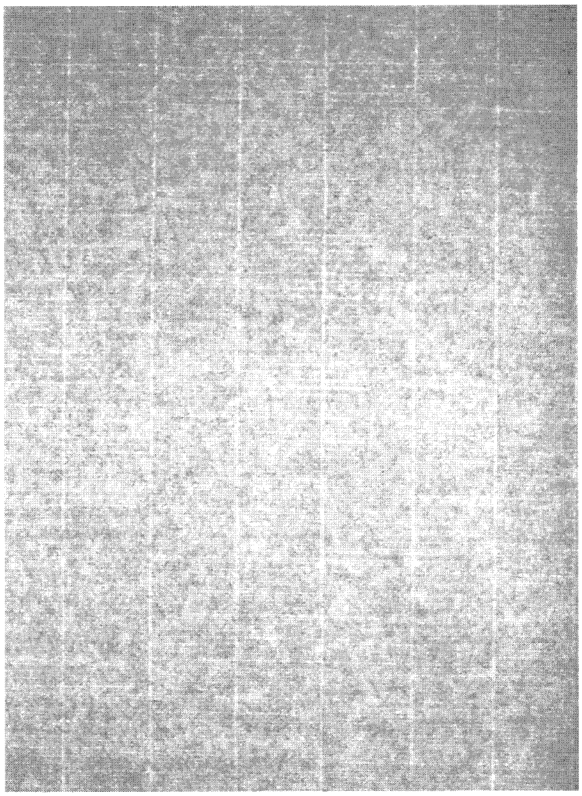


Fig. 3 Japanese paper made on a bamboo screen.

imported paper from Japan. And so they created a mechanical version of this, and the mechanical version created in France was then exported to Japan. And the Japanese copied that and created another paper called *mozōshi* (mimic paper).

P: What was the reason for drying it in a frame?

AO: Probably so the paper would look the same on both sides, although I am not sure.

And the *tengujōshi*, which is going around, is a very fine, cloud-like paper. With these very fine papers you have the bamboo screen and then on top of that you put a *sha* — a silk screen (fig. 4). But you cannot see the woven pattern of the silk on the paper.

And another kind of paper — this paper is made of *gampi* and it's a very specialized paper that is used for producing gold leaf. So they will put this *hakuuchishi* paper on the table and then on top of that they would beat down and produce gold leaf, so it is specifically for producing gold leaf. And this particular one, the pattern that you can see is produced by a *sha* that is made of hemp, not silk, and of course hemp is much coarser than silk, so it leaves a bit of a pattern on the paper. And there is some clay included in the *gampi*.

P: What do they apply the gold leaf with? What holds the gold leaf to the paper? Is it just the pounding?

AO: So the way it is done is you have this paper and then the paper is further processed by using *kakishibu* — persimmon tanin — or egg. I am not quite sure — it is very secretive and they don't let out their secrets about what exactly they use to process this paper. But they get the *gampi* paper and then they put something else on it and then what they do is layer it. So what you have is this paper, then a bit of gold, and then another paper, and then a bit of gold, and you layer it all up and then you beat it until it is a very fine gold leaf. So this paper is necessary in the process of making gold leaf and it has become a very specialized paper.

P: So this is the paper that goes in between the gold.

AO: You can see a little bit of gold still on the paper where they have hammered it. After they were finished beating and using the paper for making gold leaf they would cut this large sheet of paper into four pieces, and it was then sold as a blotting paper for women's makeup. So the gold would give you a little extra shine.

On this paper you can clearly see some large dark marks on top of the pattern of the screen. These are from the pieces of wood that support the bamboo laterally and vertically.

And among the paper in China, the most high-quality paper is called *senshi*. I believe in the talk on Chinese papers there was some mention of *senshi*, but I don't know if he mentioned the *seitan*, which is one of the fibres that is used in it. *Senshi* is made with *seitan* and *ine*. Just in case someone knows Chinese here, I should warn you that *seitan* would be the Japanese reading of the same Chinese characters, which would probably be read with a different pronunciation in Chinese, in case you are trying to correlate the two.

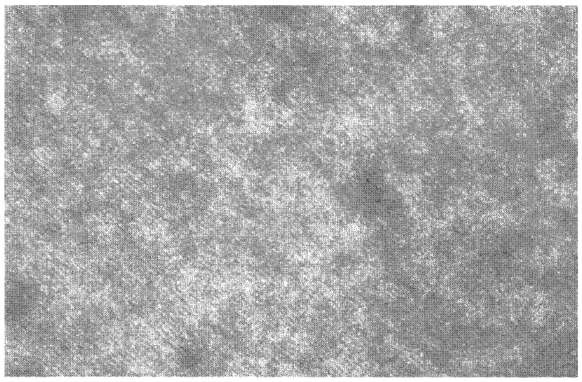


Fig. 4 Japanese paper made with a *sha* placed over a bamboo screen.

P: *Chintan*.

AO: Okay, I knew somebody would know.

Furthermore, this paper is made up of three ingredients: *mitsumata*, cotton linters and esparto. If you add the C stain the cotton would show up as red and the esparto is blue. Sometimes the esparto would be a little bit red as well, but as a general rule it is very thin and blue. The *mitsumata* would turn an olive-green colour. We will have a chance to see this under the microscope later.

This is Chinese *gasenshi* but it is slightly different. If you look at the weaving pattern it looks like the shell of a turtle. The bamboo screen is produced in such a way to make this pattern. The bamboo pieces are straight but the threads that connect the bamboo pieces and keep them tied together are threaded together in such a way to make the turtle pattern.

P: The tortoiseshell pattern I thought was from a specific province. Is that true?

AO: This is from Ankisho. The problem again is that the Japanese will read the characters in a Japanese way. So to figure out what the Chinese call that and then what it's called in English I would have to have a dictionary; I'm sorry. Yes, you are right, it is a very specific place. I am not sure what it is called. Ankisho.

P: Probably A-N-H-U-I. I have seen it in English. Does that make sense?

AO: Maybe. I am not sure where it is. I have never been there. Ankisho province and my prefecture are twin prefectures, so we have a lot of ties. These particularly high-quality papers are only found in Ankisho. For example, in Fukuiken they will have similar looking papers, but they are not all as good; they are not made as well.

P: It would definitely be Anhui province, then.

AO: And this is another way of weaving the bamboo together to make a screen that produces a pattern in the paper. It is called *ramon-shi* pattern.

P: Is there any significance to the difference in the patterns?

AO: These papers are from China, so I am not necessarily well versed on them, but from what I have heard, when you write on them (because they are used for calligraphy) with calligraphy pens or brushes, the patterns that are created by the threads give a different effect in the writing.

This paper is called *gyokubansen* and again is a Chinese paper. It is considered to be one of the finest that is imported into Japan. If you hold it at an angle up to the light you will see that in different places it tends to shine or sparkle a bit. They have polished it a little bit.

These papers here are all Chinese. And this particular paper is considered to be the highest-quality paper in China used for calligraphy and *sumi*, pictures drawn in the black *sumi* ink. If you look at it in this manner you'll see that various areas on the surface seem to be particularly shiny. It's a little hard to see. This is because they have probably polished it lightly afterwards, the surface of the paper. It's only this paper, this type of *gyokuban*.

P: That's to absorb less *sumi*?

AO: No, I don't think so. No, they are not polishing it that much.

