

INSTITUT D'HISTOIRE DU LIVRE



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*Paper and Watermarks as
Bibliographical
Evidence*



Lyon 2017

Princess Fiona: You didn't slay the dragon?

Shrek: It's on my "To do" list.

Shrek (2001)

The present second edition of *Paper and Watermarks as Bibliographical Evidence*, issued as a pdf. monograph for the benefit of readers who prefer books in a more traditional form, is identical, except for some distinctions in layout, to that published on line on the website of the Institut d'histoire du livre in Lyon in February 2017.

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Proem

This text is a bibliographical guide to texts and images relating to the history of paper and papermaking, mainly comprising the hand-papermaking period. Mechanical papermaking, beginning with the invention of the Foudrinier machine at the beginning of the Nineteenth century is briefly, but not exhaustively, treated. Its original purpose was to be included in the workbook of the eponymous course delivered at the École of the Institut d'histoire du livre in Lyon in 2009, and again in 2010, after which a “first edition” was published on the site of the IHL in the latter year.

In its conception and execution, it was intended as a sister, or possibly daughter, text to the older, and much more respectable: *Analytical Bibliography. An Alternative Prospectus*, written to accompany the IHL course on material bibliography and first published on their site in 2002, with revised versions in 2004 and 2006. For all practical purposes, it shares the purpose of the earlier work in being intended for a readership of bibliographers, and possibly even book historians, or anyone seeking ways of obtaining evidence from paper. Just a hint: it isn't easy!

In 2015 the return of a course on paper to Lyon suggested that the time was ripe for a “revised second edition”. Work began, but the author spent over much time fiddling and finding things out, and redoing previous research, so that this new version appears only in February 2017, through the good offices and patience of the IHL. To justify the wait, it ought to be pointed out that, whereas the first edition was comprised in about 70 pages, the present one amounts to over 150 and, for the first time, introduces illustrations. Given this same critical mass, to make genuine reading simpler, the whole text has been also set up in book form, as a pdf available for download.

A Brief but Necessary Premise

And yet here – he activated the *Guide* again – was his own entry on how you would set about having a good time in Bournemouth, Dorset, England, which he had always prided himself on as being one of the most baroque pieces of invention he had ever delivered.

Douglas Adams, *So Long and Thanks for All the Fish* [Part 4 of the trilogy: *The Hitch Hiker's Guide to the Galaxy*], 1984

A word of explanation about this *oeuvre* (*I use the word advisedly; chef d'oeuvre would be immodest*) might be in order, or even helpful, since anyone familiar with the website of the Institut d'Histoire du Livre knows (*well, should know, or if they don't know, they should nevertheless be nodding their heads as if they knew all too well*) that in *Analytical Bibliography. An Alternative Prospectus*, written to accompany the course on analytical (*or material or physical*) bibliography, first published by the IHL in 2002, with revisions in 2004, 2005, and 2006, Chapter 4, entitled 'Paper studies' contains some five pages expounding much the same subject [<http://ihl.enssib.fr/analytical-bibliography-an-alternative-prospectus/paper-studies>]. This same Chapter 4 has been cited in websites and other bibliographical resources (*such as the 2010 Oxford Companion to the Book and in the Wikipedia entry on 'Bibliography'*) as a source of information, which is dreamily flattering.

What – one might ask – is the relationship between that *oeuvre* and this *oeuvre*, which was written for the first edition of the course on 'Paper and Watermarks as Bibliographical Evidence' imparted at Lyon in 2009 and, after due revision was put on the site of the Institut d'Histoire du Livre in 2010? (*Since, after 2010, the course on paper was in abeyance, for reasons beyond my, or anyone else's, control, the text was not updated or revised in the short term, though I continued to gather material. This new version – mostly written in airports and railway stations, and over long, rainy weekends, but none the worse for all that – departs from an extensive revision begun in 2014, intended for a new edition of the course in June 2015 and intended to be put on the website immediately afterwards. "Intended" being the operative word. Perseverance, however, is my middle name and so in early, well, mid-to-late 2016, actually early 2017, it is here "published" as a Second edition. It maintains most of the structure of the previous version, albeit with some shifts to equilibrate chapter sizes, but adds a substantial quantity of new data, for the most part deriving from my own explorations of Medieval paper archives and printed artefacts, mainly Italian, of the Fifteenth and Sixteenth centuries.*)

But let's get back to the question. A good question; an honest question.

Apart from the blindingly obvious, but purely inconsequential, distinction that it is over twenty-five times longer, the answer, as far as it is possible to give an answer, is little or nothing, besides the incidental circumstance that both have been written by the same individual, deal with much the same subject matter, refer to the same bibliographical material, and are aimed primarily at the same students and scholars aiming to have a gorgeous gastronomic experience in Lyon (*make sure you try the andouillette with the mustard sauce!*).

I do confess, because I am a very truthful person, that my first intention was to cheat a little by taking the original Chapter 4 and amplifying it, just a trifle. This produced however a disastrous writer's block (*even academics get those*), which was only overcome by starting from scratch. The present is therefore a fuller and entirely different work, though not everything in the previous text reappears and some judgements have altered (*this does not mean that the previous text is outmoded or mistaken; in some ways it is a better piece of work and has the virtue of being twenty-five times shorter; on the other hand the outlook is dominated by the printing press, whereas here the question of paper, in all its purity and simplicity, is paramount*). In somewhat less than a decade therefore, as it completes its fourth or fifth or sixth cyclical revision, faster than Marvell's "vegetable love", it has grown to be vast.

Whether it is the least bit useful is not for me to decide.

One other thing you need to know. This work is not a guide, nor an explanation, nor an introduction to how paper is made at the vat or on a paper-making (*Fourdrinier*) machine, though the relevant processes and movements are explained in detail in the Lyon course (*whenever that gets held again*); it is instead a synopsis of the historical, bibliographical and critical discussion.

Writings about paper are a labyrinth, in which minotaurs of contrasting opinion frequently prowl, so this piece should be considered as an Ariadne's thread.

It divides into eight chapters, with some sub-headings, as follows.

1) *Introduction (or a Shot across the Bows)*. This is to explain what the other chapters are about.

2) *A History of Handmade Paper. The Basic Problem*. This gives a potted summary of the principal dates and events in paper history, although we do not actually know whether any of these dates are right; in fact most of them are probably wrong. The subheadings are:

- The Essential Early Chronology, or One Day, Somewhere, Long Ago, in China
- A Digression about the Forme: Floating or Dipping
- Paper Reaches the West
- Six Inventions that Lasted Six Centuries
- Dates, Mistakes, and Further Progress

3) *Renaissance to Eighteenth-century Accounts of Papermaking*. This is to say that if you have not read Lalande you have not lived.

4) *The Shape of Paper*. This tells you how to recognise paper sizes and formats; if you are looking for information about origami on the other hand, it is the wrong place to be. The subheadings are:

- Sheet-sizes and the Bologna Stone
- The Fifteenth-century, and Afterwards
- Unfolding Formats

5) *Dillying and Dallying with Watermarks*. This is self-explanatory and, like Marie Lloyd to whom it pays tribute, has subtly erotic overtones. The subheadings are:

- Watermarks: The Earliest Dates
- Watermarks. Names and Shapes, Ups and Downs, Lefts and Rights
- Countermarks, Cornermarks, and Other Extras
- Describing Watermarks
- Reproducing Watermarks
- Nomenclatures and Classifications of Watermarks

6) *Briquet and Switzerland's Contribution to World History*. This is to explain why Charles-Moïse Briquet is the greatest man in the history of Switzerland (*after William Tell and Roger Federer of course*). The subheadings are:

- Charles-Moïse Briquet. A Personal History
- A Tramway called Udine
- Using Briquet for the Better
- Briquet's Followers and Imitators

7) *Time-frames, Case Books, and the Value of Paper as Evidence*. This attempts to show that physical information derived from paper does have some practical use. The subheadings are:

- The "Runs and Remnants" Principle
- Just for the Record: Some Case Studies

8) *Bibliographical Annotations and Orientations*. This provides an unreliable and eccentric synopsis of writings about paper. Whereas as in *Analytical Bibliography. The Alternative Prospectus*, all the bibliographical indications were sort of mixed in with the text, albeit with a sort of dictionarial summing up in the final chapter entitled 'Devices and Desires' (*this signifies that I am an enthusiastic reader of P.D. James and I think it is a wonderful novel*), here all the bibliographical references are brought together in the final chapter, which therefore can be read as a completely separate unit. Or, alternatively, the previous seven chapters can be read in parallel with the bibliographical syntheses in the final chapter, which I agree is not always convenient, but it avoids encumbering the text.

A word of explanation about criteria. Books and articles are cited in conventional fashion and the only virtue of the citation is consistency. With older publications references are inserted to repertories such as the Incunabula Short Title Catalogue (ISTC), the English Short Title Catalogue (ESTC), the Italian census of Sixteenth-century books (Edit16), the analogous German censuses for the Sixteenth and Seventeenth centuries (VD16, VD17), since not all paper scholars seem aware of these resources, where to find them, or how to apply them. The existence of digital copies of the same publications is also referred to in an asystematic fashion, since the situation is in constant flux and expansion, while more recent books of the not-exactly-in-your-local-library variety are also indicated when I have spotted that a copy is available on line. Websites pose an analogous problem: they are cited where they appear useful and have substance, with the presumption that they are best found by googling rather than by giving an address.

The order followed corresponds, roughly but not faithfully, to the lay-out of the whole, but to help readers find their way the paragraphs are numbered and cross-references to the same have been provided in square brackets in the previous seven chapters, as follows:

- [0] Bibliography
- [1] General Introduction
- [2] China and Far Eastern Paper
- [3] Medieval and Modern Arab Paper
- [4] Medieval Western Paper
- [5] Renaissance to Eighteenth-century Descriptions and Images of Papermaking, and Manuals of a Later Era
- [6] Histories of Papermaking Districts or of Single Mills
- [7] Sheet-sizes and the Text of the Bologna Stone
- [8] Tables of Sheet-sizes
- [9] Knowing Formats
- [10] Papermaking Moulds, Watermark Patterns, and Twin Watermarks
- [11] Countermarks
- [12] Names and Dates in Watermarks
- [13] Tranchefiles
- [14] Telling Mould Side/Felt Side Apart
- [15] Wove Paper
- [16] Mechanical Paper
- [17] Papermaking Terminology
- [18] Watermarks, Briquet, and Other Repertories
- [19] Claims and Controversies about the Earliest Known Watermark
- [20] Seeing Watermarks
- [21] Naming and Describing Watermarks
- [22] Describing Unwatermarked Paper
- [23] Reproducing Watermarks
- [24] Artists, Artists' Papers, and Copperplate Printing
- [25] Music and Musicology
- [26] Maps and Cartography
- [27] Codicological and Manuscript Studies
- [28] Blockbooks, Incunabula, and the One-pull Press
- [29] The "Runs and Remnants" Principle

- [30] Analytical Bibliography and Case Studies (*Somewhat Autoreferential*)
- [31] Dedicated Collections of Paper, Watermarks, and Tracings of Watermarks
- [32] Other Sorts of Paper and Other Uses of Paper
- [33] Paper History and Paper Museums
- [34] Learned Societies and Associations
- [35] The World-wide Web (*if you can find it*)
- [36] Films, Videos, and Youtube.

The sheer scale of this final section, like a tail that wags its dog, shows the impossibility of making any bibliographical sense of the history of paper-making scholarship.

This work has been deliberately scribbled as a webtext. So, each and every unit is more self-contained than might be the case with a traditional monograph, the arguments are handled in a tight, snappy fashion, and the writing is as pithy and punchy as I can make it. The price of this approach is a certain repetitiveness, based on the assumption that no one is going to read the thing in its entirety and therefore each individual item has to be complete and self-standing. The other principal characteristic is that like Chesterton's "rolling English road", rather than an original architectural grand scheme, it has expanded through a series of infinite patches and changes and alterations, and, from the first version in 2009, has tripled in size, as well as becoming a record of my personal journey through the literature of paper-making. In the process, I have sought to keep the contradictions and the idiocies to a minimum, but I am also certain that plenty remain. My Reader, in *Jane Eyre* fashion, is someone perfectly at ease with English, but also able to cope with Latin, and smatterings of French, German, and Italian.

In other words I might just have written it for myself.*

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Chapter 1

Introduction (or a Shot across the Bows)

A knowledge of the processes by which paper is manufactured and of the substances of which it is composed has never, I think, been regarded as necessary to the bibliographer, however important it may be to the librarian, and it is no part of my intention to deal with such matters here. Of late, however, in consequence partly of the prominence which has been given to watermarks in certain bibliographical arguments, the subject of paper has received a little more attention, and it will probably receive still more in future.

Ronald B. McKerrow, *An Introduction to Bibliography for Literary Students* (1927)

Me, I prefer the world of Bull's heads and Heraldic Shields, of Basilisks, Mermaids, Dolphins, and Unicorns, especially when they are willing to go on the stand and testify for or against a bibliographic hypothesis.

Allan Stevenson, *Paper as Bibliographical Evidence* (1961)

Paper evidence is good evidence.

That's worth saying again.

Paper evidence is good evidence.

It does not require costly instruments or complex laboratory facilities.

This last fact happens to be important.

Serious bibliographers, especially those who understand and produce paper evidence, more often than not are impoverished, undernourished, and conduct their research on shoestring budgets. So, if paper evidence can be acquired at a cost that amounts to one's own time and effort, that is an advantage.

It is not however easy evidence to put together or to interpret and make sense of.

It calls for an extraordinary amount of patience, an excellent visual memory, an ability to assemble coherent information over long periods of time, and an inexhaustible love for the material object.

You have to work hard and long to make such evidence work for you. If you list the studies that spring immediately to mind for the way paper has furnished the key to the bibliographical demonstration, Greg on the Pavier quartos, Stevenson on the *Missale speciale*, ... well, the list is not so long that there is any difficulty in remembering it.

On the other hand there is nothing quite like paper and watermark evidence, or the scholar who is able to gather it in and make it say something.

It is a superior quality of hand and eye.

It comes punctuated with enigmatic, idiosyncratic phrases, symptomatic of a blandly unimpugnable one-upmanship, along the lines of "nice tail, shame about the face" (of some poor sweet little mermaid) or "it's never a dragon; look at the toes, it's a basilisk", knowing that only Harry Potter aficionados will be able appreciate the difference. It also means that obscure phrases in a novel such as *The Time Traveller's Wife* by Audrey Niffenberger (2003), in which the artist heroine couches paper, will become entirely clear.

And there are the cunning, crafty little tricks of the trade that reveal the true expert.

For instance, using a raking light to distinguish the mould or felt sides of the sheet as a preliminary to recognising and classifying the twin watermarks. For a further instance, knowing that there are twin watermarks. And for an even further instance, knowing that one of the twins is in the left-hand half of its respective mould and that the other is in the right-hand half, and knowing how to identify them on this basis.

And making it look so ever so easy-peasy.

All this seems horrendously abstruse and intricate to the neophyte, but in fact it is all ridiculously simple and unsubtle and straightforward, once someone has shown the hows, whys, and wherefores of everything. In the end it becomes a matter of habit, though it is never uninteresting, since even the most textually boring of books, printed on the hand-press without the slightest variant being introduced at any point, might be illuminated by grossly obese unicorns galloping down the chain-lines.

How does one acquire these very simple skills?

(Not for money, certainly. Love, especially of the stickier, smackier kind, on the other hand might ... ?)

The first and most important thing to have is a deeply enviable knowledge of the paper-making process. This knowledge has to be acquired from writings about paper-making, from the analysis of surviving sheets of paper, and, whenever possible, from watching someone actually doing it at the vat with a pair of moulds and a deckle. *(Be wary however of the demonstrations in the various paper museums scattered across the globe, since, as well as filling the vat with a porridge-like sludge, often a single mould is used at the vat, instead of alternating twin moulds, and various other sillinesses.)*

The second *(and even more important)* thing, especially when you are trying to bring paper evidence into codicology or bibliography, and thus are attempting to apply it to manuscripts or to multiple, printed artefacts, is to accumulate as much evidence as possible. *(Think for a long time before you set off down this particular primrose path: there is nothing more annoying and less titillating than partial, incomplete, unexciting, unconvincing paper evidence. You either give it the Full Monty or you keep your duffle coat tightly buttoned up.)* In other words, first you look at all the copies that you can go and afford to see, and next you find ways of getting someone else to pay for you to go and see the ones you can't afford to go and see. Paper research, even more than bibliography, in the words of Jean-François Gilmont, is always "une longue patience", so don't be in a hurry.

The third *(and yet more important)* thing is that paper evidence must never ever be taken in isolation. It has to be conjoined and dovetailed into the other sorts of evidence taken from the physical artefact, whether it is handwriting or the impressions from inked type, binding evidence, annotations by readers and all the miscellaneous, strange little snippets of evidence that a codicologist or a bibliographer learns how to observe, measure and record.

And this is the most tremendous fun.

Chapter 2

A History of Handmade Paper. The Basic Problem

The problem of identity is ever with us. I am afraid that many people have used the phrase ‘the same watermark’ without any clear idea of what it should mean. A common example which turns up in book descriptions is: “This book has just one watermark throughout”. If this sentence merely means that the marks are similar, that they belong to the same type, the description should say that. If it means that all the paper in the book was made on the same mould, then the writer of the sentence probably does not know what he is saying.

Allan H. Stevenson, *Observations on Paper as Evidence* (1961)

“I think the problem, to be quite honest with you, is that you’ve never actually known what the question is”.

Computer “Deep Thought” in Douglas Adams, *The Hitch Hiker’s Guide to the Galaxy* (1979)

The basic problem is all too simple. (*I hope we are not going to have too many of these titles banged in just for effect ...*).

The basic problem is that paper is a vast, vast phenomenon.

Some scholars have speculated about how many sheets of paper might have been made in the history of civilisation. But any number becomes too impossibly big to comprehend. And who cares anyway? When you start to joust with one or more pairs of watermarks in your own personal bibliographical combat, the scale of the universe becomes a very secondary problem.

From its first introduction – exactly when, where, and by whom we do not know, which is a nice simple historical fact, but some two thousand years and more ago in China is as good a time and a place as any – up to the present day, paper has been the principal vehicle for any and all texts mankind has wanted to communicate and keep. It has had its rivals of course, but has usually seen them off ignominiously. Clay tablets, which are sometimes round egg-shaped objects, beat everything else for resistance, but don’t hold much text and are cumbersome when you move house. Its ancient Egyptian counterpart, papyrus, is flimsy and has to be kept in rolls. Its most serious contender has been parchment (*or vellum, if, and only if, we are talking about calfskin*), an extremely durable material, but difficult to print on, whose utility and effectiveness is further limited by its scarcity, its cost, and by the fact that it can be difficult to store (*if allowed to warp by being placed upright, a medieval manuscript will rip a fancy bespoke modern binding apart in a matter of generations*). Celluloid, as in photographic negatives, film reels and microforms, seems to have had its day, while electromagnetic supports ... well, apart from the fact that the technology seems to hoppity-hop along rather too often for comfort (*so that instead of being able to read one’s collection of floppies and CDs on the latest generation of computers, you can moan to your offspring – or rather have them explain – about the concept of built-in obsolescence, which includes you*), their ability to subsist for more than a handful of years is very much open to doubt. Of course you can pop it into the cloud, but who is going to find it there? The loss of a password can make everything disappear.

So, for ubiquity, convenience, resistance, endurance, strength, cost, texture, pleasingness, delicacy, perfume, and softness, paper has no rival.

But the brutal scale of the phenomenon is also a challenge (*one that most scholars have preferred to decline*). Except perhaps for buildings (*but then again how many of those have not been thoroughly mucked around with in the interim and have reached us in an unadulterated state?*), hand-made paper is the artefact from the Middle Ages, Renaissance, and Early Modern period that has come down to us in the greatest quantity (*and is much more interesting than potsherd*s). Apart from the ancillary circumstance that most of it has been written on or printed on (*or both*), this paper is often in pristine condition and only in a few cases

has been messed up by restorers. Of course what has survived is only a minuscule proportion of what was made at the time: differently from other supports, paper is easily recycled through pulping and remaking in a slightly inferior quality, and it has other secondary uses (*an indescribable amount over the centuries has satisfied mankind's seriously serial physiological needs and thus has vanished into cesspits and sewers: soft-toilet paper was being made in China as early as the Fourteenth century, but in the West paper specifically for use in the water-closet was first manufactured and marketed by Joseph Gayetty in 1857; toilet-rolls followed in the 1890s. Did we need to know this? no, but it is interesting*).

What has scholarship done therefore to place paper studies on a proper footing? The correct answer is (*virtually*) nothing. It remains a scholarly S.E.P. (*Someone Else's Problem, but don't you hate unnecessary acronyms?*). Since it involves just about everybody, it is up to everybody (*else*) to do something about it. And this sort of attitude gets nobody nowhere in no time whatsoever.

If the most obvious place to start is at the beginning, at least as far as Western Europe is concerned, outside the venerable pages of Briquet, it is more than a trifle absurd that no systematic census has been conducted (*or is being conducted*) of early watermarked paper in order to denominate and describe material produced up to 1300, when Dante went on his little walking tour through the realms of Hell, Purgatory and Heaven. Why is this the case? One reason is that Briquet did the job so superlatively that it is difficult to improve on what he achieved, however incomplete that now seems. Another is that there is too much of the stuff. Yet another is that it is kept for the most part in inconvenient places, such as the archives of numerous small cities, mostly in Italy, also in France, where even specialist curators are rarely interested in paper. And yet another again is that palaeographers are somewhat snobbish and consider paper less interesting and important than parchment, which is absurd, since paper could tell them a great deal, if they were willing to learn (*which for the most part they are not*).