Probably this is made by scooping up two sheets of paper and then putting them together and drying two together, so it is actually two in one. Because this is one — one scoop, so to speak. You can see the marks of the laid lines very clearly on this one, whereas this one is not very clear. They are sort of overlapped. It is probably produced by putting together two sheets.

P: Was it done on the drying wall?

AO: Probably yes, in China. On the wall, yes. They also sometimes warm the wall and dry it there.

P: Is this *gasenshi*?

AO: Yes, these are all forms of *gasenshi* from China.

P: Does *gasenshi* paper always have narrow chain lines?

AO: Yes, *gasenshi* always has the narrow. This is the most common *gasenshi* and it doesn't really have much of a line in it.

P: Yes, but these are narrow — these are very narrow compared to other papers.

AO: Yes, compared to *washi*, it is very narrow.

P: These Chinese papers that are going around feel like they have a filler, possibly clay, in them.

AO: No, it's all fibre, but they have taken a very long time to make it. And they use lime to cook it.

P: It is cooked with lime for a long time, so the residue from that gives it this feel?

AO: First the raw materials are cooked with lime. After the cooking they are removed from the solution and left on the mountainside for about eight months, and they are rained on and the sun shines on them. During this time the lime turns into calcium carbonate, which results in a pH between 9.2 and 9.6. It is a bleaching process as well.

Recently, however, it is somewhat different. And more and more, rather than spending seven or eight months leaving it out to the elements, they choose to use chemicals to bleach it. And now, actually, people, instead of waiting for this process, put calcium carbonate into the paper. So all pH neutral paper would have this calcium carbonate in it.

P: In the West this paper would be used for lining. What is it used for in China?

AO: This would be all used for calligraphy, or *sumi* pictures. It is perfect for that.

P: In my search for 100% bamboo papers from China, we never found any contemporary papers that were white and 100% bamboo. Only the mixtures.

AO: You want paper that is white and 100% bamboo. I bought this in Japan, but it is imported from China. It is about $35 Canadian for 2,000 sheets.

P: You can buy that here in Chinatown.

AO: This particular paper is made from bamboo and it is used for funerals, where it is considered to be heaven money. You throw it into the funeral pyre or whatever, and it burns up and goes to heaven with the person who has died, so they are rich in heaven. So when they go to heaven, the more that you burn the richer they will be.

P: As a matter of fact I wrote an article on a paper exactly like that.

AO: A person called Hans Schmoller in England wrote an article on this as well. We have got bogged down in Chinese paper here.

There are various different kinds of *kōzo*. This particular one is called *udagami* and is used for sliding doors, not the earlier, lattice type of doors that I referred to, but these doors would be solid paper. This particular *kōzo* paper has clay in it. Now I will introduce you to the various Japanese *kōzo* papers. This is Japanese *gasenshi*, and in Japan we cannot leave it lying in the mountains for seven or eight months.

P: Why?

AO: Because we don't have enough room. If only we were as big as Canada! So a very small amount of calcium carbonate is added in the beginning.

P: Into the pulp?

AO: Before you dip the mould. Yes, in the vat when you put everything in.

Now this particular kind of paper may be familiar to you if you have looked at a lot of Japanese papers. This paper is produced by adding rice powder. The grains of rice are soaked in water and then ground into a very fine powder. They are added to the *kōzo* and this paper is produced in that way. This is actually a corner of a Hiroshige print. We'll look at this later under the microscope, but there is a fair amount of rice powder in this paper. So why would you put rice into paper? One reason is to make it white. This kind of paper is often used for prints or paintings, and if you don't make it white then colours won't come out accurately. And also, because *kōzo* is a very rough fibre, the rice powder will fill up the spaces between the fibres and give you a very smooth surface, which will readily reproduce the woodblock print. And the way the woodblock is printed — for example, if you are doing 100 prints, you'd do the green on all of the prints, then you'd do the yellow on all of the prints. And if the paper expands or shrinks in between those processes too much, then when you put down the next colour it won't be accurate, it won't be in the right place. When a fibre expands in terms of length it will expand only 1 or 2%. However, in terms of diameter it will often expand up to 20 to 30%. And so if the fibres are very close to each other and they start expanding, they'll start pushing against each other and they'll start affecting the other fibres around it. But if you put clay or rice in between the fibres, then even if the individual fibres expand they won't affect the fibres beside them. And as a result you get a paper that doesn't have too much stretching. And so both *misu* and *udagami* are used often for the backing of scrolls. These scrolls are hung in the house, and whether it is very humid or very dry they remain in the same shape, in the same condition. And conversely this *uchigami* that we talked about earlier on is very dense, so the fibres are very, very close together. Because of this susceptibility to change due to humidity or lack of, even by the eighth century there is a Chinese document on how this beaten paper should never be used for backing paper.

The rice powder is made like this. First you put the white grains of rice into water and you leave them overnight to soak. And then you get a mortar and pestle and put this slightly soaked rice into the mortar, soaked not cooked, and you crush it into a powder and then mix it with the *kōzo*.

I'm going back to the discussion about rice and clay used in paper. For papermakers it is very convenient. For example, the most expensive raw material right now for making paper is *kōzo*, and this would be about 4,600 yen per kilogram. And if you use a kilogram of raw material, you would probably only get about 55% of that, in other words 550 grams of paper. But if you add rice to it you would stretch it out more. For example, the paper that we will shortly be looking at underneath the microscope is probably one part *kōzo*, one part rice. And right now at the present-day market price, rice is — even the best rice would be about 600 yen for a kilogram — so somewhere between 500 and 600 yen a kilogram. So that if you used one kilogram of *kōzo* and one kilogram of rice you'd probably get about one kilogram of paper, because rice is about the same — it is maybe about a 40% yield. But if you use only *kōzo* then you'd only get 550, maximum 600 grams of paper. And so if you put the much lower-costing rice, since it would be about one-ninth of the cost — so if you use that you would be almost doubling the yield of paper that you could produce. So this works well for the papermakers. However, the downfall of this paper is that it is often eaten by cockroaches or insects, so this would be the aspect that would make paper with rice in it unpopular.

P: So the *ukioyo-e* prints, we can conclude, were made using the lesser-quality material just historically because they weren't so permanent, they weren't fine art.

AO: Maybe. Basically the example that I gave right now was the present-day price of rice and the present-day price of *kōzo*, so this equation wouldn't necessarily work for the *ukioyo-e* prints. It was still good paper. But at the same time there was the concept that *ukioyo-e* was really just something cranked out for presents that you bought to take home, so it wasn't 'art' art.

If you look under the microscope, the one on the left is 100% *kōzo*-fibre paper, and this one is the sample from the Hiroshige print containing the rice powder. All the dots you see would be the rice. And in Japan there are two kinds of rice. One is the regular rice that you eat with a meal and another one is called *mochigome*. It is much more glutinous and shiny and is used in *mochi*, which are pounded rice cakes. This particular paper uses *mochigome*.

P: So different sorts of rice are used for this or just the glutinous kind?

AO: The sample that's going around is regular rice and this one would be glutinous, or what in Chinatown would be called sweet rice.

And this *senkashi* also has rice in it. And this particular one has very, very little rice in it and it's mainly used to evenly disperse the fibres. This is a paper that is currently in production.

P: Does the amount of rice powder have any influence on the discolouration or the permanence of the paper?

AO: Rice does not discolour very much. The paper used for *ukioyo-e* is unique in that you take the *kōzo* and you wash it in a sieve. So by washing it this way you get rid of the extraneous materials other than the actual fibre itself. And the reason the paper discolours is mostly because of these extraneous materials — if you don't get rid of them

properly then it will discolour. However, the disadvantage of including rice in paper is that insects such as cockroaches love to eat it. From about 1878, the tenth year of Meiji, they decided to stop using rice in paper. This decision was made in Kōchi prefecture by Genta Yoshii, so it wasn't necessarily uniform. They started using clay instead of rice.

P: I am wondering if you washed a sheet of paper with rice in it, what would happen to the rice — would it wash out or change?

AO: The rice might wash out.

This is a book about different ways of preserving and restoring *ukioyo-e* and talks about the pigments and the paper and various different aspects of it. Included in this book is an article by Keiko Mizushima Keyes, which is a Japanese translation of her article in English.[1] In this she had not been aware of the rice in the paper, but she talks about when she used steam on the paper it became almost transparent. And so she came to the conclusion that she should not use steam on that paper, but at this point she is not sure why, the reason for this phenomenon. She was not aware that there was rice powder in the paper. Because effectively, when you steam the paper with rice in it, you are cooking the rice; it is a raw rice powder that has now been cooked and you get cooked rice, which is gelatinous.

P: That's very interesting. It would be like cooking starch paste – it goes from white to clear.

AO: That's right. So basically it changes form — it doesn't go anywhere, it goes from a grainy substance to a gelatinous one.

These are both *kōzo* paper. Can anyone guess why the colour is different? No, not rice. No, not bleach. No, not sun. No, not sizing — sizing is not relevant. It's from the portion of the plant that you take the materials from. Here you have the outer bark and then you have the very surface of the bark and then the inner bark. This particular paper is made from taking off only this very surface, dark part of the bark using both the number one and the number two layer. And if you use only the most inner, number two layer then it would be like this. So this would be more expensive. The original material here would be 2,000 yen for a kilogram, whereas this good raw material from just the inner layer would be 4,500 yen, so more than double for the same amount. The highest-quality papers are made with just the inner layers. It is a purer material without the extraneous cells.

P: This paper that is going around, when the pulp is first produced is it a lot darker and then when it is left in the sun does it tend to bleach a lot? The two papers that are going around — are they both processed the same way?

AO: The higher-quality paper, the whiter one, would have been soaked in water and then left outside to dry, where it would be bleached in the sun a little bit, whereas the other one would not have had that process.

And if you used the browner paper for calligraphy with Japanese *sumi* ink, then it would not come out very nicely. With the paper that has the raw materials washed first, the colour of the *sumi* will be cleaner and more solid. There are three kinds of paper where they wash the raw materials first. One is *tengujōshi*, which is a very thin paper. *Echizen hōsho* is a very high-quality paper made from *kōzo*. This example of *Echizen hōsho* was made by Iwano Ichibe when he was alive; he has passed away now and he was considered a living national treasure *washi* maker. And when he was chosen as a national living treasure, a presentation was made to him and the official certificate that said 'You are a national living treasure' was handed to him. He got the piece of paper and ripped it up right away. This is a very famous episode of where he received the certificate and right away chucked the paper. A papermaker is very interested in producing the most beautiful paper, so is always working towards that, and of course this piece of paper is very beautiful, particularly beautifully produced.

P: Why does it have lines, the thicker areas on the *kōzo*?

AO: I am just getting a photograph that will explain it visually. So this is a *keta*, which is the outer frame in which this screen is placed, and it is made with wood and this one has some metal on the top. You can see even on this one, too. So where the *su*, the bamboo screen, here where it hits the ribs, the ribbing there, that's where you get these wide lines.

Then there is a third paper called *Yoshino urushi-koshi-shi*, which is used as a filter paper for filtering Japanese lacquer while it is being made.

P: I wondered if the whiter paper just takes less beating to separate the fibres.

AO: Less beating, pounding — it's not necessarily connected. Whiter papers and the amount of beating are not necessarily connected.

This is a sample book of present-day papers. And this is a *kōzo* paper that is made with the *tame-zuki* method. This type of paper was exported and, for example, would be found in large quantities in France, in quite a large quantity. It was be exported after 1950 and it was known as *papier japon*. And in the United States it was known as *Inomachi-gami*.

P: Or nacre or pearl paper.

AO: Kayoko Moriki's family has been exporting fine Japanese paper for several generations and this particular paper would have been exported from the time of her grandfather. It is often used for lithographs. Chagall and Miro often used this paper.

P: Was this paper made by the *tame-zuki* method?

AO: When I get questions, my head goes in the direction of the question and I lose track of what I am talking about; I should have explained this earlier on. In the beginning I talked about how in old, ancient paper they used very, very short fibres. The raw materials were cut into very short lengths in this paper. You see a very small piece here, this white piece of paper here. This is approximately 1,200 years old and I analysed this paper and measured the length of each fibre. I measured 15,500 fibres and the average length of the fibres was 0.56 mm. Present-day *kōzo* fibres are probably about 8.5 mm. So this particular fibre is made from a plant called *mayumi*. But even the *kōzo* of old papers was much shorter as well. The name *mayumi* comes from the fact that the wood of this tree was used to make bows, so the wooden part of the bow, which is *yumi*, is made from this tree. And also a paddle which would have been used to coat things with lacquer, was also made from this *mayumi*. So the wood would be used that way and then the bark would be used to produce paper. So this is the fibre used for papers made in 740. And you can see very clearly that the fibres have been cut. This is hemp and *gampi*. And the average length would be less than 2 mm, just under 2 mm. And hemp is a very long fibre, so obviously they have cut it.

P: Is it cut with a *nagimata*?

AO: No, that is only for beating.

P: How did they cut it?

AO: With a knife, they would chop it up. There is a particular document called *Engishiki* from the year 927, which describes a cross-section of all kinds of aspects of Japanese life. In this document there is a discussion of using *gampi* and *kōzo* together to make paper, about 2 kg of *gampi* and *kōzo* would be put into making the paper and it would take between 8 and 9 days to produce. Hemp by comparison took 30 days. So around about this time they stopped using hemp in paper because it was not very efficient. The *Engishiki* is sort of like the government paper bureau and they talk about all the amounts of one year's worth of raw materials of wood ash, what all the ingredients were that were used, and how much was used. And when listing all the different materials that were used to make paper, one of the noticeable omissions was *tororo-aoi* and *noriutsugi*. This means that none of these mucilages that are now used for the *neri* were used at that time. And so if you don't use mucilage, then the only way of producing paper is by the *tame-zuki* method. However, these are official records of officially made paper, and it's believed that in fact already by this time *nagashi-zuki* had started to be used among the common people.

P: Sorry, can you remind me of the date that *nagashi-zuki* started?

AO: There is no clear starting date precisely for this reason: because the official way was *tame-zuki* and the unofficial way used by the common people just started and there is no official record of when.

P: From your research, when is the first identifiable paper containing *nagashi-zuki*?

AO: That is very difficult to say. I have seen probably over 1,000 pieces of old paper, but there are various different ways of taking — like, for example, even if you put *neri* into the water you could still do *tame-zuki*, so it would be difficult to determine that. For example, this one: you put in mucilage and you still do *tame-zuki*. And so this tradition of the official paper being created by *tame-zuki*, which started way back when, continues to be. Originally all paper was made only with the *tame-zuki* method and gradually over time the *nagashi-zuki* started up among the common people, and the officials still used the *tame-zuki* method. And with *nagashi-zuki*, the way in which the raw materials are prepared becomes different. The word *naginata* beater came up, and that is something that is used to disperse the fibres.