If we take the next benchmark down the chronological line, or the year 1400 (*just to get our literary bearings, the year of Chaucer's death*), the quantity of material surviving, still mainly in Italy, but also elsewhere in Europe, often on Italian paper exported at the time, becomes truly daunting, especially if we add a significant number of dated or datable manuscripts in libraries all over the world, which are not always easy to examine.

As for the Fifteenth century, which ends on Thursday, 31st December 1500 (*thus allowing everybody to take a long weekend*), well, don't even think about it, since printed books now come into the equation and they are nothing but trouble.

One essential fact about paper has to be remembered, though it is all too easily and too often forgotten. Just about everything we say about the whole wonderful subject, all the chronological and topical coordinates (*that means when and where*), rarely derive from the substance itself, but from what has been written or, more latterly and laterally, printed on the same. The consequential hypothesis, all too rarely voiced, is that in terms of the time and the place, the paper was made reasonably close to where it was used. As a general assumption, it is absolutely splendid; as a specific assumption, it bristles with danger.

The picture, any picture, every picture, of the way paper is brought in and used to create a record or a text, whether in a municipal archive in the late Middle Ages, or in a printing shop with the Renaissance in full swing, or in the manuscripts of an Eighteenth-century writer, has to be built up with reference to as full a context as possible. It also has to decide at what level the analysis is going to be conducted. In certain lines of research it is necessary to recognise individual watermarks, or rather the twin individuals characterising the two moulds employed in alternation at the vat and sometimes even different states of these watermarks; in others, especially when we are dealing with printed artefacts extant in multiple, widely dispersed copies, it is enough to identify a particular purchase of paper, where the watermarks set one supply apart from another, without going to all the hassle of establishing twinship; in yet others, especially when dealing with cancels and forms of substitution in printed books, the emphasis falls on other features, such as the distinction between the mould/felt sides of the sheet or the pattern made up by the distribution of the watermarks.

So, as ever, Forty-two may well be the correct answer, but that is no help if you don't know what the question is.

The Essential Early Chronology, or One Day, Somewhere, Long Ago, in China

If you flick through any sort of standard history of the book over the millennia (*probably not a good idea, unless it is a wet Sunday afternoon and you have plenty of time on your hands*), looking for information about paper, the same basic dates always pop up. The cute thing is that they are mostly wrong, or at the very best

incredibly misleading. So what follows is akin to reconstructing the universe from a piece of fairy-cake.

Traditional Chinese sources attribute the invention of paper to Cai Lun (or *Ts'ai Lun*, or some other spelling), a eunuch of the imperial court (63-121), sometime around 105 A.D. To be more exact, such is the date at which the discovery was formally reported to the court and officially adopted; experimentation had been going on for some time previously, at least a couple of centuries, since archaeologists have made solidly-grounded claims for much earlier dates on the basis of scraps of paper discovered in tombs. The main source for Cai Lun's life and achievements is a chronicle compiled in the Fifth century by Fan Yeh as the official record of the Han dynasty, at least three hundred years after the event. It is a reasonable guess therefore that a trifle, and more, of historical rewriting took place, so that what was most likely an anonymous invention, developed over time by a number of different people, could be attributed to a figure at the imperial court, allowing them to grab the glory (*and this, of course, is just what happened*). Even more intriguingly, by the by, Communist, or post-Communist China, through its Ministry for Light Industry, has sought to discredit the archeological discoveries, on the grounds that this would imperil the genius status of Cai Lun (*with effects akin to throwing away a boomerang*). Such anti-historicism might appear absurd, but of course in Europe there have been plenty of analogous squabbles for issues of municipal or national pride, such as Coster vs. Gutenberg.

Knowledge of the discovery slowly moved westwards, along what would later be known as the Silk Road (*the term itself, in German Seidenstrasse, was first coined in 1877 by the geographer Ferdinand von Richthofen, who – what's in a name? – was the uncle of the "Red Baron", Manfred von Richthofen, the First World War flying ace*). Here account has to be taken of one of the most extraordinary discoveries in the history of archaeology. The Mogao caves, or grottoes of the Thousand Buddhas, are a complex of 492 temples, mostly dug into the rock, near the Chinese city of Dunhuang. In one of these, now known as the Library cave (n. 17), in June 1900 a Taoist monk called Wang Yuanlu (c. 1849-1931), banging his pipe against the wall of the neighbouring shrine, heard an echo and uncovered a wooden door, behind which was hidden an enormous cache of documents: the current estimate is 1,100 bundles of scrolls and some 15,000 paper books [2]. The latest date recorded in the documents of the collection is 1002 A.D. The most widespread, and even sensible, interpretation is that the library was sealed up to protect it from an external threat and forgotten about for nearly nine centuries. After its discovery, some manuscripts were gifted to local dignitaries by the monks and the news soon reached the ears of the "foreign devils", as Western travellers in China were flatteringly known. First on the scene was the British archaeologist of Hungarian origin, Aurel Stein (1862-1943), who in 1907, with a mixture of threats, cajolery and bribery, was allowed to take some 9,000 documents, which, not being able to read Chinese, he chose mainly on the basis of their physical condition, and an assortment of art works. In 1909 these were bestowed on the British Museum in London and Stein was rewarded with a knighthood. In 1908 he was followed by the French professor of Sinology at Hanoi, Paul Pelliot (1878-1945), who obtained some 1,500 items, chosen on the basis of their textual quality, which in 1910 made their way to the Bibliothèque Nationale in Paris. A Japanese mission in 1912 obtained a further 400 scrolls for the National Diet Library in Tokyo, a Russian one followed in 1914, while the remnants of the collection were brought to the National Beijing Library in the 1920s. Any count of the documents has to take account of numerous fragments, since the walled up cave seems also to have served as a deposit for sacred waste. The looting or safeguarding of the library (*as with the Elgin marbles*) is a controversial issue: on the one hand the discovery would probably have been completely dispersed by the monks of the time, or destroyed in the troubled history of the area (*in the 1920s the caves were occupied and vandalised by White Russian soldiers*); on the other the loss of the collection to foreign libraries all over the world is a grievous one for the history of Chinese culture.

Among the materials procured by Stein is the Buddhist Diamond Sutra, which is one of the oldest, securely dated documents on Oriental paper, which scores double points by also being the oldest dated extant example of printing, made in 868 A.D. (*well, to be more exact, the woodblocks with which it is printed have the said date in the colophon, which actually reads "reverently [caused to be] made for universal free distribution by Wang Jie on behalf of his two parents on the 13th of the Fourth moon of the Ninth year of Xiantong [11 May 868]; so, as with all printing done from blocks or from stereotyping, the impression of the document itself might have happened at a later date*), and triple points by being the oldest dated printing to contain an illustration. It is formed from seven pieces of paper, printed on one side, and stuck together to make a scroll over five metres long, which can now be unrolled and electronically perused on the site of the Dunhuang project hosted by the British Library (*well worth doing*) [2].

What the discovery of the Mogao cave library shows is the existence of a vast culture of manuscript and printed documents, which otherwise has been lost without trace, while the other lesson to be learned from these early survivals is that Chinese civilisation did not consider paper primarily and exclusively as a writing

material, but recognised its use as multiform, as wrapping paper, toilet paper, and the infinite other uses it has in our own time (*One Chinese chronicle, written in the Seventh century A.D., mentions the existence of tea bags, or at least bags to store tea, which might explain the stale taste of some British motorway café cuppas*).

The next date that invariably pops up in histories of paper, even quite respectable ones, is 751 A.D., as a consequence of the battle of Talas between the Chinese Tang dynasty and the Arab Abbasid Caliphate. The actual site of the battle is not known, but it was somewhere on the Syr Darya (or Talas) river, which at the time flowed into the Aral sea. Victory allowed the Arabs to return to their base at Samarkand with captured Chinese papermakers, who were induced to reveal the secrets of their trade (*best not to think about how the inducing actually happened*). The problem is that the whole account is provided by an Arab historian, 'Abd al-Malik al-Tha'alibi, writing some three centuries after the event in a work entitled the "Book of Curious and Entertaining Information", or a medieval chronology. Where did he get his facts from? Of course he does not tell us and it is quite possible that the anecdote was made up to explain the flourishing industry in Samarkand in the author's own day. There is in fact evidence that paper, and perhaps even papermaking, were known in the area previous to the battle of Talas. For instance, Arab merchants travelling in China communicated with their base in Samarkand through letters written in Sogdian, or the *lingua franca* of the Silk road, of which some were on Chinese-made paper: a packet of such letters, dated 313 A.D., was discovered in 1907 in a ruined watch-tower near Dunhuang. Similarly, driven out by Arab invaders, the last king of Panjakent retreated to the fortress of Abargar on Mount Mugh, about 130 km East of Samarkand, where he died in 722 A.D.: a cache of 76 documents from the royal archive, of which 22 on imported Chinese paper, were discovered by a Russian expedition in 1933 and published thirty years later.

A further fascinating, albeit slightly later, reference to papermaking technology in the region is a fleeting mention in the *Kitab al-Jamahir fi al-jawahir*, or "Book Most Comprehensive of Knowledge about Precious Stones", by the great Medieval Islamic scholar, al-Bīrūnī (973-1048), who, in a discussion of hydraulic mechanics, talks about stones "fixed to axles across running water, as in Samarkand with the pounding of flax for paper". The fact that he considers the industrial process to be so well known as not to merit further explanation suggests that the sight was a common one.

What is certain is that a knowledge of paper and papermaking methods was spreading through the Arab world from the Eighth century onwards. Although the importance of Islam as a filter between China and the West should never be underestimated, the only real innovation of the Arab world was the substitution of rags for the mulberry bark and other bast fibres employed in the far East. The first great centre was Baghdad, where – according to encyclopaedist Yaqut, writing a mere five centuries later, and thus not entirely reliable – during the reign of the munificent and unforgettable caliph, Haroun al-Rashid, a papermaking factory was established in 794-795 (*again this date has become canonical, but the documentary basis is slender*). Afterwards factories and shops, taking advantage of the plentiful water supply afforded by the Tigris, seem to have proliferated, while the availability of this new, relatively cheaper, writing material led to a sort of cultural, or at least literary, explosion (*to the extent that things got written down*). The oldest dated manuscript written on Arab paper currently extant was produced in 848 A.D. and was discovered comparatively recently in the Regional Library at Alexandria (Egypt). It is followed by a codex in Leiden University Library, dated 866 A.D. (Cod. Or. 298), while a Greek manuscript, now in the Vatican Library, ms. Vat. Gr. 2200, was probably copied in Damascus sometime around the year 800 A.D. and is plausibly the oldest known document in a Western script on Arab paper.

By the Tenth century papermaking in Egypt had ousted the traditional papyrus industry, which wholly disappeared and had to be reintroduced in the Nineteenth century. Obtaining rags became a major business, with some nasty stories about linen wrappings being recycled from mummies (*as long as Hollywood doesn't get hold of this, I don't mind what happens*). Almost all this material has disappeared or has survived by pure chance. A few exceptional discoveries, however, have been made. In 1881-82 excavations in central Egypt, around the towns anciently known as Arsinoe or Crocodilopolis (*nowadays Faiyum, or El-Faiyūm*) and Heracleopolis Magna (*an abandoned site some 15 km West of the modern city of Beni Suef*), uncovered thousands of bits of fabric and 10,000 written documents on various supports, which were obtained by the antique dealer and carpet trader, Theodore Graf (1840-1903). He duly sold the written materials a couple of years later to the Archduke Rainer of Austria, who in 1899 donated the collection to the Imperial Library in Vienna. Although the prime interest was for the older documents on the more traditional support, papyrus, a significant number of items were on paper and stimulated the ground-breaking studies of the library's director, Joseph von Karabacek [3]. These were added to over time, so that today's Papyrussammlung in Vienna holds some 16,000 examples of Medieval Arab paper. Another equally extraordinary discovery happened around the same time in Cairo. In Jewish synagogues any document containing the name of God,

or more simply written in Hebrew, the language of God, could not be destroyed or thrown away, so they were accumulated in a storeroom known as the Geniza. Generally they were disposed of in a ritual burial, but sometimes this did not take place, meaning that the pile simply grew through the centuries. The best known instance is the cache of approximately 280,000 items discovered in the Nineteenth century at the Ben Ezra Synagogue in Old Cairo, covering a period mostly between 1002 and 1266. Again discovery meant dispersal, so that the largest single nucleus is nowadays in Cambridge University Library, comprising some 193,000 fragments [3]. The Geniza documents are on a variety of supports, including parchment and paper, but perhaps due to their fragmentary status and the immense difficulties in dating have received little attention as physical documents.

Chronicles and other documents show that by about the year 1000 papermaking as an industry had spread along North Africa and reached Arab Spain. Famously the Arab historian El-Edrisi in about 1150 praised the paper made in Xativa, mid-way between Valencia and Alicante (*rather annoyingly a lot of histories of the book and the ilk talk about papermaking being first introduced in Spain at the said date, but, from what El-Edrisi says, production is well established*).

Now here comes the rub. Dated manuscripts written on Arab paper are relatively few and on account of their antiquity very jealously guarded by libraries. As well as the wear and tear of time, one reason for the extreme rarity of Spanish Arab manuscripts is the *reconquista* in 1492, during which ensued a cultural genocide in which books and other testimonies of the scale and depth of Islamic civilisation were systematically torched. Paradoxically one of the largest collections to have survived is in the Vatican Library.

A Digression about the Forme: Floating or Dipping

Here it is necessary to digress somewhat, in order to explain that in primitive, and by “primitive” I mean “very primitive”, papermaking there were two fundamental techniques and technologies.

The oldest was the floating mould, in which the container was placed on the surface of the water and the pulp was ladled or poured into it and smoothed out. A floating mould obviously cannot employ a metal mesh, and has to be made of a light wood, such as bamboo, since otherwise it would sink. Floating moulds were not supported underneath by rods, since making the sheet did not involve the sharp lift that is typical of the dip mould. On the other hand the openings could not be too large, because otherwise fibres would be lost into the water. So the surface of the mould was formed by a rough cloth, such as calico, drawn as tightly as possible. When the sheet was made, the cloth bellied slightly, but not enough to create an uneven sheet, after which it was lifted out and the mould was put to dry in the sun, which on a hot day can be a matter of minutes. One feature, therefore, that identifies such a mould is being able to see the imprint left by the fabric on the mould side of the sheet of paper. Floating moulds were, and still are, used in Oriental papermaking, but they have the disadvantage that, if the papermaker is going to maintain a steady daily output, a large number of individual moulds is called for, though of course this does not represent a significant expense. On the other hand the floating mould has several advantages: it is low-cost in terms of materials and technology, since it can be used in the open air, on the edge of a stream or a pool (*though more permanent structures obviously progressed to a purpose-built vat*), and it requires small amounts of pulp, which is a consideration when the fibres have to be hand-beaten. It is also possible to employ this technique to make very large sheets of paper, by constructing an appropriate mould and eventually using several people to lift it out of the water. In his trips to Korea and China in 1933, to Siam in 1935, and to India in 1937-38, Dard Hunter found floating moulds still being employed and documented them photographically, as well as bringing back examples for his paper museum, now in Atlanta [33]. I have a sneaking suspicion, on the other hand, that their existence was prolonged, or renewed, by hippy culture in India in the 1970s, since the unsophisticated technology and the lack of skill required allowed footloose westerners to improvise laboratories.

The other sort of mould is the dip version, in which the sieve is plunged into a vat containing the fibres diluted in water and lifted out again. In terms of the general method, a vat specifically for this purpose had to be constructed with masonry and filled with a large quantity of water and pulp, some of which necessarily went to waste. On a dip mould, an unsupported cloth surface would belly and create a very uneven sheet of paper; if on the other hand it were held up by rods and the equivalent of wires, the pulp would have difficulty in draining. The Chinese therefore constructed the mould in a completely different fashion, from an early date, certainly by the second century A.D., by laying thin strips of rounded bamboo side-by-side and tying them together with threads of flax, silk or animal hair, leaving the equivalent of the mark of a chainline on the surface. As regards the subsequent problem of removing the sheet from the mould, there were two potential solutions, depending on whether the sheet was dried on the surface or immediately couched. All moulds, whatever the technique, have to have a deckle (*the word comes from Dutch or German, and means “cover”*),

or a wooden frame surrounding the sieve, fixed or mobile, that holds the fibres in when the frame is lifted out of the water. In the first instance, as with the floating mould, the structure was fairly lightweight and had a fixed deckle. The obvious disadvantage was that once again it required the papermaker to have a large number of moulds, which were used in sequence, after which the sheets were exposed to the sun to dry and peeled off, possibly while still damp. Nevertheless, such moulds, especially to make large sheets of paper, were and are used extensively in traditional Chinese papermaking. In the second instance, the mould was constructed with two separate side deckle sticks, which were slipped off after making the sheet, and the sieve with its still fresh layer of pulp facing down was couched onto a flat surface. In some instances this was a board with a piece of cloth on it: the mould was rolled up to separate the sheet, which was immediately taken and brushed onto a heated wall in order to smooth out any irregularities and to dry it; otherwise, it was couched onto a post of previously made sheets, and afterwards dried on a heated wall or in the sun. As the earliest account of papermaking in China, published in 1637 [5], explains, a resin, often a vegetable gum from the hibiscus plant, was added to the fibres in the vat, ensuring that there was no need to interleave the sheets in the post with some sort of cloth. The same resin also sufficed as sizing, which Oriental paper required to be much less stiff and rigid than its Western counterpart, since in this part of the world calligraphy is written with a small brush on only one side of the sheet.

What did the Arabs learn from the Chinese? Unfortunately, whereas Chinese papermaking continued unchanged up to the Twentieth century and still continues in some areas, so that ancient pieces of paper can be compared to observed procedures, in the latter Middle Ages the techniques and tools of “Arab” manufacture were displaced by Italian and French products, including in the Muslim world, and thus totally disappeared. What the Arabs certainly learned from the Chinese papermakers, supposedly captured at the battle of Talas, was the floating mould, and it is the knowledge of this procedure that spread Westwards and reached the Mediterranean. The famous *Umdat al-Kuttab*, which is the oldest extant description of the papermaking process in Arabic, written by Mu’izz ibn Badis sometime in the Eleventh century, unquestionably describes a floating mould. Did the Arabs reach the next stage, i.e. the dip-mould? Almost certainly, yes, although the evidence is necessarily deduced from the paper itself. Rather than showing a fabric imprint, where visible, sheets of Arab paper usually show sequences of thin, closely-set lines: twenty of them take up a space varying between 20-30 mm; in comparable Western paper, in which the lines are certainly metal wire, twenty occupy anything between 34 to 52 mm. The most likely explanation is that in Arab paper these lines were formed by flaxen or hempen thread boiled in oil or pitch to give it rigidity, explaining both the fineness of the wires and their density. Also evident in Arab paper, at right angles to the lines forming the surface of the mould, are series of knots, or chain-lines, possibly formed from flax or horse hair, serving their well-known purpose of preventing the lines of the sieve from shifting and opening under the weight of the water. Whereas in Western paper, especially in Italian Renaissance paper, the chain-lines are regularly spaced, in Arab paper the distances are variable, often with groupings of two, three or four chain-lines followed by a wider gap, and are at closer intervals, generally 15-30 mm. The construction of the surface of the mould in this fashion of course favours the hypothesis that the paper was made on a dip-mould, while the fact that sometimes the impression of a wall or a board is visible suggests that the sheets were couched while freshly made, probably with the same rolling mat procedure employed in Chinese papermaking. On the other hand, the fineness of the lines and the tight grouping of the chainlines make it improbable that the Arabs were the first to introduce a metal mesh, as has sometimes been claimed.

A final characteristic of Medieval Arab paper, which should be mentioned since it can puzzle those who meet it for the first time (*as happened to me on my first encounter with the phenomenon*), is that sheets were often glued together, in both cases with the uneven mould side inwards, in order to form a single, stiffer sheet. The intent was most likely to give a more rigid, “parchment” feel to the paper, but it was probably also a consequence of the fact that the sheet was not pressed while it was still wet and so it was impossible to flatten out all the mould-side irregularities.

Paper Reaches the West

At some point paper takes a huge technological stride forward.

When and where? Almost certainly in Italy, sometime around the middle of the Thirteenth century.

In the Arab world paper had become the principal communication medium, supplanting papyrus and other supports, though parchment kept its role for more prestigious and expensive documents, such as copies of the Qur’ān. Once the industry was well established and was producing significant amounts of material, more perhaps than local markets could absorb, inevitably it was exported.

One proof of this early circulation of paper is to be found in the word *ream*. The word comes into English

from French *reyme*, which in turn derives from the Spanish *resma* or the Italian *risma* (in *Medieval Italian* sometimes *lisima*); behind these shared terms lurks the Arab word *rizmah*, meaning bundle or bale, often of cotton cloth, which obviously shows how Western users first became acquainted with paper, arriving in packages from ships trading along the Mediterranean coast.