P: Yes, I know, but that is from the swords. But there are also knives in there, but they are not sharpened very much, right? I understand there are still quite a lot of hollander beaters being used in Japan, but they take the ground-plate out sometimes.

AO: If it's *mitusmata* or *gampi* then it is not a problem, because the length of the fibres is between 3 and 5 mm.

And sometimes in paper there are other things besides fibre. In this particular *udagami* there is clay mixed with the fibres. And this is *misugami*; it is sort of rough, as you will see. Both of them have quite a large amount of clay in them. And this *Echizen* paper also has some clay. In this case it is very fine, so it is hard to tell. Sometimes you use calcium carbonate, but in the case of *udagami* they actually go up into mountains and dig out the clay. So it is very difficult to reproduce this anywhere else.

P: It could be used as a means of identification of a region.

AO: Probably you could.

This is a traditional Korean paper. In Japanese papermaking, when you dip the mould into the vat it is vertical this way, and so the threads go in this direction. However, the Koreans do it the opposite way. But this traditional Korean method of papermaking is seldom used. Most papermaking in Korea is done in the Japanese way. Are there any more questions then, before we move on?

P: Are you going to show us any papers that contain wood pulp? We have a Chinese art-supply store in Melbourne, Australia, and all the Chinese papers, even the very expensive ones, have some wood content in them. Is that also often the case in Japanese papers?

AO: All the papers that are displayed today are handmade. When you get into machine-made papers there is almost always some wood-pulp content. Don't you have good handmade paper in Australia?

P: Yes, we do, but this was just Chinese papers and I was surprised. They had a paper called cloud paper. It was very fine, quite expensive, about $10 a sheet or something, and it was all wood.

AO: Is there anything you brought with you that you would like me to look at, or we could look at these? When I look at samples under the microscope on glass slides, I have two different methods. One is heating it first and drying it out and the other is without heating it. However, if there is rice in the paper and it is heated, it will start to cook.

I'll take a moment here to prepare the samples. These are *Tosa washi*. Kōchi is the area of Japan where I come from and this is a sample of papers from this area. You might find something here that has wood pulp in it. Tosa is the old name for the Kōchi region, before about 1850.

The C stain is applied to the sample and it has not been heated. This sample is a piece of the Hiroshige woodblock print. And so you will see a lot of small dots, which are the rice.

Now we are looking at the sample that has been heated. It is the same paper but it has been treated with heat, and you will find that the colour is a little redder.

P: And this is a *kōzo* paper?

AO: Yes, it is *kōzo* and rice. When you add heat it becomes an alpha starch and it basically cooks it, and that is why you get the different colouring.

I am now preparing a slide with *gampi* paper which has clay in it, which was used to prepare the gold leaf, as we discussed. When you add the C stain to *gampi*, as a rule you get a blue colour. And clay would only show up as if the surface is slightly dirty. You can't really see it. So this is *gampi*. Now if you would like to come and have a look at it . . .

It is kind of difficult to see in this one, but if you want to see the clay in it, it is much easier if you dry it out. So this is the dried one and then this is with the stain. It is hard to get it focussed. Every time we change the slide it takes a little while to adjust, so to save time what we are going to do is go through the wet version first with the stain and then you can come back and look at the dry one. *Gampi* with clay — so now it is dried and heated so that it will be easier for you to see the clay in it. When you put the liquid in it, it is hard to see the clay. And in cases like that, if you then look at the dried version, it is easier to see the clay.

The next piece of paper that is going to be viewed is over 1,000 years old. It's called the *Senpuku-ji okyō*. Senpuku-ji is a temple in Japan. It is a remnant of a burnt piece of paper on which was originally written a Buddhist prayer. *Okyō* is the word for Buddhist chants or prayers. Most of it was burnt, but we will look at a portion of what remained. It is made of *gampi* which was dyed yellow, or just unbleached, and *kōzo* which was dyed blue with indigo; the two were put together to create a lovely subdued green colour. This is the piece of paper and it will be sitting in the box next to the slides if you want to look at the large piece first and then look at it under the microscope. And this is a dry sample. The wet one is in the process of being made, so right now it is a heated, dried sample.

Usually when people talk about Japanese vellum they are referring to *gampi*. Two years ago I had the occasion to look at some Rembrandt prints at the Victoria Museum in Australia. And of the 11 prints, 5 of them were on *gampi* with rice powder in it. Someone did some research into this and the papers were probably papers that were taken from Japan, from Nagasaki, by the Dutch East India Company in 1642 — around '42, '43 — to Europe and to Holland. And the reason why is because they took this predominantly for writing on, because *gampi* paper did not bleed, so therefore it was ideal for writing with fairly wide pens and it wrote very smoothly. So, in fact, they probably didn't take it to be used for making prints but rather to be used for high-quality writing paper. And if you write on *kōzo*, then the pen will probably catch and the ink — because of the type of pens they had — would probably bleed out into the paper.

Gampi as a general rule turns blue. If the *gampi* has not been cooked sufficiently, then it will turn green, but as a general rule it turns blue. And you also have to learn the shape of *gampi* as well. You can't only use colour to identify the fibres.

P: Can you identify the different types of *kōzo* under the microscope?

AO: It is very difficult. Strictly speaking, *kōzo* is only from Japan and the others are called *kajinoki*, from Korea or China, but they are very difficult to identify. If there is someone who would like to do research into a method of identifying the different types of *kōzo*, I would be delighted to provide you with some samples.

P: If there is a certain difference, it would be useful for us to recognize in conservation.

AO: If you look at the raw materials, you could tell. The best thing is to have a sample of good-quality *kōzo*, and if your eyes are used to seeing good *kōzo* all the time, then you will know when you see paper that is not as good.

P: How long the will the C stain last if it is kept in the dark?

AO: We need a lot of this C stain, so we make maybe about 500 cc of it at one fell swoop and then it will last about a year.

P: In the dark?

AO: We wrap it in foil and put it in the fridge.

As we have run out of time, I am afraid we will have to bring it to a close. I have given you all samples of the various papers. Please take advantage of this opportunity to tear off some pieces and look at them under the microscope for yourself. Thank you very much.

JO: Thank you, Mr. Ōkawa, for a very interesting afternoon, and thank you, Deirdre and Kayoko, for your help.

Appendix

From TAPPI T 401[2]

Graff "C" stain: prepared "C" stain may be purchased or it can be prepared from the following solutions using reagent grade chemicals and distilled water (4, 24):

A. Aluminum chloride solution of 1.15 sp gr at 28°C, made by adding about 40 g of $AlCl_3 \bullet 6H_2O$ to 100 mL of water.

B. Calcium chloride solution of 1.36 sp gr at 28°C, made by adding about 100 g of $CaCl_2$ to 150 mL of water.

C. Zinc chloride solution of 1.80 sp gr at 28°C, made by adding 25 mL of water to 50 g of dry $ZnCl_2$ (fused reagent grade sticks in sealed bottles, or crystals). Do not use $ZnCl_2$ from a previously opened bottle.

D. Iodide-iodine solution, made by dissolving 0.90 g of dry KI and 0.65 g of dry iodine in 50 mL of water. The KI and iodine are first thoroughly intermixed and crushed together. Dissolve by adding the required amount of water drop by drop with constant stirring.

Mix well together 20 mL of solution A, 10 mL of solution B, and 10 mL of solution C; add 12.5 mL of solution D and again mix well. Pour into a tall, narrow vessel and place in the dark. After 12 to 24 h, when the precipitate has settled, pipet off the clear portion of the solution into a dark bottle and add a leaf of iodine. Keep in the dark when not in use.

Graff "C" Stain Color Chart

A. *Groundwood: vivid, yellowish orange*

B. *Softwood pulps*
   1. Sulfite
      (a) Raw: *vivid yellow*
      (b) Medium cooked: *light greenish yellow*
      (c) Well cooked: *pinkish gray*
      (d) Bleached: *light purplish gray to weak red purple*
   2. High alpha
      (a) Unbleached: *very pale brown to brownish gray*
      (b) Bleached: *moderate reddish orange to dusky red*
   3. Sulfate
      (a) Raw: *weak greenish yellow*
      (b) Medium and well cooked: *strong yellowish brown to moderate yellowish green and dark greenish gray*
      (c) Bleached: *dark bluish gray to dusty purple*

C. *Hardwood pulps*
   1. Sulfite
      (a) Unbleached: *pale yellow green*
      (b) Bleached: *weak purplish blue to light purplish gray*
   2. High alpha
      (a) Bleached: *moderate reddish orange to dusky red*
   3. Soda, sulfate, and neutral sulfite
      (a) Unbleached: *weak blue green to dusky blue green and dark reddish gray*
      (b) Bleached: *dusky blue to dusky purple*

D. *Rag: Moderate reddish orange*

E. *Abaca* (Manila fiber)
   1. Raw: *light greenish yellow*
   2. Unbleached: *yellowish gray to weak blue and medium gray*
   3. Bleached: *Purplish gray color*

F. *Jute*
   1. Unbleached: *vivid yellowish orange*
   2. Bleached: *light yellow green*

G. *Straw, bamboo, bagasse, flax hurds, and esparto*
   1. Raw: *light yellow to weak greenish yellow*
   2. Unbleached and bleached: *light greenish gray to dark bluish gray and medium purplish gray*

H. *Japanese fibers*
   1. Gampi and mitsumata: *light greenish yellow to light bluish green*
   2. Kōzo: *pinkish gray*

Notes

1. Keyes, Keiko Mizushima. 1988. Japanese print conservation — An Overview. In *IIC Preprints of the Contributions to the Kyoto Congress, 19–23 September 1988*. London: IIC. 30–36.
2. Technical Association of the Pulp and Paper Industry. 1993. Fiber analysis of paper and paperboard. In *TAPPI Official Standard* T 401 om-93. 10–11, 13–14.

Looking at Paper: Evidence & Interpretation

PART 3: CONTRIBUTORS

Contributors

Bell, Nancy
After completing bookbinding training in the United States and Great Britain, Nancy Bell worked at the Bodleian Library, Oxford, before gaining further training at West Dean College. For the last six years, she has been Senior Conservator in charge of implementing programmes of preservation and conservation for seven college collections in Oxford. She has served as editor of *The Paper Conservator* and has recently acted as advisor to Loughborough University, charged with developing a model for auditing collections which will be used to develop a national preservation strategy.

Magdalen College
Oxford 0X1 4AU UK
Tel.: 44-1865-276059
E-mail: nancy.bell@magdalen.oxford.ac.uk

Bower, Peter
Peter Bower is a paper historian and forensic paper analyst specializing in the examination and analysis of papers for the purposes of dating, attribution, authentication and usage. He came to the analysis of paper from a papermaking background, and the practical experience of making sheets by hand for a wide range of uses served him well as his work evolved from production into analysis. In the late 1970s he began to collect paper and to analyse the particular properties of individual papers in order to make better paper himself. Peter is currently a Leverhulme Research Fellow at the Tate Gallery, continuing the historical and technical examination of papers used by J.M.W. Turner for drawings and watercolours, 1787–1851.

64 Nutbrook Street
London SE15 4LE UK
Tel.: 44-0171-7320125

Bunting, Victoria
Victoria Bunting earned a B.A. (*cum laude*) from Smith College in 1988 and an M.A. from the Williams College Graduate Program in Art History in 1992. She earned her M.A.C. in 1994 from the Queen's University Art Conservation Programme, where she specialized in paper conservation. After graduating she was a Fellow in Paper Conservation at the Freer and Sackler galleries of the Smithsonian Institution. Following this she was an Advanced Intern in Paper Conservation at the Straus Center for Conservation of the Harvard University Art Museums, and from 1996 to 1998 she was a Mellon Fellow/Assistant Conservator at the Museum of Modern Art. She is currently Assistant Conservator at the Northeast Document Conservation Center in Andover, Massachusetts.

18 Woburn Street
Medford, MA 02155 USA
E-mail: cbunting@massed.net

Burns, Thea
Thea Burns is Associate Professor and Paper Conservator in the master's degree programme in Art Conservation at Queen's University, Kingston, Ontario, where she has taught since 1987. She worked previously as paper conservator for the Montréal Museum of Fine Arts, the Canadian Centre for Architecture and the Queen's University/City of Kingston Archives and in private practice. Her educational background includes McGill University (B.A., first-class honours in fine arts), Queen's University (M.A.C.) and the Center for Conservation and Technical Studies, Fogg Art Museum, Harvard University (Certificate in the Conservation of Works of Art on Paper). She is at present about to complete a research degree on pastel painting at the Courtauld Institute of Art, University of London (Dept. of Conservation and Technology). Both Burns and Rosenfeld have received numerous awards and published widely in their respective fields. They have worked together intermittently from 1983 to the present on the technical examination and conservation of architectural master drawings and prints.

Art Conservation Programme, Queen's University
Kingston, ON K7L 3N6 Canada
Tel.: 613-545-2155
Fax: 613-545-6889
E-mail: burnsd@post.queensu.ca

Bustarret, Claire
Claire Bustarret is currently responsible for the programme *Techniques et pratiques de l'écrit* in the Institut des textes et manuscrits modernes (ITEM), Centre national de la recherche scientifique (CNRS), Paris, where she has been Assistant Director since 1998. She is also a correspondent of the International Association of Paper Historians for France. A specialist in modern codicology, she has worked on literary manuscripts and developed methodological tools such as databases (Profil, Muse) since 1990. She co-organized an international meeting on paper analysis with the Musée du Louvre in Paris in 1993. She has published several

articles on the use of paper by writers (e.g., *Genesis* 5, 1994; *Genesis* 10, 1996; and *Cahiers de médiologie* 4, 1997) and co-ordinated a special issue of *Word and Image* (13:2, 1997) on genetic criticism. Other fields of research include manuscript semiotics, writers' drawings (in *Language and Beyond*, Rodopi, 1998) and history of photography.

Centre national de la recherche scientifique
Institut des textes et manuscrits modernes
61 rue de Richelieu
75002 Paris, France
Tel.: 33-01-4703-8943
Fax: 33-01-4703-8940
E-mail: bustarre@ens.fr

Button, Victoria

Victoria Button obtained a History of Art degree from the University of East Anglia before commencing the Higher National Diploma in Paper Conservation at the Camberwell College of Art, 1989–91. She has been employed in the Paper Conservation Department of the Victoria and Albert Museum since 1992. Previously she was self-employed, conserving original artwork for the *Thomas the Tank Engine* series of children's books. Victoria spent 10 months on an exchange in Special Preservation Services at the State Library of Victoria, Melbourne, Australia, in 1998.