The oldest known surviving piece of paper to have been written in Europe is a document in the State Archive at Palermo in Sicily, with texts in Arabic and Greek, which is dated 1109 [4]. Likewise, the State Archive at Genoa has a paper register in which the first entries were made in 1154, although the paper therein, which reuses the remnants of an Arabic scroll, was certainly imported from outside Italy. In 1231 Holy Roman Emperor Frederick II, reiterating earlier decrees of 1145 and 1220, issued legislation, ordering that all official documents written on paper be recopied on parchment. (*Scholars have traditionally attacked this seeming boycott as Medieval obscurantism; in reality, given that Arab paper has a vegetable-based sizing, which attracts microbes and insects, and is more fragile than its Western successor, Frederick, or whoever was in charge of information technology at his court, was actually being quite sensible, while the decree does not imply that the emperor was averse to other, less prestigious, uses of paper.*) For a legislator actually to prohibit something, there has to be enough of it around to create a nuisance (*like binge-drinking, or is that not forbidden?*); so we have to deduce that, although very little of it might have survived, by the beginning of the Thirteenth century conspicuous amounts of paper were in circulation.

Where was this paper made? Somewhere in the Arab world and imported? or was some of it being made in Italy itself? The latter is a beguiling hypothesis. And there is a historical pointer in the distribution of the traditional papermaking centres in Italy, which include cities such as Genoa and Amalfi. Now these localities were among what was known as the maritime republics, of which there were four altogether (*the others were Pisa and Venice, which for reasons deriving from the local terrain, did not develop paper industries*) and which specialised in sea-trade, especially with the Arab world. The records are sketchy, but it is a persuasive guess that Arab papermaking techniques were brought across the Mediterranean and established in or near these cities. Just to get the dates given above into some sort of perspective, the British Library holds what is believed to be the earliest classical text copied on paper, a copy of Aratus, probably written in the first half of the Thirteenth century in Southern Italy or in Sicily, in Arundel ms. 268, ff. 75-103 (*viewable on the library's website*). Likewise the earliest known dated manuscript on "Western" paper (*i.e. unwatermarked, but seemingly produced with the procedures described here below*) is a commentary by Ioannes Zonaras on the *Octoechos*, a Greek orthodox service book, written somewhere in an unspecified Eastern Mediterranean in 1252, again held by the British Library, Add. Mss. 27359 (*similarly viewable on the website*).

In 1888, in his famous article on the watermarks of Genoa, Briquet published the text of a document of 1235, in which Walter the Englishman (*Gualterius Englesius*) agrees to work with an Italian colleague in order to make paper, promising to keep the method secret, i.e. "nec alicui persone docere sive monstrare dictum misterium" [6e. Liguria]. Although fears about Medieval industrial espionage often feature in such contracts, the insistence on the *misterium* and the involvement of a lawyer to draw up the document suggest that the procedures were still relatively little known. It is reasonable to suppose that these early factories made paper with much the same procedures and tools as in Africa and in Spain. At a later stage, as knowledge of the revolutionary techniques being introduced elsewhere in Italy spread outwards, these centres adapted to Western methods, discarding the previous ones. But the procedures were sufficiently similar to make the change-over a seamless one.

If up to now, most of what has been said has been guesswork, what follows is pure unadulterated blind-man's buff. So let's play!

At some point in the Thirteenth century, somewhere in Italy, some one, or more likely several different people, took the centuries-old method of papermaking, more or less as it had come from China, without profound innovations in its passage through the Arab world, and transformed it. The changes that they made have remained more or less standard, wherever paper is still made at the vat, up to the present day. These innovations, which transformed paper into a major commercial product, have had enormous, far-reaching consequences for the history of records and culture (*but we don't want to go into that*).

Where did all this happen? The evidence is fragmentary, but a great deal points to the small Italian town of Fabriano.

Where?

(*Well, yes, Where? is a pretty good question. Actually a little Question and Answer session might be the best way of getting through the next bit*).

Q. Where?

A. It is a town, not a very exciting town (*if the truth be told*), in central Italy, in the region known as the Marche, 325 metres above sea-level, population in 2016 a bit less than 32,000 inhabitants.

Q. Why Fabriano?

A. That is a very good question, you know. It is not asked often enough. To be honest, it is hardly ever asked at all. Which is strange, since it is the most important single question one could ask.

Q. So why Fabriano?

A. I detect a touch of impatience on your part, but I am glad you asked that. Of course the local scholars, beginning with the brothers Aurelio and Augusto Zonghi over a century ago, have searched at great length for documents that might explain the origins and rise of papermaking in Fabriano. And found absolutely nothing. They were moreover scrupulous in avoiding formulating just the question you ask and thus did not provide any answers whatsoever to what is a very intriguing question.

Q. Therefore why Fabriano?

A. I see. You would like me to answer the question. I had not realised that.

Of course what I am going to say now is a guess, but of an informed, intelligent variety. A bit as happened in Germany three centuries later, some time around 1450, when an individual we like to think of as Gutenberg did not really invent printing, but sort of cobbled together bits of know-how belonging to several different fields, so the huge leap forward in papermaking in the middle of the Thirteenth century draws on expertise in three other domains.

Q. So, can you get to the point, please?

A. Most certainly. Fabriano, as the name itself implies, was a metal-working centre, albeit with iron and blacksmithing, rather than the softer, more malleable metals such as copper and bronze. The skills involved in metal-working, especially in shaping the wire, was certainly very necessary when we come to talk about mould-construction.

Furthermore, there are hints that, when papermaking was introduced into Italy, the extant parchment industry somehow got in on the act. With its rolling hills and pleasant meadows, which accommodated large numbers of animals, in the Middle Ages livestock was an important feature of Fabriano's economy. Animal size for paper is obtained from the collagen present in the skin, connective tissue, and bones of animals.

Here a little bit of basic (*very basic*) chemistry might be in order; or just jump this paragraph. Collagen is defined as the main structural protein in the intercellular space in the various connective tissues in animal bodies (*also human, but generally we do not use them to size paper*). The term derives from the Greek κόλλα (*glue*) and its suffix *-γέν* (*producing*), referring to the centuries-old practice of boiling down animal hide and sinews to produce glue. The boiling process hydrolises, or breaks down, the collagen, transforming it into gelatin that, much diluted, becomes the size. The various techniques involved, including the purification of the gelatin by passing it through cloth filters, were certainly known to Medieval parchment producers, while the final phase in papermaking, calendaring or polishing the surface with a dense, rounded stone, such as basalt or marble, was familiar to Oriental and Arab papermakers, but can again be related to the parchment shops.

Furthermore still, Italy's Medieval wool industry, which covered Tuscany, Umbria and the Marche, reached as far down as Fabriano and had perfected the hydraulic stamping mill as a way of "fulling" the woolen cloth. For a long time in Italy wool and paper mills – both of which require large amounts of clean, running water – occupied much the same premises and used similar equipment. Likewise the couching (*pronounced kooching, from the French coucher, since like other papermaking and printing terms it enters English from Belgian or Dutch French*) process, where sheets of paper are transferred from the mould onto felts, was thought up by someone who knew about wool and knew that it would not adhere to the linen or hemp fibres in the paper. Woolen mills also made an ample use of screw presses and this characteristic switched easily into the nascent paper industry.

Q. Can you steer clear of "Furthermore" and just say what the innovations were?

A. Apologies! A little tick I have. But let us announce them properly. All six of them.

Q. If you really must ...

Six Inventions that Lasted Six Centuries

A. If these several strands of know-how are woven into a single strand, somewhere in or near Fabriano, sometime around the middle of the Thirteenth century, there was an inventor, probably more than one, perhaps belonging to the same family, whose name remains unknown, but who, as much as Gutenberg and possibly more, has changed the history of the world. As more recent happenings have shown – for instance, the “chair triangle” around Manzano in the Friuli, or Luxottica spectacles in a valley near Trent – Italians are very good at small-scale, family-centered, concentrations of knowledge and innovation that have far-reaching consequences.

It is only a guess, but something like this happened.

First, the bamboo or reed or thread sieve of the Oriental and Arab mould was substituted with a metal mesh, formed by aligning wires of a copper or bronze alloy parallel to the long side of the mould. These are held in position by two, or sometimes three, strands of a more finely drawn metal wire, wound around small wooden bobbins, as in lace manufacture, which are knotted or plaited around the wires of the mesh (*Lalande compares the process to basket-making*). This sort of plait leaves the trace known as the chainline, running at right-angles to the wirelines, on the surface of the sheet. The chain-lines were in turn supported, although it was not strictly necessary to make them coincide, by triangular wooden struts or ribs, set at regular intervals.

Q. That is number one. And next?

A. Well, yes. Second, the couching process, or the removal of the sheet from the mould, was made quicker and more effective.

When in the West papermakers first experimented with a metal construction for the sieve, the new material necessarily made the mould heavy, rigid, and inflexible. A different technique therefore had to be devised to get the sheet off the mould, while an additional problem was posed by the fact that the laid surface, formed by parallel brass or copper wires, was much less regular than its Oriental counterpart and left a deep indentation in the surface of the sheet that had to be smoothed out. The solution involved, first, changing the nature of the deckle, which became a single, removable frame, and, second, alternating the sheets with pieces of woollen cloth or felt, somewhat larger than the paper. In other words, seconds after the removal of the deckle, the mould is turned upside down and the sheet is couched with a rolling, semi-circular pressure onto the felt (*best to see it rather than have me describe it*). It is better if the woollen surface is slightly yielding, so a pile of felts gives the best result. In most Western papermaking the sheet is added to the top layer of the “post”, i.e. the pile of interleaved felts, usually 250, that forms a unit of work, and another felt is laid on top of it before continuing with the next sheet. At Fabriano, however, the sheet is couched onto the topmost felt of the pile, which is immediately taken by its corners and lifted across to the post. The pressure exerted in couching required the mould to be extremely robust, in other words metal and hard, seasoned wood; anything else would simply disintegrate in a short space of time.

The woollen felts absorbed a proportion of the moisture of the sheet, but at the same time prevented the wet fibres from sticking together (*Anyone in the textile trade will tell you that it is difficult to mix vegetable and animal fibres, so the couching process was thought up by someone who knew this fact*). They also made it possible to press the post while the sheets were still densely hydrated. Pressing not only removed the excess liquid, allowing the easy separation of the sheets from the felts, but also flattened out the indentation left by the wire-lines on the mould side of the sheet. In early Medieval paper, in which the wires and thus the gaps between the wires were particularly thick, this process was extremely important. Without pressing in fact, it would have been impossible to write on more than one side of the sheet, with the additional disadvantage that sheets of paper would have easily broken along the chainlines when folded.

Like the chicken and the egg, what came first, the rigid mould with its metal sieve or the couching onto a post of woollen felts? The best answer is that the two processes were intimately connected and probably evolved simultaneously as a way of overcoming the limits posed by the flexible mould.

Q. I count two innovations so far, and this is taking a long time. And the others?

A. Certain things cannot be expounded in haste. So, third, as has already been said, instead of beating the rags with a foot-actuated treadle or a crushing wheel activated by a donkey or mule, Fabriano modified the fulling-mill, or *gualchiera*, widespread in the Medieval textile industry harnessed to a water-wheel. Fulling actually involves two phases. The first, known as “scouring”, was required to remove the dirt, oil, and impurities from the sheep’s wool: in Roman times the cleaning agent was urine, which was trampled by slaves in appositely constructed vats known as *fullonicae* (*a pleasant task!*), whereas by the Middle Ages

urine was substituted with fuller's earth, a soft clay derived from prehistoric deposits of volcanic ash; the second, known as "thickening", consisted in compacting or felting the fibres to give them strength and resistance.

In arguing that the application of the stamping mill to beat rags for paper first happened in Italy, account has to be taken that hydraulic mills were known and widespread in Islamic and in Christian Spanish culture. In particular, sweeping claims have been made by Spanish scholars for the existence of hydraulically-powered stamping mills to produce pulp, both in Islamic Spain and in the subsequent Christian industry, which have however been denied by more recent (*and less partisan*) research, since in most cases the mills concerned were fulling mills for the textile industry. The earliest certain reference to a water-powered papermill in the Spanish Kingdom of Aragon occurs in 1282 and involves a dispute between the crown and the community of Muslim papermakers at Xàtiva, the main centre of the industry. Faced with luddite-style protests from the papermakers, who wish to continue with their traditional handbeating methods, the king exempts them from service in the new mill. The obvious implication is that the beating technology is a novelty being imposed top downwards. Of course, by that date Italians had mastered the procedures involved in water-powered beating and were beginning to experiment with watermarks.

Progress in technology, especially Medieval technology, where secrecy abounded and there was no concept of free sharing of knowledge, was rarely linear or straightforward, so it is quite possible that experiments were made at various dates in the mechanical beating of rags, without success or a permanent solution. What has perhaps not been sufficiently understood is how, when the technological leap-frog took place, all the various innovations interacted. In Oriental papermaking, the rate of production was necessarily slow, since thin sheets of paper were fabricated in a process that either required the sheet to stand on the mould to dry, or to be couched by taking the mould apart. Likewise, the subsequent drying on boards or walls required quite a lot of effort and space. Smaller amounts of pulp were consumed therefore and were easily supplied by hand- or foot-treadle beating. It ought also to be remembered that the raw pulp has to be used quickly, especially in a hot climate, otherwise it will ferment and go bad, so a hydraulic stamping mill might have been excessive to requirement. The introduction in the West of twin moulds and couching on woolen felts meant, instead, that a sheet, often of thicker paper, could be made every twenty seconds, while the post, usually containing 250 wet, freshly-formed sheets, took up less room, and subsequently the drying of the sheets happened on the meadow outside or by taking them up to the attic. So much larger quantities of pulp were called for and this impulse saw the adaption of the fulling mill traditional in the textile industry.

The mechanization of the process allowed the mill to beat larger quantities of rags in relatively shorter periods of time, thus obtaining a smoother mix of fibres, as well as to wash the rags, if necessary, by adding soap or cleansing substances, such as ashes, in the initial stages and filtering water through to export the dirt. In this phase of experimentation, not necessarily immediately, papermakers discovered that a controlled rotting, or retting, process (*as in the compost heap at the bottom of the garden*), before beating, made it easier and quicker to reduce the rags into their constituent fibres. Using rags had a further advantage, as well as being cheap (*as anyone who goes round the charity shops knows*). Years of rubbing against human flesh, and subsequent washing (*not too often in the Middle Ages*), and wearing again, broke the fibres down, making them more suitable for paper. In fact papermakers rarely employed new material, for example cuttings from tailoring shops, since it resisted the retting process and was only usable for rough paper.

Q. We are only halfway through the list. Can you speed things up a bit?

A. I'll try. Fourth, not long after the introduction of the rigid mould and the immediate couching onto a felt, as in a Fordian organization of labour, where the aim is to produce more objects for less cost, it was discovered that the most efficient procedure was to employ a two-man team, one acting as the vatman and one as the coucher. The consequence of this discovery was the introduction into the process of a second or twin mould, perfectly uniform in terms of size and shape to the first, since otherwise either the vatman or the coucher would have been inactive for 50% of the time. While some sort of detachable mould surface, as has been said, was a characteristic of Chinese and later Arab papermaking, here the deckle had to fit exactly onto both the moulds in the same fashion, but also be easy and rapid to remove. The craftsmanship involved saw the rise of the specialist mould-maker, who in due course also took on the task of shaping and attaching the twin watermarks. The process led to a differentiation of the moulds, which over time involved a placing of the watermarks alternately in the right- or left-hand half, as member of a pair of twins.

Q. At least that was quicker. And next?

A. Fifth, and penultimately, as a substitute for the lichens or vegetables – usually rice, sometimes wheat – employed in sizing oriental or Arab paper, animal sizing was introduced, in which the sheets of paper received an infusion of dilute collagen solution. Again, the innovation shows the debt of early papermaking to

the parchment industry, since the best sizes derived from scraps of skin left over when the membranes were cut into rectangles. This sizing, essentially glue, not only bettered the impermeability of the paper, but also made it much less prone to microbe or insect attacks. Perhaps even more importantly (*most scholars who talk about the early history of papermaking rarely grasp this point*), animal sizing, when it dried made the surface hard, more like parchment, and thus it was easier to write with a goose-quill pen, in which the ink is made to flow by exercising a light pressure on the point. As noted above, much the same effect was obtained in Arab paper by glueing two sheets together.

While Oriental and Arab methods seem to have preferred sizing with a brush (*when and if they did size*), Fabriano probably introduced dip-sizing, in which a handful of sheets at a time are briefly immersed in a vat. One probable cause was that animal size required the fluid to be warm, otherwise the collagen would solidify and form a jelly on the surface. The solution was therefore to heat the liquid in a copper cauldron over a small charcoal brazier. Dip-sizing also meant that afterwards the sheets could be pressed once again, both to remove the excess fluid and to distribute the size evenly through the pile of sheets.

Q. Good. And to finish?

A. Sixth, last, but by no means least, by stitching a piece of wire bent into a distinctive shape to the surface of the mould, which duly left its indentation in the surface, papermakers found a way of marking the sheet with a sign of its provenance or quality or anything else one might want to say. Obviously, but obvious things are not always obvious, watermarks were made feasible only by the introduction of a rigid metal sieve, since on a flexible mould the rolling involved in couching would soon have broken or bent the watermark wire.

Dates, Mistakes, and Further Progress

Q. What a tiresome list! Can we date any of these innovations?

A. Apart from watermarks, which appeared in the mid to late 1280s (*not quite as early as the "1282" claimed by Briquet*) [18], only very approximately. The numerous links with the wool industry mean that, even if the word "gualchiera" appears in a document, it does not necessarily refer to papermaking. And matters are not helped by other muddles.

Q. Explain yourself.

A. Quite a lot of general histories of the book (*especially those that take everything in secondary sources at face value, can't read any language outside of English, and copy large chunks of information off the Internet*) do indicate the introduction of the paper industry in Fabriano, or in Italy in general, or even in Europe in general, as 1275 or 1276, but herein lies an amusing little tale of scholarly ineptitude [6e. Marches]. The story is a somewhat complicated one and begins with the publication of the first edition, by the great Estense librarian, Girolamo Tiraboschi (1731-94), of his gigantic, multi-volume *Storia della letteratura italiana*, first published in nine tomes, comprising 13 volumes, from 1772 to 1782. (*The real novelty is the invention of "letteratura italiana" in the title: the literature existed previously, but not the concept; on the other hand Ugo Foscolo's venomous suggestion that the work be re-entitled Archivio ordinato e ragionato di materiali, cronologie, documenti e disquisizioni per servire alla storia letteraria d'Italia is not so very far from the mark!*). In tome V (1775), the author touches briefly on the history of papermaking in the Middle Ages, and makes a fair mess of things, culminating in a vague claim that the use of linen rags was first introduced at Treviso around the middle of the Fourteenth century. Fabriano pride was touched to the quick and Tiraboschi received a lengthy communication from a local erudite and aristocrat, Luigi Mostarda (1723-1801), which made its way into his second, even more lengthy, edition, again nine tomes, this time in 16 volumes, published from 1787 to 1794. To give credit where it is due, Mostarda's note, which Tiraboschi included in the most uncritical fashion imaginable, has a lot of pertinent and helpful information in it, but it also included, fatally, reference to a deed dated 1275, but which correctly had to be 1276 (*thus explaining the oscillations in the many mentions by subsequent scholarship*), that in his opinion contained a term describing a papermaking factory, i.e. *cartere* or *carterem*.

Q. This all sounds implausible.

A. It is pure unvarnished truth. As might all too easily have been guessed, but wasn't, the text of the original documents actually read *carcere* or *carcerem*, i.e. normally a prison, but here designating the cell of a Benedictine nun (*to read "c" instead of "t", and vice versa, in Medieval handwriting is a standard slip of the pen taught in any basic course on Latin palaeography*). The other fact that makes the interpretation implausible is the ownership. Of course, a document such as the *Diario di Ripoli* two centuries later does tell us that a Dominican nun, called suor Marietta, in Florence set type to print the *Morgante*, but here we are

constrained to believe that Benedictine nuns owned or ran a papermaking factory! But believed it was, for a very long time.

Q. That sounds sexist! but I get the point. So?

A. To the credit of Fabriano's home-grown erudition, in 1930 the mistake was identified by local scholar, Romualdo Sassi, who did take the trouble to go and read the original (*and thus gets lots of brownie points*). But of course, once the virus has got into the academic bloodstream, it is almost impossible to get it out (*it still appears in the Wikipedia entry and there is no point in removing it, since some well-intentioned person would just put it back in*). A few years ago I was reading through a draft for the synthesis of the history of paper for the 2010 *Oxford Companion to the Book*. The article was carefully documented and well-informed, but up popped the date 1276 for the introduction of paper into Italy. I drew attention to the erroneous nature of the same, but with no success, apart from the addition of "ca." (*in other words a transition from "harmless" to "mostly harmless"*). Likewise, the much vaunted, and emphatically promoted, new volume *The Paper Trail. An Unexpected History of the World's Greatest Invention* by Alex Munro (2014): well, even the blurb on the Penguin Book website tells us how "Paper finally reached Europe in 1276 and was indispensable to the scholars and translators who manufactured the Renaissance and Reformation from their desks" (*one would like to think that the printers got a look in somewhere, but no matter*).