Paper Conservation
Victoria and Albert Museum
London SW7 2RL UK
Tel.: 44-0171-9388585
Fax: 44-0171-9388661
E-mail: vbutton@vam.ac.uk

Carton, Deborah

Deborah Carton received her B.A. in Art History at Villanova University. She attended New York University's Institute of Fine Arts Conservation Center, where she received an M.A. in Art History and Diploma in Conservation, specializing in works on paper. Her graduate training has included a final year's internship at the Brooklyn Museum of Art and will continue with an advanced internship at Harvard's Straus Center for Conservation.

301 East 45th Street, Apt. 19E
New York, NY 10017 USA
E-mail: dac207@is5.nyu.edu

Christie-Miller, Ian

Ian Christie-Miller, a former RAF pilot disabled in a flying accident, was awarded a Ph.D. at London University for his work on Jean Thenaud's sixteenth-century French kabbalistic manuscript. That research led him to develop the watermark-imaging device and its patented Four Images scanning technique. He is a part-time information technology teacher, contributes to the St. Andrews University sixteenth-century French Religious Book Project with bibliographical research at the British Library and is working with Professor Roudaut of Montpellier on the translation of his thesis into French for publication as *Introduction en la Kabbale* with Champion later this year.

The Dairy, Coldharbour Farm
Hundred Acre Lane, Wivelsfield Green
Sussex RH17 7RS UK
Tel.: 44-1444-471810
E-mail: ian@christie-miller.demon.co.uk

Dirda, Marian Peck

Marian Peck Dirda is a paper conservator in private practice. She graduated from the Cooperstown Graduate Program in Art Conservation, and has worked at the Library of Congress and the National Archives of the United States. She currently works in private practice at home, and on part-time contract in the National Gallery of Art paper lab.

1200 Woodside Parkway
Silver Spring, MD 20919 USA
Tel.: 301-589-6412
E-mail: dirdam@twp.com

Eagan, Jane

Jane Eagan obtained an Hons. B.A. in translation (French and English) at York University, Canada, in 1982. After working as a translator, she studied conservation at Camberwell College of Art, London, receiving her M.A. in 1995. She is employed as Conservator at the Oxford Colleges Conservation Consortium, Oxford, and has edited the postprints *IPC Conference Papers London 1997*.

Oxford Colleges Conservation Consortium
Magdalen College
Oxford OX1 4AU UK
Tel.: 44-1865-276059
E-mail: jane.eagan@magd.ox.ac.uk

Hills, Richard

Richard L. Hills' links with the history of papermaking originated in 1968 when the newly formed Manchester Museum of Science and Technology, of which he was the curator, accepted care of the British National Paper Museum collection. This comprised both exhibits and a library. Demonstrations of making paper by hand were soon arranged and proved to be very popular. He joined the International Association of Paper Historians and, after some years as a member of its council, became president in 1978, a position he held for 10 years. He was chairman of the British Association of Paper

Historians from 1988 to 1995. He has written numerous articles on aspects of paper history, and in 1988 he published *Papermaking in Britain, 1488–1988, A Short History*.

Stamford Cottage
47 Old Road, Mottram
Hyde, Cheshire SK14 6LW UK
Tel.: 44-01457-763104

Krill, John

John Krill is Senior Conservator, Paper, at the Winterthur Museum, and Adjunct Associate Professor in the University of Delaware/Winterthur Museum Art Conservation Program. He has been employed at Winterthur for 22 years and previously worked at the National Gallery of Art, Washington, DC, and the Baltimore Museum of Art. He is a graduate of the Conservation Center of the Institute of Fine Arts, New York University. He has been an active member in the International Association of Paper Historians (IPH) since 1974 and has been an advocate of the value of understanding paper history in the field of paper conservation.

Winterthur Museum, Garden and Library
Winterthur, DE 19735 USA
Tel.: 302-888-4716
Fax: 302-888-4838
E-mail: jkrill@winterthur.org

Maheux, Anne

Anne F. Maheux graduated from Guelph University in 1979 with an Honours B.A. in fine art and received a Master's degree in art conservation from Queen's University in 1981. She received a Certificate in the Conservation of Works on Paper from the Center for Conservation and Technical Studies, Fogg Art Museum, Harvard University, in 1982. Since then, she has been a conservator of prints and drawings at the National Gallery of Canada, Ottawa. She was made a Fellow of the American Academy in Rome in 1996.

National Gallery of Canada
380 Sussex Drive, PO Box 427, Station A
Ottawa, ON K1N 9N4 Canada
Tel.: 613-991-0009
Fax: 613-991-2680
E-mail: amaheux@gallery.ca

Mayer, Debora

Debora Dyer Mayer graduated from the University of Delaware/Winterthur Museum Art Conservation Program in 1982, with an M.S. in paper conservation. Her professional experiences include an internship at the Fogg Art Museum Center for Conservation and Technical Studies at Harvard University, Assistant Paper Conservator at the Conservation Center for Art and Historic Artifacts in Philadelphia and Associate Paper Conservator at the Winterthur Museum. Currently, Debora is the principal of a private paper conservation studio in Portsmouth, New Hampshire, and she is adjunct faculty at the University of Delaware, teaching fibre microscopy for the Art Conservation Training Program.

64 Cabot Street
Portsmouth, NH 03801 USA
Tel.: 603-433-7020
Fax: 603-433-7131
E-mail: Mayergrpnh@aol.com

Meredith, Philip

Philip Meredith is currently Head of the Far Eastern Conservation Center, Leiden, Netherlands. As a resident of Japan for 15 years, he trained and worked in the conservation of Far Eastern pictorial art at the studios of the Usami Shokakudo in Kyoto and carried out research into Japanese handmade papers and their uses.

Far Eastern Conservation Center
PO Box 212
2300 AE Leiden, Netherlands
Tel.: 31-71-516 8795
Fax: 31-71-512 8437
E-mail: fecc@rmv.nl

Miller, Elizabeth

Elizabeth Miller has worked at the Victoria and Albert Museum since 1979. She has been Assistant Curator of Prints in the Prints, Drawings and Paintings Department since 1990, where her chief concern is printmaking before 1800. She has organized displays on hand-colouring, eighteenth-century caricature, prints of the Raphael cartoons, the mezzotinter John Smith and, most recently, the newly discovered Lafrery volume. This year she is publishing a fully illustrated catalogue, *16th Century Italian Ornamental Prints in the Victoria and Albert Museum.*

Prints, Drawings and Paintings Department
Victoria and Albert Museum
London SW7 2RL UK
Tel.: 44-0171-9388612
Fax: 44-0171-9388612
E-mail: lmiller@vam.ac.uk

Mosser, Daniel

Daniel W. Mosser is Associate Professor of English at Virginia Tech and Director of CATH (Center for Applied Technologies in the Humanities). He is completing a *Catalogue of the Manuscripts and Pre-1500 Editions of the Canterbury Tales* and has published

'Witness Descriptions' on the *Canterbury Tales* Project's CD-ROM editions of *The Wife of Bath's Prologue* and *The General Prologue* (Cambridge University Press). Information about the project is provided on the Web (http://www.cta.dmu.ac.uk/projects/ctp/). Daniel Mosser is co-editor, with Ernest W. Sullivan II and Michael Saffle, of the recently published proceedings volume from the 1996 International Conference on Watermarks in Roanoke, Virginia (*Puzzles in Paper*, Oak Knoll Press). With Ernest Sullivan he is creator of the Thomas L. Gravell Watermark Archive (http://ada.cath.vt.edu:591/dbs/gravell/).