Q. Something of a blooper, I must admit. So, when did paper really come to the West?

A. To my mind, the introduction of papermaking with Arab techniques in Italy has to be pushed back as early as the 1220s, certainly no later than the 1230s, as is confirmed by the 1235 Genoa document, first published by Briquet in 1887 [**6e. Liguria**]. The subsequent metamorphosis through contact with the wool industry probably happened between 1240 and 1250, so that by the second half of the century the new procedures were beginning to turn out a significant quantity of material. Since this paper started as an inferior and cheaper substitute for parchment, at least until the sizing problem was worked out, it is understandable that very little of it has remained. Elementary common sense suggests that, if Fabriano's papermakers had overcome most of the technical obstacles by the 1280s and were playing around with the frills, such as watermarks, then the real developments must have taken place at an earlier stage, probably a much earlier stage. In recent times attention has been drawn to documents in the archive of the Matelica, a town some twenty km south of Fabriano, which in 1264, and again in 1268, mention purchases of paper from an unnamed locality, but almost certainly Fabriano. We don't know what this paper looked like, but since Fabriano seems to have been supplying the stuff on a fair scale, it is reasonable to assume that the industry was up and booming.

Q. So why has all this not been explained before?

A. Without accruing too much merit to myself, researchers are always bad at seeing what is not there, as in this instance, where there is a curious, even amusing, black hole in the scholarship. Almost all inquiry into the history of paper, quite legitimately, has developed out of specific areas of interest, which have led scholars to highlight and privilege some chronologies and geographies with respect to others. The most enlightening work has been done by bibliographers of the printed book, such as Alan Stevenson and Paul Needham (*just to give two of the names that pop up most often in this piece*): now, of course, since printing only appears in the middle of the Fifteenth century, such scholars have had no reason to go back any further in time. Codicologists have manifested an attention for earlier paper (*as is shown by the valuable contributions of Jean Irigoien*), although most of their interest focuses on parchment, and of course, since paper began as a brownish-coloured, poor quality substitute, some attitudes appear mere palaeographical snobbery. Most manuscripts are also deracinated from their context and time of making: even if a colophon tells us when and where it was written, rarely is it conserved in the same place, and equally rarely is it possible to relate the paper to other documents in the same collection. Filigranologists, to give a fancy name to people interested in watermarks, spread their net more widely, but of course their starting point is c. 1282, with the earliest instances of dated marks, and given the vast quantities of watermarked paper still unstudied, they have little reason to adventure into earlier periods (*unwatermarked paper is as taciturn as a headless corpse*). As a result there is a gap of some sixty years that has never really been looked at, by anyone! Although there is an abundance of material in Italy's city and state archives, which provide sequences of paper over long chronological periods. Now archivists, in my bitter experience, rarely if ever know anything about paper, except sometimes for conservation purposes, and archive 'cataloguing' (*for want of a better word*) is extremely poor on the whole at telling a user anything about the physical support of documents. The only solution is a hands-on one, in which one goes *in prima persona* to the archive and looks at the documents there (*and, having done just that several times, it is also a good idea to enlist the support of a competent Medieval historian*).

Q. Can you give some examples?

A. One series of documents I have personally handled, and which convince me that an Italian papermaking industry was established, and possibly even thriving, as early as the 1220s, are the acts of the city of San Gimignano in Tuscany, held mostly in Florence's State Archive, though some volumes have remained at the city's Biblioteca Comunale. This sequence of 494 registers are the object of an ongoing transcription and study by historian Oretta Muzzi, but also provide a unique example of a paper supply that shows a remarkable evolution in the space of relatively few years. The series begins in 1228, and the sheets of paper display irregularly distanced (oscillating between 38 and 47 mm), wide-set, chain-lines, while the surface has a sort of mushy feel, like soft toilet-paper. Within some twenty years, however, the surface has become harder and much more resistant, probably due to the introduction of animal sizing. It ought to be possible, especially using digital scanning techniques, to decide whether these sheets are produced on a common set of moulds, perhaps a single pair, which would point to a vatman and a coucher working together; or on a large set of similar moulds, which would suggest a continuation of the Arab method. These are however single sheets, not a pair of sheets glued together, as is the norm in Arab manuscripts of the time, and they also show the strange zig-zag striations known from Spanish-made paper of the same period, which have remained largely unexplained. Most importantly the study of a long sequence of documents, used and conserved in the same place, should make it possible to see significant innovations when they first appear. Another famous series of documents is the *Liber plegiorum*, or the oldest sequence of documents written on paper in the Venice State Archive, dating from 1223.

What scholarship is crying out for, therefore, is an exhaustive census of Thirteenth-century paper in archives and manuscripts, employing non-destructive methods such as Fourier Transform-Infrared Spectroscopy, which will tell us not only what the paper is made from, but also whether the sizing is vegetable or animal, whether there is evidence for moulds with a metal sieve, whether twin moulds are being used, and other interesting things.

Sorry, have I been going on too long?

Q. A bit too long. What happened next?

A. Very little for nearly five centuries. As will also be the case with printing, a remarkable technological step forward, achieved in a mere handful of years, transforms itself into a stable, wealthy manufacturing industry, with little need for innovation. Culture had to catch up with the consequences of having a new, much cheaper support for texts and took a fair amount of time to adapt.

During this period Fabriano continued to dominate the Italian industry, though other Italian states, and even other European countries, gradually lured away people with the necessary know-how and so other centres were set up. Papermaking required an ample supply of clean, running water, as well as a nearby market, both to collect the rags and to sell the finished product. Venice, in particular, made determined efforts to develop its own industry, which grew up principally in the valley of the *cartiere* above the town of Toscolano, on a promontory of Lake Garda [6e. Lombardia]. Lesser centres appeared near Voltri, to the West of Genoa (or rather, as at Amalfi, the Arab papermaking methods gave way to the new industrial process), and in Tuscany at Colle Val d'Elsa and Pescia. Elsewhere in Europe, important factories were set up in Basle [6k] and in the Auvergne in France [6c], but up to the Eighteenth century Italy remained dominant and exported on a huge scale.

Q. Were there no novelties at all?

A. There were plenty of small changes, mainly of the improving variety or to do with watermarks, with which we shall deal with later.

A very important improvement occurs towards the end of the Fifteenth century, when the wires forming the mesh of the mould become much finer and are more closely set, with obvious advantages for the quality of the paper, which was not only more even, but also much thinner. It is probable that this development derived from a not entirely recent discovery in metallurgy, in which wire was drawn instead of being hammered. The wires plaited together to form the chain-lines also become much thinner, to the point that it is no longer possible to decipher their number or how they are being tied.

As the industry expanded Northwards, in the late Fifteenth century, mould-makers started to introduce tranchefiles to reinforce the narrow ends of the moulds [13]. A tranchefile is a thin wire placed on the underside of the mould between the last rib and the short edge, usually at a distance of 18 mm from the former and some 10 mm from the latter, but of course the binder's plough means that this last measurement is often uncertain. A chainline is plaited along it, but there is no supporting rib underneath. (*Images of how*

and where they were placed are provided in the illustrations to Lalande in 1761 and to the Encyclopédie in 1765.) The presence of tranchefiles in a book can be helpful in establishing a format or the imposition of a printing forme, since they tell us where the short edges of the sheet happened to be.

My own experience suggests that tranchefiles appeared some time in the first half of the Fifteenth century, somewhere in the area shaped by South-East France, Western Switzerland, and North-West Italy. Work on the Gutenberg Bible, which can be dated to 1454-55, draws attention to the presence of tranchefiles in sheets of Royal paper and argues that the provenance of the paper was one or more mills at Celle, near Turin in Piedmont. On the other hand tranchefiles are conspicuously absent from the moulds of major Italian papermaking centres, such as Toscolano and Fabriano.

Apart from watermark practice, there were no significant changes in papermaking processes in the Sixteenth and Seventeenth centuries. The Eighteenth century brought however two major innovations. The first was the Hollander beater, originally invented in the Netherlands in the Seventeenth century to work with a windmill, and in the Eighteenth adapted for hydraulic power. There are detailed early accounts of how the machine – basically a giant-sized Moulinex – worked in Lalande (1761) and in the entry on papermaking in the *Encyclopédie* (1765) [5]. The Hollander was much quicker – according to Lalande it could reduce a load of rags to pulp in eight to ten hours instead of twenty-four to thirty – and it had a larger capacity, but traditional papermakers claimed that it chopped the fibres too short and often left knots of material. In Italy therefore it never entirely replaced the traditional stamping-mill, which remained cheaper to construct and run, something the small family firms characteristic of the peninsular industry preferred.

The second, extremely important, change was the introduction of *wove*, instead of *laid*, paper (*actually a reintroduction, since a wove surface, usually a thin piece of cloth, was characteristic of Oriental papermaking*) [15]. *Laid* is the term for traditional paper, in which the fibres deposit themselves directly on the wire and chainlines, which leave a visible mark on the sheet. In *wove*, as the name implies, a thin mesh is placed on the surface of the mould and the fibres deposit thereon, so that signs of the chainlines and wirelines disappear. It is a metamorphosis whose inception has an exact date, since wove was famously employed for the first time in Baskerville's Birmingham edition of Virgil in 1757, for which the paper was made by James Whatman at the Turkey Mill in Maidstone. Wove was also the essential technological step forward for the next stage in the process, the invention of the mechanical papermaking machine at the beginning of the Nineteenth century; but that is another story.

Q. Thank Heaven that is over. Is there much more?

A. We are not even half-way.

Chapter 3

Renaissance to Eighteenth-century Accounts of Papermaking

“... and what is the use of a book,” thought Alice, “without pictures or conversations”.

Lewis Carroll, *Alice's Adventures in Wonderland* (1865)

Probably the worst way there is to discover the most important thing done in any historic period is to take the word of that period for it. What to the generation of its occurrence is merely a casual happening, an amusing toy, or an impractical intellectual or physical adventure, in time frequently becomes all-important for the world.

William M. Ivins, *Prints and Visual Communication* (1953)

Descriptions of the papermaking process have appeared various times over the centuries and are a prime source of information, especially when they are accompanied by images. Rather perplexingly on the other hand, there is no one work that brings these texts together, with due commentary, interpretation, and bibliography. In particular the very early descriptions, albeit brief, are at times difficult to find in more recent published sources and so, although the present work is intended primarily as a bibliographical helpmeet, as a concession to *vox populi*, the texts of Bartolo da Sassoferrato, Francesco Maria Grapaldo, and Angelo Rocca are duly transcribed. While the Seventeenth century account by Giovanni Domenico Peri is a pleasing exception, since it is available in an high quality, scholarly edition, there is no proper modern edition of the French text of Lalande, though strangely the Italian, English, and German translations, that appeared almost immediately, have all been republished in modern times, and a similar absence is true for the paper-related entries in the *Encyclopédie*, which went through a complicated evolution [5].

In his treatise *De insignis et armis* the Fourteenth-century Italian jurist, Bartolo da Sassoferrato (1314-57), famously talks about brands or griffes in surprisingly modern fashion and gives the watermarking of paper at Fabriano as an example: “Quedam vero sunt signa cuiusdam artificii seu peritiae. Et hic advertendum, quandoque sunt signa artificii in quo principaliter operatur qualitas loci. Exemplum: in marchia Anthonitana est quoddam castrum nobile cuius nomen est Fabrianum, ubi artificium faciendi cartas de papiro principaliter viget, ibique sunt edificia multa ad hoc et ex quibusdam edificiis meliores carte proveniunt, licet ibi faciat multum bonitas operantis. Et, ut videmus, quodlibet folium carte suum habet signum propter quod significatur cuius edificii est carta. Dico ergo, quod isto casu apud illum remanebit signum apud quem remanebit edificium in quo fit, sive iure proprietatis, sive iure conductionis, sive quovis alio titulo, sive in totum, sive in partem, sive etiam mala fide teneat, toto tempore quo tenet non potest prohiberi uti signo, sicut in ceteris iuribus realibus” [translation: *Some trade marks are proper to a particular craft or skill, and here it should be noted that sometimes they are connected to the nature of the place in which the product is chiefly made. For example, in the March of Ancona, there is a certain noble city called Fabriano, where the manufacture of paper is the main business. Here there are many paper mills, and some of them produce better paper, although even here the skill of the worker is of considerable importance. And here each sheet of paper has its own watermark by which one can recognize the paper mill. Therefore, in this case the watermark should belong to the one to whom the mill itself belongs, no matter whether it remains in his possession by right of ownership or lease, or by any other title, wholly or in part, or even in bad faith. During the entire time in which he has possession of the mill, he cannot be prohibited from using the watermark, as with other rights to immovable property*] [5]. Although one hates to embarrass or contradict such an eminent Medieval jurist, he just happens to be wrong! Very early watermarks might well have been a means of identifying the maker of the paper, since signs such as the Greek cross have much in common with the marks employed by the wool merchants to identify their bales. By the middle of the Fourteenth century, or the period when Bartolo was writing, rather than signify individual makers or mills, watermarks had transformed themselves into symbols denoting types of paper. Unfortunately the symbolism for the most part today appears as an only partially-understood Linear B, as Briquet and other repertories make all too clear.

In his large volume *De partibus aedium*, published in Parma, probably in 1494, better known perhaps for its references to cheese and wine making, the humanist Francesco Maria Grapaldo, after a disquisition on book

practices in the ancient world, introduces a contemporary first-hand account of papermaking, as he had perhaps seen it practiced in the paper mills in the hills above Parma: “Apud nos hodie charta e lineis canabinisque pannis veteribus et attritis producitur. Secti in frustula aqua inspersa per dies xi macerantur et in pila aquaria pilis ferratis minutim contusi addita calce in alteram transferuntur. Exemptos deinde in aquaria tinia cum posuerint formis aquam transmittentibus in singula extrahunt folia, quae laneis pannis alternatim commixtis proelo calcantur aedificioque ad id patulo prius siccata [*>siccantur*]. Mox glutino facto ex pellium quisquiliis sive ramentis, quae coriarii et membranarii reponunt ad hunc usum fervefactis intincta. Rursus siccata et vitro levigata aptissima redduntur ad tolerandos calamos: et atramentum non transmittendum. In hoc Parmenses chartae sibi principatum vendicarunt, cum in candore prae caeteris Fabrianae commendentur. Prima enim chartae datur adorea: si non est bibula et atramentum non sorbet, quod si fuerit siccandae scripturae, ne fiant liturae erit utilis” [translation: *Nowadays we make paper from old and worn out rags of linen and hemp. These are cut into pieces, water is poured over them, and they are left to soak for eleven days, after which they are transferred into vats filled with water and, with the addition of lime, pounded into pulp with iron mortars. Next they are removed and placed in a vat of water, in which the workers dip frames that allow water to pass through and so draw out the individual sheets. These they interleave with felts and squeeze in a press. After they are dried in a spacious building specially designed for it, they are dipped in hot glue made from the fragments and scraps which tanners and parchment makers set aside for the purpose. After being dried again, they are calendared with a piece of glass, so they will take writing and not let the ink through. In this respect Parma paper is reckoned to be the best, while Fabriano paper is highly praised for its whiteness. It is held to be a prime quality in paper that it is not absorbent and does not soak up the ink – yet if it does, it will still be useful for drying the handwriting so as to avoid blots*]. This passage is followed by remarks about sheet sizes and names, in which, after the Augustan and Claudian sizes in the classical era, he notes that “imperialis” and “regalis” are characteristic of Bologna and adds remarks about paper made for wrapping purposes, as follows: “vilior est emporetica, quae inutilis scribendo involucre segestrium vice mercibus praebet, et ideo a mercatoribus cognominata. Graece enim emporos mercator et emporium locus mercatus et nundinationis ad quem distrahendi praestinandique causa conveniunt mercatores. Chartaceum involucre cucullum dicemus et venditorem chartarum chartularium nos, graeci chartopolin” [translation: *a cheaper sort is emporetica, which is no good for writing on, but in the manner of a straw wrapper provides covering for goods, hence its name. For in Greek a merchant is known as an emporos and an emporium is the market place where things are traded, to which merchants go to buy and sell goods. We shall call a paper wrapper a cucullus or ‘hood’, and the seller of paper a chartularius in Latin, in Greek a chartopola*]. Although the text was republished five times during the Sixteenth century, with variants, there is no modern edition [5].

A recent and extremely interesting discovery is a manuscript sketch by Italian artist, Alberto Alberti (1526-98), military architect, sculptor and engraver, attributed to c. 1558-65, in the collections of the Canadian Centre for Architecture in Montreal. It shows a traditional stamping mill, with considerable accuracy, and includes notes about the technical features of the machine [5].

The first example in history of a picture book, also known as the ‘Book of trades’, where two separate texts are modelled around the same set of 115 woodcut images, showing the professions of the time, was conceived by the Swiss-German artist and sometimes xylographer, Jost Amman (1539-91), who signs it with his monogram in the lower left-hand corner [Figures 1-2]. The image enjoys celebrity status, and no bibliography could begin to enumerate the times it has been reproduced in writings about paper and elsewhere. As a depiction, however, it contains some massive inaccuracies, interestingly compared to the related activities such as typesetting or printing, evidently drawn from life, where it is less easy to fault Amman’s depiction. Paper mills, however, were found out of town and were not necessarily straightforward to reach, especially for an artist based in Nuremberg. The scene therefore appears to have been drawn from memory, or from a very rough preliminary sketch, and betrays a limited understanding of the process: for instance, the waterwheels (*why have two?*) outside the windows cannot connect up to the trunk of the stamping machine, while the stamps themselves – which look like the legs of a creature from a sci-fi movie – have no connection with the multiple basins, shown however as a single trough, in which the rags are beaten; the threads of the screw on the large press against the wall turn the wrong way; the vat is only just large enough to get the mould in; the vatman is holding the mould at the centre of the long sides, instead of the short sides, and what presumably are intended as chainlines are parallel to the same long side, when they should be parallel to the short side; part of a post is visible, although it should be covered by the barrier which normally protects the feet of the coucher from falling water; on the other hand, no coucher is visible, though he might be just off screen; the young boy strolling across in front of the vat may be carrying a freshly-made post, which would be too heavy to lift in such a nonchalant fashion (*if on the other hand the paper is dry, it has no business being in this part of the factory*); and so on and so forth. The work was first

published in Frankfurt in 1568 in parallel versions, the first in German with the title *Eygentliche Beschreibung aller Stände auff Erden*. The image of the papermaker “Der Papyrer” is accompanied by verses in German by Hans Sachs (1494-1576) reading: “Ich brauch Hadern zu meiner Mül, | Dran treibt mirs Rad deß wassers viel | Daß mir die zschneitn Hadern nelt | Das zeug wirt in wasser einquelt | Drauß mach ich Pogn, auff den filtz bring | Durch preß das wasser darauß zwing. | Denn henck ichs auff, laß drucken wern | Schneweiß vnd glatt, so hat mans gern” [translation: *I need rags for my mill. The mill churns through lots of water, so the cut-up rags are beaten. The stuff is full of water. I make sheets out of it and put them on the felts. Using a press I squeeze the water out, then I hang them up and let them dry. Snow-white and smooth, that is how we want it to be*]. In the Latin version by Hartmann Schopper (1542-c. 1598), entitled *Πανοπλία. Omnium illiberalium mechanicarum aut sedentariarum artium genera continens*, the text for the “Chartarius/Der Papyrer” becomes: “Ex vetulis pannis tenuem contexo papyrum | Vertitur in gyros dum mola scabra suos: | In tabulis olim sua scripsit verba vetustas, | Quas rudis ex caera dextra liquente dabat. | Cùm mera simplicitas aevo rarissima nostro, | Et merus in terris scribere iussit amor. | Principibus nostris vix sufficit aurea charta, | Sit licet aurata saepe notata manu. | Fama vetus nulli certos adscripsit honores, | Istius inuentor qui prior artis erat” [translation: *From old rags I weave my thin paper, as the rough millstone turns round in circles. Antiquity once wrote its words on tablets, which an unskilled hand formed from liquid wax, though sheer simplicity (rare among us nowadays) and sheer love had people writing in earth. For our princes gilded paper scarce suffices, though it be often inscribed with golden hand. Ancient report gave no one any definite credit as the first inventor of this art*]. Hardly epic verse!

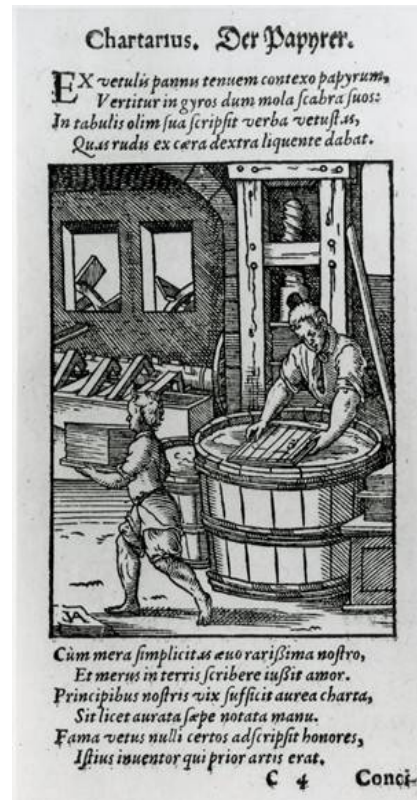
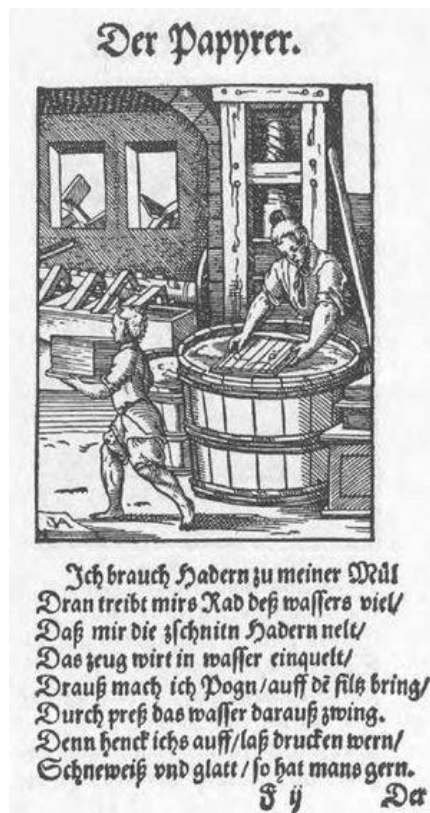


Figure 1. Jost Amman, “Der Papyrer”, in Hans Sachs, *Eygentliche Beschreibung aller Stände auff Erden, hoher und nidriger, geistlicher und weltlicher, aller Künsten, Handwercken und Händeln*, Franckfurt am Mayn, bey Georg Raben in Verlegung Sigmund Feyerabents, 1568, f. F2r. Image by courtesy of Wikisource.