Department of English
Virginia Tech
Blacksburg, VA 24061-0112 USA
Tel.: 540-231-7797
Fax: 540-231-5692
E-mail: dmosser@vt.edu

Ōkawa, Akinori

In his position as Technical Manager at the Paper Technology Centre in Kōchi, Japan, Mr Ōkawa has developed the ability to analyse and reproduce exactly many varieties of early Japanese and other Asian papers. Since 1979, through workshops with conservators in Japan, his visits to China, Korea and Vietnam and in consultation with art institutions around the world, he has researched and been able to assist in the identification and treatment of over 1,000 works on Japanese and other eastern papers.

Kōchi Prefectural Paper Technology Center
287-4 Hakawa, Ino-cho
Agawa-gun, Kōchi Pref. 781-21 Japan
Tel.: 81-0888-92-2220
Fax: 81-0888-92-2209

Perkinson, Roy

Roy Perkinson obtained a Bachelor of Science degree in physics and philosophy at the Massachusetts Institute of Technology. Studio art training was received in the private atelier of Chapman Kelly in Dallas, Texas, and at the School of the Museum of Fine Arts in Boston. His Master of Arts degree in history of art was completed at Boston University. An apprenticeship in paper conservation under Francis W. Dolloff was done at the Museum of Fine Arts, Boston. He founded the Western Regional Paper Conservation Laboratory in San Francisco. Currently, he is Head of Paper Conservation, Museum of Fine Arts, Boston.

Museum of Fine Arts
465 Huntington Avenue
Boston, MA 02115 USA
Tel.: 617-369-3428
E-mail: rperkinson@mfa.org

Porck, Henk

Dr Henk J. Porck studied biochemistry at the Free University of Amsterdam. His Ph.D. thesis was a biochemical-genetic study in the field of anthropogenetics. In 1983 he was appointed conservation scientist at the Conservation Laboratory of the Koninklijke Bibliotheek, the Dutch Royal Library in The Hague. In 1991 he was also offered the curatorship of the Historical Paper Collection, one of the special collections of the Koninklijke Bibliotheek.

Koninklijke Bibliotheek
PO Box 90407
2509 LK The Hague, Netherlands
Tel.: 31-70-314 0572
Fax: 31-70-314 0655
E-mail: henk.porck@kb.nl

Price, Lois Olcott

Lois Olcott Price received her M.S. in art conservation from the University of Delaware/Winterthur Art Conservation Program. She worked at the Conservation Center for Art and Historic Artifacts in Philadelphia for 13 years, where she supervised the treatment of library and archival materials and directed the survey program. In 1994 she accepted the position of Conservator of Library Collections at the Winterthur Museum, Garden and Library, where she also serves as Adjunct Assistant Professor in the Art Conservation Program. Since 1991 she has pursued a long-standing research interest in the fabrication and preservation of American architectural drawings and plans to publish a monograph on her work.

Winterthur Museum, Garden and Library
Winterthur, DE 19735 USA
Tel.: 302-888-4600
E-mail: lprice@winterthur.org

Reynard, Pierre Claude

Educated in France and Canada, P.C. Reynard now teaches early modern European history at the University of Western Ontario. The focus of his research is economic history and, in particular, the papermaking industry. It offers rich evidence of various aspects of pre-industrial entrepreneurship, such as sub-contracting networks, maintenance patterns and relations with the state.

Social Science Centre
University of Western Ontario
London, ON N6A 5C2 Canada
Tel.: 519-679-2111 ext. 4988
Fax: 519-661-3010
E-mail: preynard@julian.uwo.ca

Rischel, Anna-Grethe
Anna-Grethe Rischel became a member of the Conservation Department staff at the National Museum of Denmark in 1980, and since 1993 she has been the head of the Paper, Leather and Textiles Section and is also a member of the Conservation Department Board. Her educational background includes four years at the Technical School of Arts and Crafts, ten years as a private textile designer and three years' training in paper conservation at the Royal Danish Academy of Fine Arts School of Conservation. She gained a diploma as paper conservator in 1991 from the School of Conservation with an analytical project on oriental paper, and has continued projects in this field.

National Museum of Denmark
Conservation
PO Box 260, Brede
DK-2800 Lyngby Denmark
Tel.: 45-33-473302
Fax: 45-33-473327
E-mail: anna-grethe.rischel@natmus.dk

Rosenfeld, Myra Nan
Myra Nan Rosenfeld was Senior Research Curator at the Canadian Centre for Architecture in Montréal from 1985 to 1999. Previously she taught art history and the history of architecture and urbanism at the University of Washington (Seattle), the College of Environmental Design at the University of California (Berkeley), McGill University and the Université de Montréal. From 1974 to 1983 she was Research Curator and Curator of European Paintings at the Montréal Museum of Fine Arts. Dr Rosenfeld was educated at Sarah Lawrence College (B.A.), Columbia University (M.A.), Harvard University (Ph.D.) and the Institut d'art et d'archéologie, Université de Paris-Sorbonne. Both Burns and Rosenfeld have received numerous awards and published widely in their respective fields. They have worked together intermittently from 1983 to the present on the technical examination and conservation of architectural master drawings and prints.

1520 Avenue Docteur Penfield, #24
Montréal, Quebec H3G 1B9 Canada
E-mail: mrlittle@sprint.ca

Schenck, Kimberly
Kimberly Schenck studied paper and photograph conservation at the University of Delaware/Winterthur Art Conservation Program and received additional training at the National Museum of American History and the National Archives and Records Administration. In 1988 she joined the Baltimore Museum of Art, where she is now Paper Conservator. She has published articles on Hendrick Goltzius' use of grey ink, *cliché-verre*, inpainting materials for paper conservation and adhesives for photograph conservation, and has presented lectures on the photographic works of contemporary artists Mike and Doug Starn.

Baltimore Museum of Art
Art Museum Drive
Baltimore, MD 21218 USA
Tel.: 410-396-6341
Fax: 410-396-6562
E-mail: kschenck@artbma.org

Shep, Sydney
Dr Sydney J. Shep is the Printer and Research Fellow at Wai-te-ata Press, Victoria University of Wellington, New Zealand. The press is a centre for teaching and research in printing history, information technology and design, communication theory and cultural studies, as well as an active fine-printing letterpress, desktop and electronic publishing house. Dr Shep's research into the history of New Zealand colonial paper and papermaking is made possible by a three-year Marsden Fund grant from the Royal Society of New Zealand in conjunction with the Alexander Turnbull Library, the Humanities Society of New Zealand and Victoria University of Wellington.

Wai-te-ata Press
Victoria University of Wellington
PO Box 600
Wellington, New Zealand
E-mail: sydney.shep@vuw.ac.nz

Stratis, Harriet
Harriet K. Stratis is Conservator of Prints and Drawings at the Art Institute of Chicago. Her research is devoted primarily to the study of pastels, charcoals and the drawing techniques of nineteenth-century artists, including Odilon Redon, Edgar Degas and Mary Cassatt. She received her B.A. in art history and visual arts from Barnard College, Columbia University, and an M.A. in art history and Diploma in conservation from the Institute of Fine Arts, New York University. Most recently, she served as co-editor and is one of four authors of the newly published catalogue raisonné of the lithographs of James McNeill Whistler.

Art Institute of Chicago
Department of Prints and Drawings
111 S. Michigan Avenue
Chicago, IL 60603 USA
Tel.: 312-857-7662
Fax: 312-443-0085
E-mail: hstratis@artic.edu

Thompson, Ruby Reid

Ruby Reid Thompson is Archivist and Resident Associate and Music Representative at Clare Hall, Cambridge University, as well as Senior Music Adviser at Newnham College, Cambridge. From 1995 to 1997 she was Assistant Archivist in the Department of Manuscripts at Nottingham University, where she provided physical descriptions and analysed data from the Portland Collection. She presented the paper 'Watermarks and other Physical Evidence from the Portland Literary Mss' at the First International Conference on the History, Function and Study of Watermarks held in Virginia in 1996. Her in-depth research in English archives includes work at the Public Record Office, the British Library, Christ Church, Oxford, the Fitzwilliam Museum and Trinity College, Cambridge, as well as the New York Public Library. She holds a B.Sc. and M.A. (Music) from the University of Chile and an M.A. (Early Music) from Yale University.

The Archivist, Clare Hall
Herschel Road
Cambridge CB3 9AL UK
Tel.: 44-1223-332360
Fax: 44-1223-332333

Walsh, Judith

Judith Walsh has worked at the National Gallery of Art, the Worcester Art Museum, the Williamstown Regional Art Conservation Laboratory and privately in Portland, Maine. Her other area of interest is watercolour techniques of American artists, including Winslow Homer, Thomas Moran and Georgia O'Keeffe. She is currently Senior Paper Conservator at the National Gallery of Art.

DCL-PA
Paper Conservation Department
National Gallery of Art
Washington, DC 20565 USA
Tel.: 202-842-6443
E-mail: j-walsh@nga.gov

Woodward, David

David Woodward (Ph.D., University of Wisconsin – Madison, 1969) began his career at the Newberry Library, Chicago, as Curator of Maps and Director of the Smith Center for the History of Cartography. He returned to Madison in 1980, where he is currently Professor of Geography, editor of the multi-volume *History of Cartography* and a Senior Member of the Humanities Institute. His publications include 'The Analysis of Paper and Ink in Early Maps,' 1987; 'The Correlation of Watermark and Paper Chemistry in Sixteenth-Century Italian Printed Maps,' 1990; and *Catalogue of Watermarks in Italian Maps, ca. 1540–1600*, 1996.

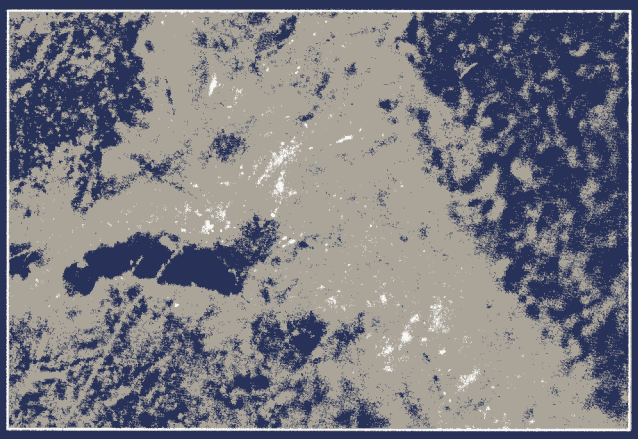
1443 Mound Street
Madison, WI 53711-2221 USA
Tel.: 608-262-0505
Fax: 608-263-0762
E-mail: dawoodwa@facstaff.wisc.edu

Yeh, M. Brigitte

M. Brigitte Yeh obtained her B.A. from Princeton University and an M.A. from the University of California at Berkeley in the field of East Asian art and archaeology before enrolling at the Conservation Center, Institute of Fine Arts, New York University, where she is a candidate for the M.A. in art history and Diploma in conservation. She completed her final year internship in the Paper Conservation Division of the Library of Congress and at present is an Andrew W. Mellon Fellow at the Art Institute of Chicago.

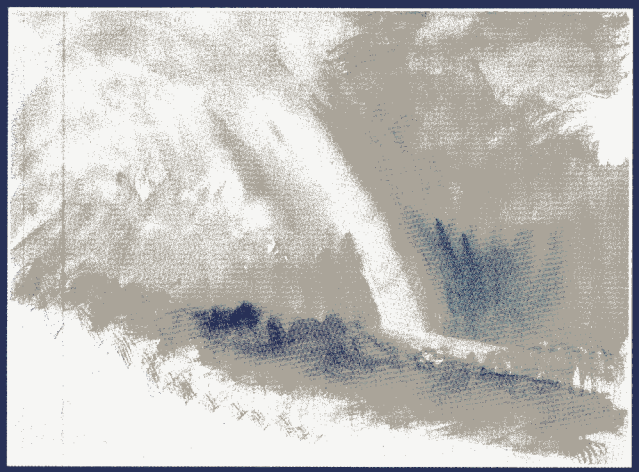
Art Institute of Chicago
Department of Prints and Drawings
111 S. Michigan Avenue
Chicago, IL 60603 USA
E-mail: mbyeh@alumni.princeton.edu

Canadian Conservation Institute
Institut canadien de conservation
Canada
ISBN 0-660-18571-7
9 780660 185712



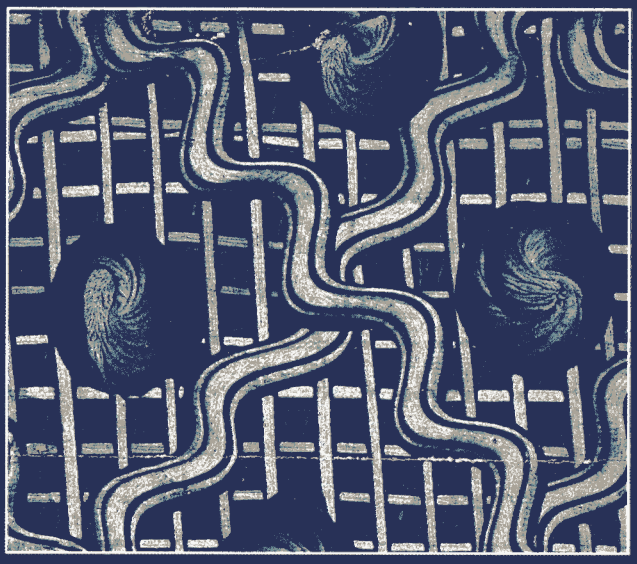
2. Surface detail of *Study of a Mourning Woman* by Michelangelo Buonarroti, showing a tear in the primary support and the blue paper underneath. This was discovered after separation of the papers. See page 238.

3. Thomas Girtin (1777–1802), *Okehampton Castle*, *c.*1797, graphite, watercolour and gouache on laid paper, Art Gallery of Ontario, Toronto. See page 218.



4. J.M.W. Turner (1775–1851), *Stormy Landscape with Rainbow*, 1824, watercolour on wove paper, Art Gallery of Ontario, Toronto. See page 221.

5. François Boucher (1703–70), *Young Country Girl Dancing*, *c.*1750, black, red and white chalks and stump on buff laid paper, Art Gallery of Ontario, Toronto. See page 223.



6. *Stijfselverfpapier (Herrnhuter papier)*/paste paper (Herrnhut paper). See page 198.