Figure 2. Jost Amman, “Chartarius. Der Papyrer”, in Hartmann Schopper, *Panoplia. Omnium illiberalium mechanicarum aut sedentarium artium genera continens*, Francoforti ad Moenum, apud Georgium Coruinum, impensis Sigismundi Feyerabent, 1568, f. C4r. Image by courtesy of Wikisource.

In his famous *Theatre des instrumens mathematiques & mechaniques* or *Theatrum instrumentorum et machinarum*, according to the issue, published at Lyon by Barthélemy Vincent in 1578, Jacques Besson,

includes a copperplate illustration of a hand-activated beating machine. According to the *didascalium*, among the possible materials that can be pounded therein is paper, i.e. “Noua moletrinae trusatieis structura, ad premendos, et parandos pannos, et chartam, et terenda aromata, et comminuenda saxa metallis gruida ...”. Given the much greater efficiency of a water-powered wheel and stampers, it is unlikely that this device, if ever constructed, had any real application in the paper industry.

One writer, who had an exceptional chance to produce what might have been a first-hand account of the papermaking process, was Tommaso Garzoni (1549-89), whose *La piazza universale di tutte le professioni del mondo*, first published in Venice in 1585, in some ways is a precursor of the *Encyclopédie*, consisting in an attempt to describe in detail the contemporary industries and manufacturing procedures. On the other hand he has evidently not been near a paper mill and has no idea what the process consists in, so the four pages he dedicates to paper are largely waffle and an opportunity wasted. The only element of interest is a brief mention of paper types and sizes, which he obviously obtained from a shop in town: “et finalmente la carta o buona, o rea, o picciola, o commune, o mezzana, o reale, o imperiale, o papale, o da strazzo, o succhia, o capretta, o cartone, o fabriana, o ferrarese, o d'altri paesi” [translation: *and finally the paper of good or inferior quality, or small, or standard, or Median, or Royal, or Imperial, or Papal, or for wrapping, or blotting, or as parchment, or card, or from Fabriano, or from Ferrara, or from other places*].

The first successful commercial paper mill in Britain, established at Dartford in Kent in 1588 by German-born Thomas Spilman (*or Spielmann*) was celebrated in doggerel by poetic hack, Thomas Churchyard (c. 1520-1604). Just as a sample, here is his description of the papermaking process: “The Hammers thump and make so loud a noise, | As fuller doth that beats his woollen cloth | In open show, then Sundry secret toys | Make rotten rags to yield a thickened froth. | There it is stamped and washed as white as snow. | Then flung on frame and hanged to dry, I trow. | Thus paper straight it is to write upon, | As it were rubbed and smoothed with slicking stone”. Hardly exalting as a technical description of the process, and absolutely dreadful poetry!

Just under a century after Grapallo, another brief sketch of the papermaking industry was published by bishop Angelo Rocca, founder of the Angelica Library in Rome, who in his history of the Vatican Library published in 1591 has this interesting *excursus*: “Reliquum est, vt de charta, qua hodie omnes fere vt solent, sermonem habeamus. Haec ex linteolis contritis multiplex fieri solet iuxta varias telarum species, quarum vna praetenuis, altera minus, tertia rudior, aut crassior, quarta vero crassissima, quam Latini vocant telam cannabaceam, filo admodum raro, & rudi contextam, Italice *cannauaccia*: ex ijs tribus fiunt chartae ad scribendum, & ad imprimendum optimae: ex quarta specie iuxta varium telarum colorem fit charta bibula & emporetica, quae mercium involucris deseruit. Fit autem charta ex telis in frusta secatis, & in mortario ligneo, interiori tamen atque inferiori parte mortarij ferro cooperta, ferroque pistillo contritis: quae quidem prius quindecim dierum spatio in aqua marcescunt, deinde dum teruntur, perpulchro sane artificio, lauantur, atque ita, vt fluxibilitate, & albedine lacteum repraesentent colorem. Postquam vero huius generis massa quattuor ac viginti horarum interuallo contrita in materiam subtilem ac fluidam redacta est, illa eadem super forma, siue, vt aiunt, modulo filis aeneis iuxta latitudinem, longitudinem, & profunditatem folij, quod faciendum curatur, confecto, extenditur, deinde ipsum chartae folium ad aerem exsiccat. Vbi vero exsiccatum est, in aquam, in qua excocta sunt pellium bouillarum residua, siue nerui, immittitur, & statim inde, ex aqua scilicet illa, hoc est glutino extrahitur, & ad aerem iterum exsiccat, exsiccatumque super tabula lapidea, frusto marmoris fricatur, & expolitur: atque hunc in modum charta suam ipsius recepit perfectionem. Chartariae officinae in Europa multae sunt; sed Italia alijs praestantiores habere existimatur. Quae autem sunt in Fabriano, & chartarum copia, necnon praestantia ceteras excellunt officinas: in ijs enim omnia chartarum genera, & optima quidem conficiuntur, praesertim vero tres chartarum species, Papalis scilicet, Imperialis, & Regalis, quae non nisi eo in oppido confici solent. Quamuis autem charta ex omni genere, maxime omnium continens atramentum, ne effluat, Fabriani conficiatur: Fulginea tamen paginula tantae est praestantiae, vt nulla alia cum haec conferri queat. Multae aliae in Italia chartariae extant officinae, quae breuitatis causa subticentur. Sunt autem in ora Salonina officinae insignes circiter viginti, quarum charta est ad imprimendum optima, sed non satis alba. Extra Italiam Lugduni in Francia, Francofurti in Germania, & alibi chartae conficiuntur...” [5] [translation: *It remains for us to say something about the paper that pretty much everyone uses on a daily basis. This is generally made from pulped linen rags in various grades corresponding to the various types of cloth. The first is extremely fine, the second less so, the third rougher or thicker, and the fourth very thick indeed. This last is called tela cannabacea or hemp weave in Latin, cannavaccia in Italian, a weave made up of very few and coarse fibres. The first three types produce paper which is excellent for both writing and printing; depending on the colour of the cloth, from the fourth is made blotting paper or wrapping paper, suitable for covering goods. Paper is made from cloth cut into pieces and put into a wooden trough, the inside and base of which are lined with metal, and then broken up with an iron pestle. The rags have been previously been allowed to soak in water for fifteen days, and then – this is the ingenious part – they are watered as they are being broken up, so that they liquefy and turn milk white in colour. After twenty-four*

hours of being beaten in the trough, the raw material is reduced to a smooth liquid. It is then spread out on a forme or "mould", as they call it, made of copper wires to the same width, length, and depth of the sheet of paper that it is desired to make. The sheets of paper are then dried in the open air. When they are dry, the sheets are dipped again in water, in which the leftovers of hides and sinews of cattle have been boiled, and at once taken out of the liquid, or rather glue, and left out again to dry. After more drying, they are put on a stone surface and rubbed and polished with a piece of marble. In this way the paper is finished off. There are many papermaking factories in Europe, but the best are held to be those in Italy. The ones in Fabriano in particular surpass the other centres in quality as well as quantity of paper made. There they make all sorts of paper, and of all grades of quality, especially three varieties, Papal, Imperial, and Royal, which are only made in that one place. Though paper of every sort is made at Fabriano, and it is the best of all at taking ink and not letting it run, yet the small paper made at Foligno is of the very highest quality and no other can match it. There are many other papermaking factories in Italy, which cannot be mentioned for reasons of space. Some twenty well-known factories are found on Lake Garda, whose paper is fine for printing, though it is not white enough. Outside Italy paper is made at Lyon in France, Frankfurt in Germany, and elsewhere].

The contemporary interest in machinery and in the workings of machinery inspire the description of the stamping machine in the *Nouo teatro di machine et edificii per uarie et sicure operationi con le loro figure tagliate in rame et la dichiarazione e dimostrazione di ciascuna. Opera necessaria ad architetti, et a quelli, che di tale studio si diletmano*, posthumously published by the Padua city architect, Vittorio Zonca (1568-1602), in the same city in 1607. Importantly, the account also includes a copperplate illustration, showing the interior of a papermaking mill, described as a "Cartiera overo Pistogio che pesta le strazze per far la carta". The brief accompanying text is however largely uninformative.

The first extensive Chinese account of papermaking, including woodcut illustrations of the process, is published by Sung Ying-Hsing, *Thien Kung Kai Wu* [The Exploitation of the Works of Nature] in 1637. In his account the raw material, comprising bamboo shoots, is soaked for more than a hundred days, after which it is boiled in a vat for a further week or so. After further washing and rotting, the fibres are suspended in a vat and sheets of paper are made with a dip mould. Since the mix includes a resin or gum, sheets are couched onto a flat surface without interleaving with other material and are dried on a heated wall.

The city of Amsterdam has a tradition of gablestones showing the commercial and mercantile activities conducted in the building. One such, on a house built in 1649 for merchant Pieter van Haack, shows the interior of a papermaking factory and is arranged in two tiers: on the upper floor sheets of paper are hanging up to dry and rags are being sorted; on the lower floor, paper is separated from the felts after pressing, two men work at the vat, and a waterwheel turns a traditional stamping mill. The house was demolished in 1908 and the stone was placed in the Academy of Fine Arts. A modern replica can be seen at the corner of Keizersgracht and Leliegracht.

Half a century after Zonca, a Genoese scholar, Giovanni Domenico Peri (c. 1590-1666), not to be confused with the earlier Tuscan poet from Archidosso, born in the same year as Shakespeare, published a lengthy volume entitled *I frutti d'albaro*, Genova, Giovanni Maria Farroni, 1651, in which he dedicated several pages to a description of the papermaking process. This account is the most accurate and detailed account of the papermaking process previous to Lalande, although the text contains quite a few dialect terms and is anything but straightforward. Fortunately, it was edited and translated in 2003 by Conor Fahy [5].

The *Orbis sensualium pictus* by Czech writer and teacher, Jan Amos Komenský, latinized as Johann Amos Comenius (1592-1670), published in Nuremberg in 1658, is rightly celebrated as the first picture book for children. The first edition was bilingual, German and Latin; it was followed in 1659 by an English-Latin version translated by Charles Hoole, and before long was succeeded by polyglot versions in up to four languages. It was an enormous bestseller and went through numerous editions all over Europe, of which a fair number have probably not survived. In the sequence several images and texts are dedicated to the arts of the book, in the order 'Ars scriptoria', 'Papyrus', 'Typographia', 'Bibliopolium', 'Bibliopegus', and 'Liber'. The images are simplistic, but effective, and were obviously cut in many different versions. The papermaking factory (*n. 92 in most editions, but the numbering can vary*) shows the vatman and the coucher working together; in a next door room sheets of paper are hanging to dry over bales of paper; and on the floor below is a stamping machine. Alternative, later versions of the woodcut also show the hydraulic wheel outside the mill.

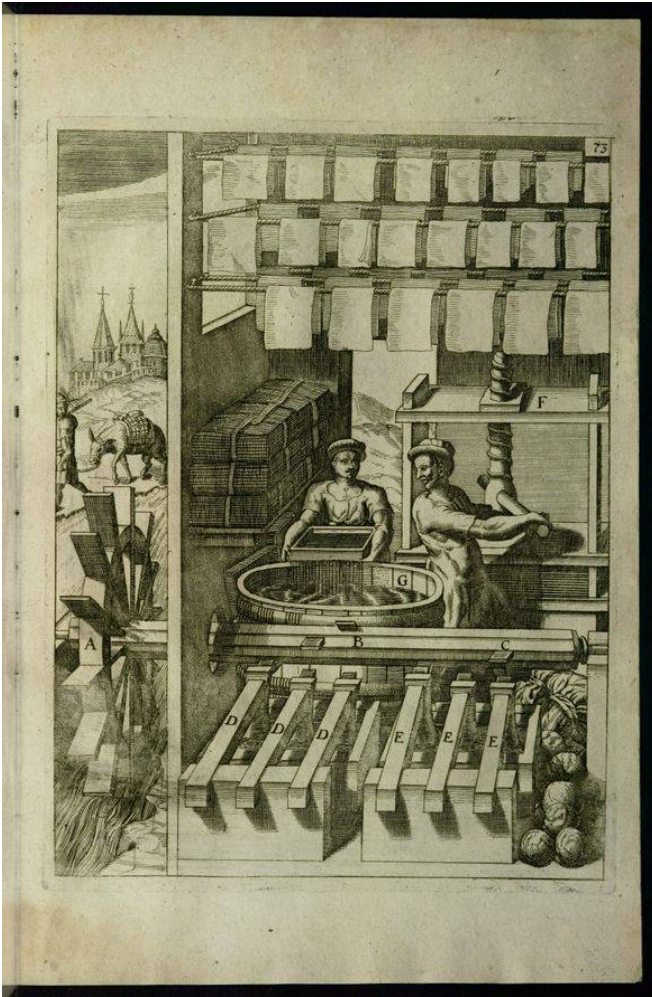


Figure 3. Georg Andreas Böckler, *Theatrum Machinarum Novum, neu-vermehrter Schauplatz der mechanischen Künsten, handelt von allerhand Wasser-Wind-Ross-Gewicht- und Hand-Mühlen, wie dieselbige zu dem Frucht-Mahlen, Papyr- Pulver- Stampff-Segen- Bohren- Walcken-Mangen, und der gleichen anzuordnen*, Nürnberg, in Verlegung Paulus Fürsten, gedruckt bey Christoff Gerhard, 1661. Image by courtesy of Wikisource.

Georg Andreas Böckler (ca. 1617-1687) was a hydraulic engineer from Nuremberg, and his *Theatrum Machinarum Novum*, published for the first time in Nuremberg in 1661, was primarily dedicated to water-driven machinery, including a contemporary papermill [Figure 3]. Although many of the details in the copperplate image showing a papermill are interesting, it contains several inaccuracies, some obviously due to the desire to compact into the same picture operations that would actually take place in different rooms and on different floors of the same building. It should be noted, however, that the mould being held by the vatman looks more like a baking tray (*square rather than rectangular*), and that, instead of holding it lightly but firmly in the middle of the short sides, he is clutching it to his chest; that the coucher, rather than handing back the twin mould, is pulling on the press, where the screw turns the wrong way, while the post under the press is implausibly large; that the struts on the rotating trunk cannot reach the heads of the beaters; and that the sheets of paper, hung over the workmen's heads rather than in the attic, seem more suited to wallpaper than to the invariant rectangle.



Figure 4. Elias Porzelius, “Das wohlausgesonnene Pappiermachen”, in *Curioser Spiegel, in welchem der allgemeine Lauff des ganzen menschlichen Lebens... vorgestellt wird*, Nürnberg, verlegt bei Johann Endter, 1689. Image by courtesy of the Objektkatalog der Sammlungen des Germanischen Nationalmuseums.

Elias Porzel, latinised as Porzelius or Porcelius (1662-1722), included in his collection of images *Curioser Spiegel, in welchem der allgemeine Lauff des ganzen menschlichen Lebens ... vorgestellt wird*, published in Nuremberg in 1689, reprinted in 1812 and 1824, easily the most accurate depiction of the inside of a papermill previous to the *Encyclopédie* [Figure 4]. In fact, no criticism can be made of it.

In 1693, a Jesuit priest, Jean Imberdis, celebrated the papermaking industry of his home town, Ambert, in the Auvergne, by publishing at Clermont-Ferrand a Latin poem in 486 hexameters, based on Vergil's *Georgica*. As Don Marquis once said, publishing a book of poems is like dropping a rose petal into the Grand Canyon and waiting for the echo: this example made even less noise, until the Nineteenth century, when a single surviving copy was rediscovered. It has, however, been republished and translated into French, German, and English, which fortunately makes reading a bit less hard.

The prize for the first ever book entirely about paper goes to the Ferrara doctor and lecturer in law, Francesco Maria Nigrisoli (1648-1727), whose *De charta ejusque usu apud antiquos*, was published in Venice by Girolamo Albrizzi in 1699. Unfortunately that is its only merit. In terms of content, apart from a very brief explanation of the papermaking process, it is just academic waffle.

The Eighteenth century of course provides us with several accounts of papermaking, some of them magnificently illustrated, that have dominated all subsequent discussions. The first is the *Cyclopædia, or, An Universal Dictionary of Arts and Sciences* by Ephraim Chambers (c. 1680-1740), best remembered today as

the root out of which grew the *Encyclopédie* of Diderot and D'Alembert. First published in 1728 in two volumes, the entry relating to Paper is not in the main sequence, but is to be found in the lengthy unpagged *Addenda* placed at the end of the second volume. Since it takes up six pages, it is a conspicuous afterthought. The description of the papermaking process, obviously written from first-hand observation, is concise, but valuable, and has been heavily drawn on by English-language bibliographers, such as Philip Gaskell.

The invention of the Hollander beater at the end of the Seventeenth century aroused immense interest at the time. It was described therefore in a number of contemporary technical treatises, of which the earliest is the *Vollständige Mühlen-Baukunst* by architect Leonhard Christoph Sturm, published in Augsburg in 1718. It includes copper-plate illustrations both of the traditional stamping mill and of the newer Hollander beater, though of course the discussion limits itself to the beating process and does not deal with papermaking as such. Leendert van Vuuren, Jacob Polly, and Cornelis van Vuuren, *Groot Volkomen Moolenboock*, Amsterdam, Johannes Covens & Cornelis Mortier, 1734-36, 2 vols., likewise explain how to harness a Hollander beater to a wind-powered mill (*the same illustration as is taken up subsequently in Lalande*).

All these early treatises were eclipsed, however, by what was originally conceived and written as a technical report, but has since become a keystone in the history of papermaking scholarship. First published in 1761, *L'Art de faire le papier*, signed by one of the most important scientists and astronomers of the day, Joseph Jérôme Lefrançois de Lalande (1732-1807; *the name comes with alternative orthographies*), is by far the most reader-friendly account of the process produced at any time in history, and is also famous for its magnificent, albeit not always accurate, illustrations [5]. The work had a complex genesis over a period of some seventy years. It began with a manuscript commissioned by Jean Anisson in 1693, entitled 'Description d'une des plus considerables papeteries d'Auvergne' by artist Paul Sevin (1650-1710). These drawings became the basis of plates showing papermaking engraved in 1698 by Louis Simonneau (1654-1727), intended for the project of the "Description des arts et métiers" undertaken by what at the time was the Académie Royale des Sciences. The next step was a paper, read to the Academy in 1706, entitled 'Description de l'art de la papeterie', by academician Gilles Filleau Des Billettes (c. 1634-1720), whose contribution is mentioned by Lalande in his introduction. Another fifty years passed, however, before Lalande took up the baton and wrote a treatise that was above all an explanation of the Hollander beater employed at the L'Anglée factory in Montargis, though the older 1698 plates, showing the traditional stamping mill and papermaking at the vat, were recycled and integrated with further plates dated 1761, showing above all the new sort of beater.

The other text that dominates Eighteenth-century writing about papermaking is the entry 'Papeterie' in the *Encyclopédie ou Dictionnaire raisonné des sciences, des arts et des métiers*, Paris, 1751-72, more generally known by its editors Diderot and D'Alembert [5]. Authorship of the entry has been attributed to perhaps the most important figure to have worked on the project after the two editors, Louis-Jacques Goussier (1722-99), who was also responsible for the drawings behind the wonderful copperplate images, while the related entry on 'Papier' is by Louis de Jaucourt (1704-80). What has not yet been properly explicated is the relationship of the 'Papeterie' entry, which appeared in 1765, to Lalande, while the illustrations also show several debts to the example of a few years earlier. It cannot be a coincidence that both of them base their accounts on the same paper factory, known as L'Anglée or Langlée, just outside Montargis, at Châlette-sur-Loing. Begun in 1739 and completed in 1741, the complex represented the state of the art and was fitted with the new Hollander beaters. In 1852 the building was sold and the following year was converted into a rubber-processing plant by the American businessman, Hiram Hutchinson (1806-69), who however only spent a year in France before turning the factory over to his son, Alcander. On the night of 23-24 September 1869 most of the structure was destroyed by a disastrous fire, which left only one of the original wings intact, and meant that the factory had to be entirely rebuilt. Initially named the Compagnie du Caoutchouc Souple, the Hutchinson firm produced rubber-coated garments and boots, but from the 1890s won fame as a producer of bicycle tyres and remains France's only manufacturer in this field. The Châlette-sur-Loing site was quitted in 1967 for a new purpose-built factory at Ingrandes; after a number of years of neglect and abandon, the buildings were recovered and are now the Hutchinson Centre de Recherche. On Google Maps the rectangular-shaped basin dug for the original paperfactory, which drew water from the nearby canal, is still clearly visible.

Not exactly a description of the papermaking process, but still an absolutely fascinating book, especially if you can view the original is the *Versuche und Muster ohne alle Lumpen oder doch mit einem geringen Zusatze derselben Papier zu machen*, self-published in six volumes in Regensburg between 1765 and 1771, by Jacob Christian Schäffer (1718-90), theologian, pastor, scientist, botanist, inventor, and various other things. The increasing scarcity of rags by the end of the Eighteenth century led Schäffer to experiment with

other sorts of vegetable fibre, including poplar, hops, and moss. What is remarkable about the books, but also accounts for their rarity, is that they include sample sheets of each and every type of paper (*so it is also the first known example of a paper sample book*). Although the use of alternative fibres did not take off at the time, the experiments pointed a long way into the future.

In 1762 a Dutch scholar, Gerard Meerman (1722-71), offered a prize of twenty-five ducats for whomever could establish the date of the earliest rag-based paper. Answers arrived from all over Europe and in 1767 were published as *Gerardi Meerman et Doctorum Virorum ad eum Epistolae et Observationes De Chartae Vulgaris seu Lineae Origine*, edidit ac praefatione instruxit Jacobus van Vassen, Hagae-Comitum, apud Nicolaum van Daalen, 1767. This work is notable also for containing the first published reproduction of watermarks [23]. The two images – a crown and a bull's head – are far from being a faithful representation of the originals, but they would make an amazing T-shirt!

The *Dizionario delle arti e de' mestieri* by Francesco Grisellini, published in Venice from 1768 to 1778, as the title implies, is little more than an Italian paraphrase of the *Encyclopédie*. The entry on the 'Cartera' in the fourth volume (1769), rather engagingly, or disgracefully, depending on how you see it, renders technical terminology straight from the French rather than seeking out the true Italian equivalent. For example, the workmen at the vat are described as the *tuffatore* and the *distenditore*, from the French *plongeur* and *coucheur*, rather than the correct Italian terms, *lavorente* and *ponitore*. The illustrations are also copied straight out of the *Encyclopédie*.

A little beyond the *terminus* of the end of the Eighteenth century is an exceptionally interesting publication that has been much used by subsequent generations of paper scholars, interested in Oriental methods, or the *Arts, métiers et cultures de la Chine*, published in Paris in 1814. Based on the observations of Catholic missionaries François Xavier Dentrecolles (1664-1731) and Pierre Martial Cibot (1727-1780), it includes twelve hand-coloured plates, and has its own undeniable charm [2].

To conclude by returning to the absence of a hierarchical text mentioned above, papermaking lacks an equivalent of Moxon's *Mechanick Exercises on the Whole Art of Printing* (1683-84) or Fertel's *La science pratique de l'imprimerie* (1723) for the printing world, i.e. a manual written not for bibliographers or scholars, but to give a professional in the field an overview and appropriate guidelines. Or rather, such texts were written, but for the world of mechanical papermaking, and for the most part they are technical manuals about the workings of now obsolete machinery. The one partial exception is Robert Henderson Clapperton and William Henderson, *Modern Paper-making*, a book with a complicated history: first published in London, Ernest Benn, 1929, with distinct impressions in April and June; with a second edition in Oxford, Basil Blackwell, 1941, followed by a third with the same imprint in 1947; the work was substantially expanded in what is confusingly called a "Third edition", signed only by Clapperton, published again by Blackwell in 1952. Although most of the book is about the machinery and the practical running of a mill, there are interesting pages about the sorting of rags, in a period before artificial fibre destroyed the centuries-old basic material of papermaking.

Chapter 4

The Shape of Paper

La feuille de papier, comme tout objet moulé, reçoit donc une empreinte parfaitement distincte et caractéristique, image de la forme sur laquelle elle est faite. Ce sont ces empreintes, ou images, qui permettent de classer les papiers, de reconnaître leur identité ou de constater leurs dissemblances.

Charles-Moïse Briquet, 'Papiers et filigranes des Archives de Gênes 1154 à 1700' (1888)

I should mention what is perhaps the most neglected single aspect of paper study, at least in the fifteenth century: paper sizes. I must confess that the importance of recording, and thinking in terms of, paper sizes has come upon me only slowly over the years, but I see now that it is really fundamental. It is also, like so much in paper study, very simple.

Paul Needham, 'The Study of Paper from an Archival Point of View', *IPH Yearbook*, vol. 7 (1988)

One may state almost categorically that the formats of small manuscripts have never been properly studied. As for small printed books, formats have been assigned to them by various incunable catalogues and bibliographies, but the assignments are often wrong; I suspect, indeed, that they are almost as often wrong as right.

Paul Needham, 'Res papirea: Sizes and Formats of the Late Medieval Book' (1994)

Let us get back to basics.

Sheets of paper are made with a mould, or rather a pair of moulds, at a vat.

The mould leaves its imprint on the object that is made.

Some of these signs are not voluntary, but intrinsic to the construction of the mould, in particular the dimensions, the distance between the chain-lines, and the density and thickness of the wires; others have no structural purpose, but were introduced intentionally to make the final product recognisable, such as the watermarks and other forms of decoration. For scholarly and other purposes, we have to turn this individuality to advantage, since if we can assign dates and places to these features, they provide access to information available in no other way.

As Briquet forcefully reminds us on more than one occasion, the identification of a sheet of paper, or many sheets of paper, as having been produced on the same mould, or same pair of moulds, rests on four factors:

- 1) the size of the sheet, which is necessarily modified by folding in order to make up a gathering, as well as by subsequent trimming and binding;
- 2) the wire-lines, i.e. their thickness and frequency (*Briquet often marks where the sewing of the watermark to the chainlines has pulled them slightly further apart, leaving a gap, which he indicates with a thicker line. In my experience this is an helpful, sometimes decisive, distinguishing element, especially with very look-alike twins*);
- 3) the chain-lines, most notably their distances apart;
- 4) the watermark(s) and the condition of the same (*especially in their position with respect to the chain-lines, which he is scrupulous about indicating, whereas some other repertories even omit the chain-lines*).

In their inspection of members of the opposite sex, human beings tend to be very particular about the difference between *front* and *back*; in the way they look at sheets of paper on the other hand, they do not

seem to care, but the distinction is just as important. If you are trying to decide whether sheets of paper all come from the same mould, it helps if you have enough expertise to interpret the physical signs and look at the objects from the same direction (*watermarks are sexy too!*).

Whenever we approach the task of reconstructing the physiognomy of a sheet of paper through the format, we need to remember that what is put on a press to be printed, or is taken by a scribe to be written on, can have one of four different directions, i.e. mould-side up and right way up (*if the work is a folio; with any other format the idea of "right-side up" is delightfully absurd*); mould-side up and upside down; felt-side up and right way up; and felt-side up and upside down. When we add to the equation the fact that twin moulds are involved, the number of possible situations rises to eight. Bibliographers and paper-historians have not actually devised a way of describing the positions of the sheets of paper in a manuscript or in a printed book (*this has to be good news, since any attempt would make the choreography of Nutcracker look like a morris dance*). Anybody analysing paper evidence in detail has nevertheless be prepared to work out the relative positional equation (*hint: model the sheet of paper and it's simple enough!*).

Easier said than done?

Undoubtedly. On the other hand, if you never start, you'll never get anywhere. So let's have a quick whip through the essentials, remembering always that a mould is a complex object and that, as with printing type, what we are studying is not the original, but the imprint it has left in another artefact. Since paper shrinks on drying, the original was larger than the trace it leaves: according to the make-up of the fibres and the thickness of the sheet, as well as the treatment it has received over time, shrinkage can vary (*for instance, the experience of collating, using transparent photocopies, some Sixteenth-century books caught up in the 1966 Florence flood, during which, after a long soaking, they were disbound, washed to remove the mud, and subsequently rebound, sometimes encountered reductions of a couple of millimetres in the measurements of the printed type-page with respect to other unrestored copies*).

Sheet-sizes and the Bologna Stone

It is obvious, all too obvious, to say that if two sheets of paper have markedly different dimensions, the watermarks they exhibit might be look-alike, but they cannot be the same (*unless, of course, you are set on demonstrating that the twin watermarks were detached and attached to another pair of moulds; but such a demonstration requires filigranological skills of a high order*). On the other hand studies frequently come to grief on this issue, since they do not take the elementary precaution of establishing their sheet-measurements and comparing them to those in Briquet. *Les filigranes* gives the sheet-size as the first element in the description and so you ignore it at your peril. If the measures do not match, you are barking up the wrong tree and need to try elsewhere in the wood.

Medieval paper in Italy has four basic sheet sizes. These are usefully summed up on the so-called Bologna stone and hereby lies something of a tale. Italian cities seem quite often to have affixed on public buildings plaques or stones establishing the official sizes for local manufactures. Another well known example, still in its original place on the Palazzo del Capitano del Popolo in Assisi, is a red stone with the measures of bricks and tiles placed there in 1349. It is accompanied by three pieces of iron giving the standard measurements for cloth, i.e. the 'canna', the 'passetto', and the 'palmo'. The Bologna inscription relating to paper sizes was first discovered, discussed and reproduced photographically by Briquet in his 1907 introduction (I, p. 3), whence it has been taken up on various occasions by others, who generally have not gone to the bother of actually going to Bologna in order to look at the original, which in 1912 was donated to the city [7]. Its original home, on the wall of a building at Via Accuse 8, Bologna, at the time home to the Tipografia Merloni, in an earlier epoch was the headquarters of the *Società degli Speciali*, or the Guild of Pharmacists, whose emblem – a pestle and mortar – appears on both sides of the inscription. The symbols are now much blackened by age and oxide, but direct scrutiny of the original shows that once upon a time they were gilded.

More than one scholar, writing about it, has stated that the stone is marble. I have traced this mistake (*which I suspect is polygenetic*) back as far as Gasparinetti's article in *Papiergeschichte* in 1956, where he describes it as a "Marmorplatte", something he repeats in other articles, and the error has been promulgated elsewhere, for instance in the important book on watermarks by Karl Theodor Weiss in 1962 (*but the text was actually written between the two wars*), as well as in writings by Needham. In defence of these scholars it has to be said that the line-cut used to print the image in Briquet makes it impossible to tell. In fact, it is a block of limestone, according to the museum's experts, probably imported from Capodistria. Of course, if you've made the pilgrimage to Bologna's Museo civico, where the stone is kept in the *lapidarium*, and set eyes on the original object, there is no way you are going to mistake it for marble.

Beginning with Briquet himself, writers on the history of paper have consistently linked this inscription with the text of the Bologna city statute in 1389, which contains a clause *De facientibus cartas de papiro et earum forma, pretio, pena et diversis capitulis*. Here is some of the text: “Statuimus et ordinamus quod quilibet magister qui facit seu futurum faciet vel fieri faciet cartas de papiro, teneatur ipsas facere seu fieri facere ad mensuram ordinatam prout et secundum quod continetur in marmore posito in muro contiguo palatii dominorum Antianorum super quo est curitorium ligneum dicti palatii in qua sponda muri sunt posita et affissa alia assadia seu mesure comunis Bononie, videlicet cartas imperiales, reales, mezanas et rezutas” [translation, with apologies for the original: *we decree and order that anyone who makes or shall make or shall have made sheets of paper, is bound to make them or have them made according to the fixed sizes, which are shown on the marble plaque placed on the wall next to the Palace of the City Elders, underneath the wooden porch to the palace, and on the same bit of wall are found other standards or measures of the city of Bologna, and these are measures for Imperial, Royal, Median, and Chancery sheets*] [7]. Now here of course we have an explanation as to why various people have made the above-mentioned mistake, since the document unequivocally refers to a text inscribed on a piece of marble. On the other hand, according to the statute, the block of marble is *already* on public display and thus must be earlier than the edict, though there is no way of knowing by how much. The other important point to be taken into account is that the original marble was affixed on the building, known as Palazzo d’Accursio on Piazza Maggiore, which from 1336 had housed the council of the city elders and today is still home to the municipality. It could not therefore have displayed the symbols of one of the city’s guilds. The stone known today is therefore a replica – probably a very close one – of a lost original: having examined the surviving artefact at leisure, especially from the style of the gilded emblems, I suspect that it is Sixteenth- or Seventeenth-century copy of the Medieval original; but for the moment this is only a personal judgement.

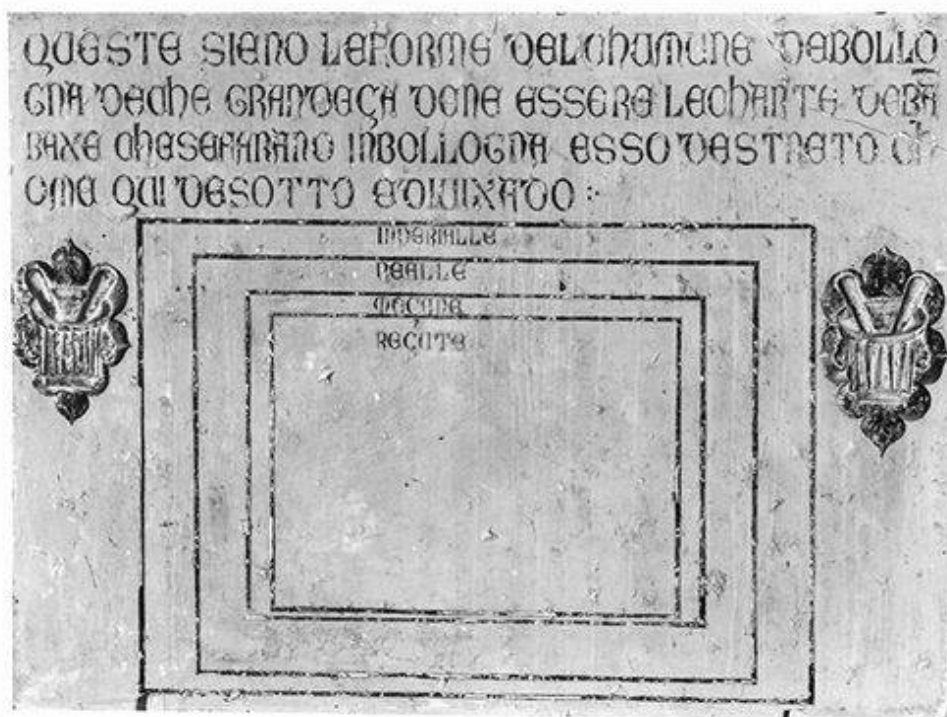


Figure 1. The Bologna stone. Traditionally attributed to c. 1389, but perhaps a Seventeenth-century copy. Image by courtesy of the Museo Civico Medievale, Bologna, Italy.

The text cut into the stone and filled with a black stucco reads, in Medieval-looking script and with Medieval-style word-spacing: “QUESTE SIENO LEFORME DEL CHUMUNE DEBOLLOGNA DECHE GRANDEÇA DENE ESSERE LECHARTE DEBA(M)BAXE CHE SEFARANO INBOLLOGNA ESSO DESTRETO CHOME QUI DESOTTO EDIUIXADO” [Figure 1]. Rendered into an approximate English, since the Medieval Italian is not exactly straightforward, it says: “These are the moulds of the city of Bologna, which say what the sizes of the sheets of cotton paper must be, which are made in Bologna and the surrounding area, as is set out here below”. There follow underneath four

rectangles, boxed inside each other, in progressive sizes, labelled “INPERIALLE”, “REALLE”, “MEÇANE”, and “REÇUTE”, which are of course the same four measurements prescribed in the statute.

The purpose of the stone is self-explanatory. In the case of a dispute about sheet-sizes, the piece of paper was placed on the stone and compared to the official measure, revealing immediately any discrepancy. The practical function is shown by the fact that the phrasing is in Italian, rather than in Latin, and thus available to people with perhaps only basic reading skills. It has been suggested that the text be taken very literally and that the moulds are meant to be compared to the stone, but this seems unlikely, both for practical reasons (*carting the moulds in from some paper-mill out of town would have pleased no one*) and for the fact that the text does distinguish between the *forme* (i.e. shapes or moulds) and the *charte* (i.e. papers or sheets), making it clear that it is the latter that are to be compared to the rectangles on the stone.

Some minor features in the text of the stone and in the nature of the rectangles require, however, additional comment, beginning with the word “bambaxe”, i.e. *bambagia* or “cotton”, to describe the nature of the fibres. Medieval and Renaissance paper, as Briquet took a lot of trouble to show at the end of the Nineteenth century [7], does not contain cotton fibres in any significant quantity; it is made up with linen and hemp. So where does the word “cotton” come from? We need to take a step backwards in time and understand that up to the Renaissance the Latin word *charta*, the equivalent of our modern paper, referred to parchment or vellum made with animal skin. When a new material appeared, in the shape of Arab paper imported from the Middle East, it is reasonable to suppose that there was some uncertainty about how it was made and what it was made with. Cotton, made from the flower of the *Gossypium* plant, was little known in Europe at the time, except as an expensive luxury material imported from the Eastern Mediterranean, together with silk. The problem is all too visible in the Medieval Latin terminology, in which the classical term for silk, *bombyx* (genitive *bombycis*), albeit a completely different substance, made from insect secretions, was extended to cotton, thus generating a long-standing ambiguity. In Medieval Italian a distinction appeared in time between *bombacina*, designating silk, and *bambagia*, which meant cotton, though the two terms were sometimes confused. According to the Nineteenth-century German scholar, Joseph von Karabacek, matters were further complicated by the provenance of some early paper from the city of Manbij (Arabic: منبج, Turkish: *Münbiç*), known in the West as Hierapolis Bambyce, also a cloth-making centre, near Aleppo (*famous also for its brand-mark soap, made with laurel oil*), in what today is Syria.

For all these reasons, when in the Thirteenth century documents in Medieval Italian begin to talk about paper, they designate it as *bambagia* or something similar. In Florence, for instance, the account book of Bene Bencivenni, written between 1262 and 1275, refers to a “quadernuccio dela banbasscia”; another document written in Prato in 1275 distinguishes explicitly between “quaderni di pechora”, or sheepskin parchment, and “quaderni di banbagia”, or paper; and so on [7]. Two centuries later, in the inventory of the manuscripts of the library of Borso d’Este at Ferrara in 1467, the document lists 148 titles, almost all of them distinguished on the basis of their physical support. The vast majority are on parchment, indicated as “in membranis”, while the twenty-seven paper and two mixed manuscripts are variously described as “in carta bombicina”, “in cartis bombicinis”, or “in papiro”. A later inventory, this time for the books of Eleonora d’Aragona in 1493, lists 71 titles, with the manuscripts in parchment described as in “charta de capreto” or “in charta buona”, while the eighteen paper items, of which half are printed artefacts, are listed as “in bambasina” or “in charta de bambaso” [7]. The advent of printing soon ensured the almost total demise of parchment as a book material, except for binding, and thus the transfer of the term *carta* in Italian (*but also the Latin charta*) to signify paper made with waste vegetable fibres.

Before turning to the four rectangles corresponding to the four different sheet sizes, a word of caution, not only about the stone itself, but also about the much wider issue of determining the ratio between the sides of the rectangle in handmade paper of any era. Mouldmaking was never rocket science. The craftsmen, who made the moulds for the paper factories in the Middle ages and Renaissance, probably possessed only basic numeracy and certainly didn’t understand all the geometry; they did know, however, roughly what shape was required. They also knew that the mould would produce a sheet with an irregular edge, which would necessarily be trimmed, that shrinkage on drying was uneven, and that serious binding would reduce the proportions even further, so absolute precision served no purpose. Over the centuries, therefore, most sheet sizes fall between and around the two ratios defined here as the “invariant rectangle” and the “double golden rectangle” (*see explanations below*), but with a certain amount of approximation, even where official legislation is concerned. These rectangles, or anything intermediate, not only produced books or documents of a more or less standard codex shape, but they were also best suited to the work at the vat in terms of balance and weight.

Since Briquet first described the Bologna stone in 1907, oscillating somewhat and rounding off his measurements to the nearest half centimetre, dimensions given for the same have varied in the literature

and so it is advisable to check which and whatever source you are using. In the following table, the measurements provided in millimetres have been uniformed by giving the height, which is the shorter measure, before the width. There is on average a difference of a centimetre between the measurements of the inside and the outside of each frame [Figure 2]. It is worth reflecting on how the stone actually worked in practice. If it was placed on a wall in the centre of Bologna, a disputed sheet of paper would have to be held in position, or possibly dampened and plastered to the marble, while officials from the municipality looked at it. In the circumstance it is plausible that the sheet had to fit tightly into the rectangle without covering the rectangle and therefore that the inner measurement should be taken as the norm represented by the stone, taking account also of deckle edges and possible shrinkage. In the final column is provided the ratio between the shorter and longer sides of each inner frame, which show a general adherence to the principle of the invariant rectangle.

	Briquet	Outer frame	Inner frame	Ratio
Inperialle	500×740 mm	510×740 mm	500×725 mm	1.45
Realle	445×615 mm	450×615 mm	440×608 mm	1.38
Meçane	345×515 mm	350×504 mm	345×490 mm	1.42
Reçute	315×450 mm	318×450 mm	310×440 mm	1.42

Figure 2. Table of measurements for the rectangles on the Bologna stone.

The terms “Imperial” and “Royal” applied to large sizes of paper, albeit with some variations, remain in constant use for the whole of the hand-made paper period and beyond; “medium”, albeit with a greater oscillation, also survived for a long time. The fourth term *reçute* defines a sheet more generally known in Italian as “comune” and in English as “chancery” (*itself a derivation from the Italian “cancelleresco”, i.e. the Papal administration*): this is the essential dimension that, albeit with minor variations, will dominate the papermaking market for centuries to come, especially after 1500 and the advent of printing.

As a word, *reçute* has puzzled scholars and Briquet himself wrote that “la signification même du mot ... n’est pas certaine”. In 1956, however, Andrea Gasparinetti cleverly suggested that the term derived from parchment making and stood for *reciso* or “cut”, i.e. it was half of a full sheet of *Royal*, which was the usual size derived from the animal [7]. The link confirms the close relationship maintained between parchment and paper in the Fourteenth century, which was only really broken by the advent of printing and the vast gearing up of the paper industry driven by the new medium. The sheet-proportions set-out on the Bologna stone therefore are not innovative; indeed it would be surprising if they were. They reflect a much older *status quo*, established by the handwritten Medieval book on parchment, which the city’s legislators faced with the new medium are rendering official.

Now here is an enjoyable little game to play on people who know nothing about paper and even on those who know quite a lot about paper. Take a sheet of modern A3 or A4 paper out of the nearest photocopying machine or printer: it is difficult to think of a more ubiquitous object or more representative of what we think of as modern civilisation. Project an image of the Bologna stone on a screen, hold the sheet of A3 or A4 in the beam of light so that it covers one of the rectangles on the stone: the audience will note with amazement that the proportions are (*almost*) exactly the same. Why? If we exclude that Bologna’s Medieval university, which had been in existence for three hundred years before the approximate date of the stone, had a science park where some time around 1300 photocopiers were invented, there has to be some other reason, such as geometrical.

The A and B series of paper sizes were established at an international level in 1975 with ISO 216, although they actually go back to the older DIN (Deutsches Institut für Normung, *at the time called the Normenausschuß der deutschen Industrie*) standard 476 of 1922. In the A series the measurements are as follows:

0: 1189×841 mm [= a physical area of 1 square metre]

1: 841 ×594 mm [= a physical area of 1/2 square metre]

2: 594×420 mm [= a physical area of 1/4 square metre]

- 3: 420×297 mm [= a physical area of 1/8 square metre]
- 4: 297×210 mm [= a physical area of 1/16 square metre]
- 5: 210×148 mm [and so on]
- 6: 148×105 mm
- 7: 105×74 mm
- 8: 74×52 mm
- 9: 52×37 mm
- 10: 37×26 mm

The A3 sheet therefore is a couple of centimetres smaller than the Medieval *reçute* shape, but maintains the same approximate proportions. In the DIN standard the ratio between the sides, albeit rounded off to the nearest millimetre, is 1 to 1.414, but refers to an irrational number, which, reduced to a mere 65 decimal places reads 1.41421 35623 73095 04880 16887 24209 69807 85696 71875 37694 80731 76679 73799. More simply, for those who, like myself, did so badly in maths at school that this figure leaves them totally perplexed, it is the square root of two, or $1 : \sqrt{2}$, which the ancient world knew as a Pythagorean constant [7]. The larger B series, which we commonly perceive as squarer, in which B3 measures 500×353 mm and B4 353×250 mm, is also an expression of the common mean of square root of two (*i.e. if you divide the short side into the long side, you still get a ratio of 1.416*).

A rectangle based on the proportions $1 : \sqrt{2}$ has a special property: you can double it or halve it and the relationship between the sides remains invariant. (*We are actually familiar with the fact from knowing that, if we run out of A4, we can tear sheets of A3 in half, but I suspect few of us knew that this trick has been around for nearly a millennium.*) Equally interestingly, the rectangle based on the square-root of two seems to go back to well before the beginning of the Western book, since the sheet-sizes of Arab and oriental paper often, albeit not always, seem to have been constructed according to the same principle (*unfortunately codicologists have not investigated the phenomenon with any sort of thoroughness; in fact I doubt whether most of them are even aware of it*). It is a moot point as to whether the Medieval Italian parchment workers, who passed this precious snippet of knowledge on to the papermakers, were aware of all the geometry, since in cutting up an animal skin, this particular rectangle produces the least wastage. However, they knew enough to understand the principle and to construct their rectangles accordingly.

On the Bologna stone *Meçane* is half the size of *Imperiale* and *Reçute* is half the size of *Realle*: the latter fact leads to a circumstance that some manuscript scholars, but above all incunabulists, know from bitter experience, *i.e.* books with a mixed format, in which half-sheets of royal have been introduced together with full sheets in chancery. The fact that early printers frequently used a variety of sheet sizes has also caused confusion in the cataloguing history of some editions. Just to give one example, based on a census of all the extant items, the height of the surviving copies of the first edition of Pius II's *Epistolae in cardinalatu editae*, published in Rome in 1475, vary between a minimum of 255 mm and a maximum of 290 mm (ISTC ip00710000) [28]. A book of the latter height would normally be a folio, but in fact the edition is a quarto printed on Royal paper, albeit with one sheet reset and printed on two sheets of Chancery, so that technically the format is mixed. In any survey therefore the sheer amount of variation that copies, which were once identical, have acquired in five hundred years of separate history remains a daunting obstacle.

The Fifteenth Century, and Afterwards

By the final quarter of the Fifteenth century intermediate sizes entered into circulation, in addition to the four basic measurements represented by the Bologna stone. Clearly the demands of the printing press and the rapid rise in the request for paper brought about by the new medium played the main part in their divulgation. The scholar who has drawn attention to these different measures, with due nomenclature, in a series of brilliant articles, has been Paul Needham [7]. Taking the year 1500 as a cut-off point, or rather just a year further to include the Aldine shop in 1501, six new measurements, are defined and described: five in a 2017 article, which represents a summa of his thoughts on paper, and the other in an earlier article on Aldus, as follows:

- “Papal” or “Gradual”. Famously, the largest book, in terms of its physical height and breadth, published in the Fifteenth century was the 1499 *Gradual* published in Venice by Lucantonio Giunta on 28 September 1499 (ISTC ig00332000), and it was followed by the two volumes of the associated *Antiphonarium* in 1503-

04. These remarkable editions, printed in red and black, with extensive musical notation and appositely cut woodcut initial letters, must have been enormously costly to produce and required an extra large sheet, measuring approximately 560×770 mm, which was also exceptionally thick and strong, almost leathery in its consistency. At least one copy of the Gradual, now in the Marciana Library in Venice, was also produced on parchment. Needham draws attention also to the *Graduale abbreviatum*, printed in Parma in 1477 (ISTC ig00329800)

- “Super-royal”, “Law-royal”, or “Reale bolognese”. Needham challenges the measure for “realle”, at least as far as the Bologna stone is concerned, arguing that very few manuscripts and printed books in the Fifteenth century have sheet-sizes of the dimension 445×615 mm (*as in Briquet, or 440×608 mm, if we base the measurement on the inner frame*), and therefore that genuine Royal in this period is a smaller sheet close to 400 mm in height. He identifies, however, a larger sheet-size, which he designates Super-royal, in which the original dimensions were approximately 430–440 mm in height, while the width perhaps broke with the tradition of the invariant rectangle, remaining narrower at about 590 mm. The outcome in folio format is a rectangle that appears narrower and higher, and thus more suitable for legal texts with lots of surrounding commentary, than its Royal cousin.
- “Super-median”, or a larger than Median size, is defined, for instance, in the contract to print the *Lexicon graecum* of Suidas in Milan in 1499 (ISTC is00829000), where the printers accept the requirement to print “dictum opus ... in papiro in forma paulo maiori quam sit mezana” [translation: *the said work in a size that is a little larger than Median*]. Larger than Median sheets were also employed in ambitious large-scale projects, such as the Bibles in folio format published in Venice by Scoto in 1489 or by Paganinus in 1495, where the unusual sheet-size is marked by the anomalous placing of a small flower watermark in the corner of the mould [see Chapter 5]. Extant copies of these editions possess heights that are consistently too small for Royal sheets, even heavily cut down, but are superior to the maximum measurement of a Median sheet. In these editions the height of the largest documented copies suggest a height in the order of 360 mm; assuming again a divergence with the invariant rectangle, so as to obtain a folio with a taller, narrower, shape, the width of the sheet was probably about 500 mm.
- Fitting into the sequence, but strictly speaking belonging to the first year of the Sixteenth century, is “Narrow median” for the Aldine octavo format. Needham has convincingly demonstrated that the illustrious series of Aldine octavo editions of Greek, Latin, and Italian classics, launched in 1501 and famous as the progenitors of the Italic typeface, were also the first to change radically the shape of the small-format book. Aldus ordered and obtained from the paper mills a squarer sheet with dimensions approximately 350×420 mm, in other words a “Narrow median”, or, alternatively, a double golden rectangle with proportions of 1 : 1.236. In formats, in which the principal fold is parallel to the short side of the sheet, such as folio and octavo, the result is a golden rectangle, or 1 : 1.618 *ad infinitum*. What Aldus in his 1513 sale catalogue termed the *Libelli forma enchiridij*, or pocket books, have a terribly familiar oblong shape for modern readers, since they were taken as inspiration by Hans Mardersteig for the first Albatross editions, followed by Jan Tschichold in the design for Penguin.
- “Super-chancery”. A slightly higher sheet, albeit with much the same width as Chancery, seems to have been prevalent in the Aldine shop in the 1490s, in particular in the printing of the great five volumes of Aristotle in Greek from 1495 to 1498, also in the 1499 *Hypnerotomachia Poliphili*. The measurements suggested by Needham are approximately 330×460 mm.
- “Half-median”. An unusual, smaller than Chancery, sheet, measuring approximately 250×350 mm, employed in particular in the Venetian printing shop of Franciscus Renner in and around 1480. The characteristic is that it is used together with a mix of half-sheets of Median in the several editions identified as employing this particular size of sheet.

When handling Fifteenth-century printed editions, it is important to understand that the different sheet-sizes are distributed in very different ways. In terms of quantity, Chancery sheets are increasingly common in printed editions in the last two decades of the Fifteenth century. Royal is the next most frequent size, and though less ubiquitous than Chancery, is relatively easy to find up to about 1480, especially for the printing of legal texts. Imperial on the other hand was reserved for special projects such as the 1493 Schedel Nuremberg chronicle. The most difficult size to identify is Median, since generally there is a possibility that it is a cut-down copy of a book in Royal sheets. Likewise the intermediate measures are not found in large quantities and can be tricky to identify: Super-royal again is associated mainly with legal editions; Super-median, Super-chancery, and Half-median are recognisable in relatively few instances, while the Gradual size used in 1499–1504 by Lucantonio Giunta was very much a once-off commission.

Working out the original sheet-size in a manuscript or in an incunable requires expertise and experience. It is

important to note not only the measurements of copies, but also the density of the sheet: the larger the original sheet, the thicker the consequent leaf. Apart from the complication posed by folding and formats, copies have obviously been cut down by the binder, so, where possible, it is important to base the assessment on a copy still in its original binding. Another good idea for printed editions is to collect the measurements of copies described in catalogues (*with the proviso that not all cataloguers are clear whether their measurements are for the binding or for the leaf, and also that the largest collections, which most helpfully provide indications about the size of copies, such as the British Library (BMC) and the Bodleian (Bod-Inc), have a high proportion of copies in modern bindings*).

In the process of identification one generally departs from the assumption that the watermark is regularly placed at the centre of the leaf in a folio format (*or one chainline in towards the true centre in many Fabriano papers*). Complications can arise, however, when slightly different sizes are mixed together. For example, the Venetian edition of the chivalric romance *Merlin*, published in 1480 (ISTC im00498500), is in a folio format, while copies vary in height between 257 and 302 mm. Normally this would be a chancery measure, but most of the watermarks are markedly off-centre, generally in the inner column, though sometimes in the outer. What plausibly happened is that a supply of median sheets was used for the edition and deliberately placed in an off-centre position on the tympan, leaving a large margin at the bottom and on one side, which was subsequently cut away by the binder.

Another instance, and a book I invite people to look at if they get a chance (*it is not rare*), is the fascinating little Bible published in Venice by Franz Renner in 1480, where repertories of incunabula have struggled to recognise the correct format. Older authorities departing from Hain 3078 give it as quarto; the *Gesamtkatalog der Wiegendrucke*, n. 4241, followed by the Italian *Indice generale degli incunaboli*, n. 1661, describe it as mixed quarto and octavo; while an alternative interpretation, beginning with Pellechet and Proctor, followed by BMC V, 195, and the ever-modifiable ISTC, say that it is a mix of folio and quarto. This last indication is the most correct, but the format is only half the question, since the edition is a complicated pot-pourri of different sheet-sizes. One sample copy in the Franciscan library in Florence is made up with 127 sheets of folio Half-median, 67 half sheets of unwatermarked quarto Median divided before printing, and 41 sheets of folio Chancery, placed slightly off-centre on the tympan, while other copies also contain the odd stray sheet of folio Median, placed well off-centre on the tympan.

As far as understanding book-sizes goes, the Sixteenth century and afterwards is largely uncharted territory. What certainly happens in the short term is that books get smaller, both in terms of sheet-sizes and formats. Outside legal publishing in the first quarter or so of the Sixteenth century, where Median, Super-median, and Royal remain extant, Chancery is the dominant form, though this label probably covers a multitude of sizes and sizes. By about 1540 in Italy over 80% of formats are medium and small, which lead the printers to order thin sheets of paper in order to cope better with the multiple folds, as well as making them lighter in terms of transport. The abandonment of parchment as the principal writing and printing material, the decrease in the size of the books, and the vast increase in the number of books in circulation, brings about a revolution in the way books are stored. Instead of large volumes placed horizontally and chained to a bench, as is still the situation in the extraordinary Malatestiana Library in Cesena (*if you have gone for a week to Rimini and not taken a day away from the beach to see this enchanting library space, you have seriously wasted your suntan lotion, and your entire existence*), books were placed upright. The bookshelf came into being, one of the most significant and earthshaking revolutions in the whole history of the organisation of knowledge, and thus almost entirely unnoticed.

No general survey to establish post-1501 sheet-size ratios, to my knowledge, has been conducted. Such information naturally cannot derive from bound imprints, which have often gone through several rebindings and consequently been cut down. On the other hand, unbound books, of which the Rare Book School in Charlottesville has a fine collection, albeit mostly late Eighteenth century, might prove a valuable starting point. Sheets in archive volumes are certainly a better prospect and a preliminary assay could easily be obtained by tabulating the measurements in Briquet, discarding perhaps those entries marked as "r.", or *rogné*, though, as ever with a repertory on this scale, it would be an immense task. The material in my own collection of handmade sheets of paper, mostly made in Tuscany in the second half of the Eighteenth century, as well as a set of unbound items from Florence from the beginning of the Nineteenth century, suggest that Italy kept its penchant for the invariant rectangle. Northern Europe on the other hand leaned more towards the double-golden rectangle.

Paper Formats ca. 1672

Dimensions and format names of 67 French, Dutch and Italian paper stocks from the English merchants Alexander Merreall (b. 1635?) and Thomas Seaward (d. 1673). From a list drawn up by Thomas Yate, John Fell's partner operating the University Press at Oxford.

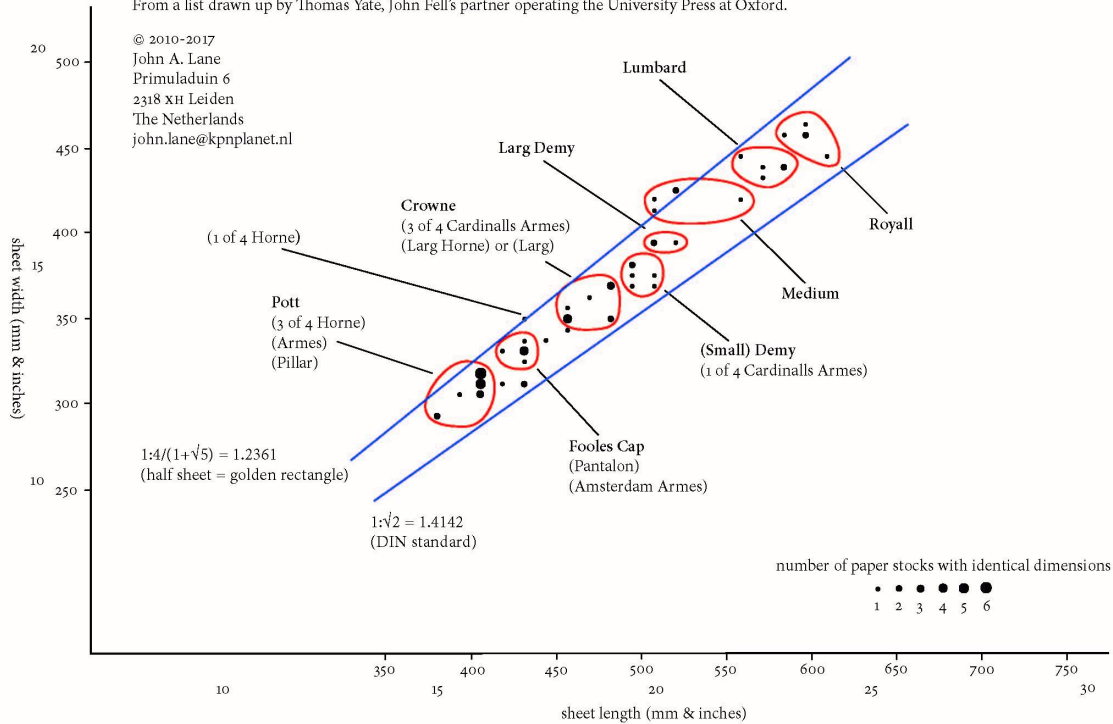


Figure 3. Tabulation of the sheet-sizes and ratios of the same in the late Seventeenth-century inventory sent to the Oxford University Press. By permission of John Lane, to whom I express my gratitude for allowing it to appear here.

One fascinating document, first published by R.W. Chapman in 1927, is a late Seventeenth-century list of paper-sizes sent to Oxford University Press, which includes the measurements of the same in traditional inches [8]. The relative dimensions have been tabulated in graph form in an ongoing research project by John Lane (*whom I thank for his generosity in allowing me to make it available here*), making it possible to see at a glance the relationship between the sheet-sizes and the hypothetical norms of the double golden rectangle and the invariant rectangle. What appears is a distancing from the Medieval norms, with a distinct preference for squarer shapes, but also inconsistency, and perhaps a certain forgetfulness of the geometrical principles involved [Figure 3]. A quick glance also at the measurements provided in subsequent official legislation, in particular the French law of 1741 and the English one of 1781, confirms this impression, though the French shapes remain closer to the invariant rectangle.

Unfolding Formats

When a sheet of paper or parchment is folded, its size inevitably changes and this introduces the bugbear of format, which is nevertheless the key to understanding all book structure [9].

The format of a manuscript or a printed book is defined by the number of leaves created by folding the sheet of paper made at the vat.

If it has not been folded at all, it is a broadside or 1°. This format, however, ostensibly the most simple of all, generates numerous problems. First, in the inability of cataloguers (*and bibliographers*) to recognise it; second, in knowing what to call it. The earliest examples, in terms of printed texts, are single sheets, sometimes as halves or quarters, usually ephemeral and thus with a very poor survival rate. The principle

obstacle to doing anything on a larger scale evidently was the binding, since the single sheets had to be mounted so as to be sewn, which was a time-consuming and costly operation. On the other hand, if a printer wanted to produce a very large book, sometimes in conjunction with large copper plates, this format was the best option. The earliest example I have personally encountered is the hefty *Imperatorum Romanorum ... Verissimae Imagines* by Iacopo de Strada, published in Zürich in 1559, where single copies are 50+ cm. in height. Hardly surprisingly, perhaps a trifle disappointingly, the more prestigious standard repertories, such as VD16, the Italian SBN Libro Antico, the USTC, the UK libraries united in COPAC, unanimously describe the format in this instance as folio. Of course, “broadsheet”, applied to such a bulky volume, is not a happy term and one can understand people feeling uncomfortable with it. Alternatives I have noticed are “double-folio” (*which is tautologous*), “portfolio” (*which is meaningless*), “in plano” (*which is Latin and thus difficult to understand*), and “atlante” (*advised by the Italian SBN manual, which appears limiting in terms of its category*); on the other hand, the American manual, *Descriptive Cataloguing of Rare Books*, 2nd edition, Washington, Library of Congress, 2007, rule 5D1.3, suggests: “Use ‘full-sheet’ for publications made up of unfolded sheets”. This appears excellent advice and I should follow it.

If the sheet has been folded once, it is a folio or 2°. Printing manuals, beginning with Hornschuch's *Orthotypographia* in 1608, and their bibliographical counterparts invariably furnish diagrams of formats for the printed book. It is quite common, however, for archive documents to employ “agenda” formats, in which the fold is parallel to the long side of the sheet. For instance, the manuscript *Zornale* of bookseller Francesco de Madiis (1484) in the Marciana Library in Venice is formed with eight 20-leaf gatherings of perhaps cut-down Median sheets, folded in parallel to the long side, creating a tall, narrow ledger, ideal for book-keeping purposes.

If twice, it is a quarto or 4°. Again, music books often employ an agenda format, in which the sewing fold is parallel to the short side of the sheet.

If thrice, it is octavo or 8°.

If four times, it is duodecimo or 12°, or it can be sextodecimo or 16°; and so on.

Outer/inner frame	Fullsheet	Folio	Quarto	Octavo
Papal/Gradual	520×770 mm	520×385 mm	385×260 mm	260×183 mm
Imperial [inperialle]	500×725mm	500×363 mm	363×250 mm	250×182 mm
Super or Law-royal	440×590 mm	440×295 mm	295×220 mm	220×148 mm
Royal [realle] Bologna stone	440×608 mm	440×304 mm	304×220 mm	220×152 mm
Royal (Needham)	400×566 mm	400×283 mm	283×200 mm	200×142 mm
Super-median	360×500 mm	360×250 mm	250×180 mm	180×125 mm
Narrow Median (Aldine octavo)	350×420 mm	350×210 mm	210×175 mm	175×105 mm
Median [meçane]	345×490 mm	345×245 mm	245×173 mm	173×123 mm
Super-chancery	330×460 mm	330×230 mm	230×165 mm	165×115 mm
Chancery [reçute]	310×440 mm	310×220 mm	220×155 mm	155×110 mm
Half-median	250×350 mm	250×175 mm	175×125 mm	125×88 mm

Figure 4. Table of sheet-sizes and formats in late Fifteenth-century and early Sixteenth-century paper.

If the sheet of paper is made according to the invariant ratio $1 : \sqrt{2}$, folio, quarto, octavo, and all the lesser formats based on folding in eights maintain the same proportions. Formats based on folding in sixes or twelves, however, such as duodecimo, 18°, 24°, 36°, produce a taller narrower rectangle. Music formats often employ solutions, in formats such as 4° and 8°, in which the rectangle is horizontal rather than vertical, involving a different folding pattern in order to sew the gathering along the short edge.

Though the measurements on the Bologna stone are not to be taken to the letter, since time and geography inevitably saw differences and the sizes themselves in two cases do not correspond perfectly to the invariant rectangle, they are necessarily a valuable departure point. The table provides an indication, for the three most common formats, of what leaf-sizes become in uncut copies after folding [Figure 3]. As well as the four sizes on the stone itself, given on the basis of the inner rectangle, the table introduces the alternative measures suggested by Paul Needham, including a separate calculation for a smaller version of Royal. All these indications should be taken as approximate, and in some cases as hypothetical (*Papal and Half-median, for instance, are only known as folio formats*).

In the calculation of size it is reasonable to assume that each binding in the history of a book results in the removal of a couple of centimetres for large formats (*folio-quarto*) and a centimetre for small formats (*quarto-octavo and downwards, though on a fold this doubles*). It is therefore important to gather measurements from as many copies as possible, including reliable indications of leaf sizes in those catalogues that do provide accurate leaf-size measurements, before attempting a diagnosis.

At some point in history, library cataloguers decided that actually looking at the paper was too difficult and therefore adopted a system of standard measures, i.e. a folio was any book more than 28 cm, and so on. This sublimely unhappy piece of idiocy was promulgated on a large scale in card catalogues and in some printed sources up to the end of the Seventies, when it quietly disappeared. So far I have not discovered where it originated, but it seems to have derived from publishing practices in the Nineteenth century [9]. Its wholly erroneous practice and conceptual laziness probably accounts for a fair number of the bad and mistaken indications relating to format that persist in various bibliographical repertoires, though it should be said that these are being gradually identified and weeded out. As matters stand, however, any indication provided about a format inferior to 16° in a catalogue should be treated with caution (*and in some cases even this assertion is over-optimistic*).

The make-up of gatherings adds a further complication to the problem of correctly diagnosing a format and consequently the structure of the book.

From the binder's point of view, when the book was a folio, there was no purpose in treating each and every sheet as a separate gathering and so printers had no difficulty in adopting the solution, prevalent in manuscript culture, of constructing gatherings with several sheets of paper sewn at the centre, so that bibliographers speak of a book as gathered in twos (*one sheet*), fours (*two sheets*), sixes (*three sheets*), eights (*four sheets*), and tens (*five sheets*); much beyond this point, the strain on the sewing at the centre tended to exclude larger constructions, although cases are known. Chronologically, incunables tended to favour gatherings in eights or tens; in England in the Seventeenth century gatherings in sixes were commonplace, the exceedingly famous example being the 1623 Shakespeare *First Folio*.

If the format is quarto, it is not uncommon for the sheet to form the whole gathering, but it is even more common for it to be gathered in eights, i.e. a second sheet is placed at the centre of the first. In this structure leaves 1.2.7.8 belong to the outer sheet and leaves 3.4.5.6 to the inner sheet. Together with octavo, the latter is the most frequent of all book structures. Some early English printers, however, employed quarto formats with six-leaf gatherings, i.e. a full sheet and a half-sheet in the middle.

If the format is octavo, in most cases the sheet and the gathering coincide. The same is true of duodecimo, although in France in the Seventeenth and Eighteenth centuries printers were fond of quiring them as successive gatherings of eight and four leaves, each pairing being from a full sheet printed as a single unit. Take note, however, that printers had two radically different approaches to duodecimo. The older solution is substantially Venetian, in which the layout was parallel to the long side of the sheet (*horizontal chainlines*) and a strip at the bottom of the sheet was cut off to be placed at the centre of the gathering; in Northern Europe, however, printers preferred the long 12°, in which the layout is parallel to the short side (*vertical chainlines*) and the gathering is folded accordion-wise, without having to cut off a strip, so the result is the same height as an octavo, but much narrower.

If we go a step further down the rung, into formats such as sextodecimo, the sheet is generally divided between more than one gathering. Printers did, however, have the option of using half-sheet imposition, in which the text of the gathering was set in its entirety in the same forme, which printed both sides of the sheet; each sheet thus generated two copies and had to be cut in half and separated before the book was bound. (*But if you want to explore these arcane matters more fully, you really want the parallel course on analytical bibliography, where these problems will be explained with admirable clarity.*)

Among the smaller formats it is also possible to note different habits and preferences in the various geographical areas. In the Sixteenth century duodecimo format was hardly ever used in France, the

exceptions being mostly books in Italian. The format Lyon printers, especially a firm such as De Tournes, preferred was conversely sextodecimo: in one sense, therefore, this is not an Italian format, but the close links between Lyon and Venice meant that it was often imitated in peninsula centres, mostly for texts in Latin being exported back over the Alps. Other formats that characterise particular geographical areas are long twelves or twenty-fours, in which the first fold of the sheet is parallel to the long edge. The Elzevir firm in Holland and Belgium used these distinctive formats for their prestigious series of classics.

If this last page and a half has troubled you, do not worry, most Medieval and Renaissance books employ large and medium formats, which are simple enough to identify. It is difficult, however, to obtain precise figures across a number of centuries, and any and every consultation of online repertories gives wildly variant results. As an alternative, a number of years ago, I spent a week ploughing through the entries for the books printed in Italy recorded in the first two letters of the alphabet (A-B) in two printed catalogues, i.e. the *Indice generale degli incunaboli* (IGI) issued in 1943, updated in 1981, and in the *Edizioni italiane del XVI secolo*, of which 'B' appeared in 1989 and the revised 'A' in 1991. The operation involved a fair amount of bibliographical manipulation and compensation, since some authors, even well known ones, have different headings: most notably Dante Alighieri, who is entered under his name in the incunable repertory and under his family name in the Sixteenth-century follow up. Albeit largely overtaken by events, the table that resulted provides a useful little summary of the relationship between the different formats in Italian publishing of the said period of 135 years [Figure 5].

	1465-80	1481-1500	1501-20	1521-40	1541-60	1561-80	1581-1600
2°	241 (54,2%)	515 (39,4%)	295 (32,7%)	142 (13,0%)	188 (12,6%)	230 (13,2%)	231 (9,8%)
4°	180 (40,5%)	653 (50,0%)	389 (43,1%)	345 (31,6%)	423 (28,4%)	766 (44,1%)	1091 (46,2%)
8°	23 (5,2%)	135 (10,3%)	207 (22,9%)	573 (52,5%)	768 (51,5%)	531 (30,6%)	740 (31,3%)
12°			2	11	49	157	225
16°	1	4	5	15	50	45	53
18°					1		6
24°			2	3	6	5	14
32°			3	3	5	2	1
% small formats	(0,2%)	(0,3%)	(1,3%)	(2,9%)	(7,5%)	(12,0%)	(13,1%)
total	445	1307	903	1092	1490	1736	2361

Figure 5. Table of formats in Italian printed editions 1465-1600.

Up to the end of the Sixteenth century, as the table shows, the extremely small, difficult to diagnose, formats are produced in almost negligible quantities. An edition of Dante was published in 18° in Venice in 1545, while early in the century a virtuoso (*show-off*) printer such as Alessandro Paganino experimented with a series in 24° [9]. Formats become more problematic in the Eighteenth century, when presses improved and thus were able to print larger sizes of sheet, while in the Nineteenth century the introduction of the iron hand-press took the process a stage further, especially when microscopic formats became a way for pupils of the typographical schools of the time to display their skill.

Paper-making techniques also evolved and added complications. In response to the request for small sheets of an appositely watermarked quality paper, for the purpose of letter-writing, special double-moulds were constructed, which made simultaneously two small sheets. Deciding what to call the format in these cases is never straightforward, but they remain exceptions that do not invalidate the general rule.

The truly big complication of course comes with the appearance of wove paper from 1757 onwards, since the helpful wire and chain-lines that play such a large part in deciding format promptly disappear [15]. Nevertheless, if wove paper made at the vat is used in a printed book, every effort should be made to determine the correct format. Early wove paper shows irregular striations in correspondence with the ribs underneath the mesh; once the experimental phase was over, watermarks were again attached to the surface and by their placing, especially the fact that the alignment is with the long edge, make it possible to determine format.

One reason for the relatively slow introduction of wove was the greater expense, not only in terms of making the mould, but also because the work at the vat was slower, since the water drained through the mesh less quickly. A consequence of this increase in cost is the variance in prices when an edition was printed with distinct print runs, one on laid and one on wove: for instance, the second edition of the *Tragedie* of Vittorio Alfieri, published in Paris in six volumes in 1788-89, was advertised as "Prix 48 livres les six volumes en feuille. Les copies en papier vélin, 100 livres", or more than double; in Milan in 1827 the first edition of Manzoni's *Promessi sposi* offered copies on laid at 12 lire, while those on wove were priced at 20 lire [30]. This fact means that, if there is some difficulty in deciding a format in wove, another copy may exist printed on laid, in which the solution is more simply diagnosed.

With the arrival of mechanical paper-making at the beginning of the Nineteenth century, in which the sheets are cut from a continuous roll, the concept of format becomes improper and redundant [16]. It is nevertheless always useful, in the case of a printed book, to apply paper analysis in order to discover the imposition of the typographical forme, but this operation should never be confused with the format derived from the sheet printed at the vat.

The difficulty, if anything, is to decide between wove paper made at the vat and mechanical paper made on a Fourdrinier or on a cylinder machine, since in appearance the two are very similar. One simple test, with loose sheets of paper, is to place it on a damp cloth and to allow it to absorb moisture. If all four edges rise, it is vat-made; if only two, due to the alignment of the fibres, it is mechanical. Of course this sort of experiment is frowned upon in most major libraries and archives, so the alternative is to scrutinise the paper with care. Up to about 1850, if the paper is watermarked, it is almost certainly vat-made. In 1836 a dandy-wheel was introduced for mechanical paper-making machines, which left an imprint on the sheet a second or so after it had formed. It was not possible, however, to position this with the same accuracy as in hand-made paper, until somebody had the idea of punching holes in the continuous sheet to act as a guide in the subsequent printing process. This expensive procedure was nevertheless reserved mostly for bank-notes, share certificates, and other documents that had to be forgery-proof.

What most often betrays mechanical paper is the seam that resulted from the two ends of the length of wire being sewn together. If a bibliographer has the patience to search through a certain number of copies of the same book, which it is believed is on mechanical paper, sooner or later the seam will reveal itself. In some instances, when the net began to suffer wear and tear, repairs were made to the same, in the form of stitching or small patches attached to the mesh, which in turn leave distinctive signs on the surface of the sheet.

Chapter 5

Dillying and Dallying with Watermarks

A distinguishing mark or device impressed in the substance of a sheet of paper during manufacture, usually barely noticeable except when the sheet is held against strong light.

The Oxford English Dictionary, s.v. Watermark § 5

Watermarks like wrens go in pairs.

Allan H. Stevenson, 'Watermarks are Twins', *Studies in Bibliography*, vol. 4 (1951)

A daring dash of schoolboys, safely, shoulder to shoulder, with their fathers' trilbies cocked at a desperate angle over one eye, winked at and whistled after procession past the swings of two girls arm-in-arm: one pert and pretty, and always one with glasses.

Dylan Thomas, *Quite Early One Morning* (1954)

Not surprisingly, the Guide's graphically enticing description of the general state of affairs [the Fuolornis Fire Dragons] on this planet has proved to be astonishingly popular amongst hitch-hikers who allow themselves to be guided by it, and so it has simply never been taken out, and it is therefore left to latter-day travelers to find out for themselves that today's modern Brequinda in the City State of Avalars is now little more than concrete, strip joints and Dragon Burger Bars.

Douglas Adams, *So Long and Thanks for All the Fish* (1984)

What can be said about watermarks?

That they are beautiful, enigmatic, intriguing, fascinating ... (*did I just describe myself? well, like Garfield, whom I fervently admire, if I were just a little bit more modest, I'd be perfect*).

People who know nothing about paper are often filled with wonder when they see these translucent images of long-lost or fantastic objects peering out of centuries-old sheets of paper.

Of course just being able to recognise a watermark is an underappreciated skill that requires in the first place a more than passing acquaintance with the visual conventions of filigranology, since what appear to a novice a flying saucer and a space-rocket are in fact a cardinal's hat and a key (*at least, one hopes, but UFO-ologists may think differently*).

Matters are complicated, especially in printed books, by formats, bindings and long-standing conservation practice (*i.e. what goes under the iniquitous and misleading term of "book restoration"*), to the point that even finding the sign can be a frustrating experience. Rare books in prestigious collections have often been washed and ironed before rebinding, with consequent loss of evidence; any format lesser than folio pushes the watermark into the margin or onto the edge of the leaf, where chunks can be cut away; heavy manuscript or print can obscure the forms of the object represented; and the ubiquitous neon light of expensively refurbished reading rooms in libraries leaves paper about as transparent as marble. And librarians can be extraordinarily unhelpful (*though most are absolutely charming!*).

In what are therefore far from ideal working conditions only genuine expertise can piece together the *disiecta membra*, give a name to the object and point the inquirer to the relevant page in Briquet or some other manual. But there is a touch of vicarious satisfaction, when others are not even sure that something is there, in being consulted in some library, glancing at the paper stock, and recognising a fragment of a foot as belonging to a *Pilgrim* or to an *Angel*. (*Well, even if you are not insanely into filigranological one-upmanship, it's usually worth a coffee and a brioche from a fawningly grateful colleague.*)

Nothing like watermarks exposes the bitter fragility of observation. It is not gracious to say so (*so I'll say it*),

but few, if any, scholars, even experienced bibliographers, can be trusted to observe paper in general and watermarks in particular with any degree of reliability or accuracy. They fail to take notice of the size of the sheet or the distance between chain-lines, whether the watermark is resting on a supplementary chain-line, whether they are looking at the sheet from the mould or the felt side, whether the watermark is in the right or left-hand side of the mould, whether they have identified the twin watermarks, whether there are tranchefiles, and so on and so forth. These drawbacks in preparation and knowledge on the other hand rarely, if ever, prevent them from building towering castles of hypothesis on these sloppy, wobbly, happy-go-lucky foundations.

If a casual inquiry about whether they have understood any of the above points meets only with a blank look, the wisest policy is just to walk away. Some people will never get it.

Watermarks. The Earliest Dates

A sheet of paper is a moulded object. Briquet said it. Please understand this one, single, bloody-minded fact.

If we can work backwards from the object made on the mould to establish the physical characteristics of the mould itself, and thus to relate it to other objects formed on the same mould, the outcome is an important tool for bibliographical research.

On this particular fact I have always felt that the man himself, who after all spoke in the guise of a former employee of a paper-mill and somebody who worked all his life in the stationary trade, so he had a good idea of how often it was necessary to fork out for a new pair of moulds, puts things beautifully in a rightly celebrated passage, first published in 1892 and reprinted in his *Opuscula* in 1955 [10]. Harken therefore:

“Toute feuille de papier filigrané porte en elle-même son acte de naissance, le difficile est de le déchiffrer. Rappelons qu’une telle feuille a reçu en effet l’empreinte de la forme sur la quelle elle a été faite; c’est donc un objet moulé, comme une médaille ou une monnaie, dont tous les exemplaires sont semblables entre eux. Or, une forme à papier est promptement mise hors de service; sa durée moyenne ne dépasse pas deux ans. Lorsqu’elle est usée, elle est remplacée par une autre, qui n’est jamais absolument identique à la précédente; elle en diffère par la vergeure, par le nombre et l’écartement des pontuseaux, par les contours ou les dimensions du filigrane ou par la position qu’occupe ce dernier sur la forme. Pour pouvoir préciser la date de fabrication d’une feuille de papier, il ne suffit donc pas qu’elle porte un filigrane analogue à celui d’un papier d’une date connue; il faut que les deux filigranes soient identiques, placés au même endroit de la forme, il faut que le format, la vergeure et les pontuseaux des papiers comparés soient les mêmes. Il convient encore de rappeler que, dans la fabrication du papier, on se sert toujours simultanément de deux formes et que, bien qu’exactement contemporaines, ces deux formes offrent toujours quelque dissemblance” [translation: *Every sheet of watermarked paper is in itself its own birth certificate. The difficulty is in deciphering it. Remember that every such sheet bears the imprint of the mould on which it was made. It is therefore a moulded object, like a medal or a coin, of which all the copies are alike. Now, a papermaking mould does not last long, on average not more than a couple of years. When it is worn out, it is replaced by another one, which is never absolutely identical to the previous one; it will differ in the wires, in the number and the distances between the chain lines, by the shape and the size of the watermark or by the placing of the same on the mould. In order to be able to state the date of fabrication of a sheet of paper, it is not enough therefore that it has a watermark similar to that on a dated piece of paper; the watermarks have to be identical, positioned at the same point on the mould, and the sheet-size, the wires and the chain lines must also be the same. It should be remembered moreover that, when making paper, two moulds are used at the same time and therefore, although made and shaped simultaneously, these two moulds always present some differences].*

Of course this statement needs some qualification. Pairs of moulds made for larger sizes of paper were used much less and thus lasted much longer (*sometimes decades rather than years*); stocks of paper could be warehoused for long periods, and so on and so forth, but when all is said and done the above is a spot-on summary of how paper scholars think and go about their business.

Not all watermarks are equal, although some are more equal than others. Over a period of seven centuries watermarks go through several evolutions in terms of their placing and their functions, which vary according to the different geographical areas.

The earliest dated instance of a watermark, according to most people who have written about paper since Briquet’s *magnum opus* first appeared in 1907, is in a document of “1282” in the city archive at Bologna (*Les filigranes*, n. 5410). The year 1282 forms part of the title of the work, which was perhaps a shade audacious,

given that it has had the unfortunate and perhaps unintentional consequence of canonizing the statement [19].

In fact, the evidence is rather more dubious and the correctness of the date is very much open to question. If we actually take the bother to read entry n. 5410, which refers to a tracing of a large Greek cross, i.e. in a circle with four pommels, it should be noted, first, that the date was followed by a question mark, so Briquet was not sure about it – what he writes is “Bologne, 1282? et 1287-88”, followed by references to another larger sheet found at Naples, dated 1321, and to Keinz’s 1896 catalogue of manuscripts at Munich, where the example is dated 1294 – , and, second, if we browse through the surrounding images, relating to analogous Greek crosses, most of them relate to the 1290s and none are for the years 1283 or 1284.

Returning to entry n. 5410, what was the document involved? Unfortunately, and unfortunately is something of a misnomer, the reference Briquet provides to the archive series is a blithely unhelpful “Podestà” (i.e. Mayor) for Bologna’s State Archive, located just by the city’s Piazza Maggiore and very pleasant place to work (*Bologna’s fame as a gastronomical paradise is entirely deserved!*). One wins no prizes for guessing that “Podestà” is a sizeable archive in its own right. One would like to think that subsequent scholars, given that a century and more has passed, have sought out this earliest example recorded by Briquet. Like Hell! The whole issue remained as dead as a doornail, up to very recently, when Bologna scholar, Nicoloangelo Scianna, deserving of high praise, began a systematic trawl through the late Thirteenth-century documents in the Podestà series. His study, published in 2009, sadly – at least for the moment – has had to admit defeat, since it failed to uncover a watermark with the sought-for date and matching Briquet’s tracing.

No one is accusing Briquet of fabricating evidence or anything similarly heinous. He definitely saw something with that date and, even if it cannot be found today, it is important to understand what it was and why he himself expressed a doubt. My private suspicion is that the sheet was a wrapper, i.e. the outermost in a gathering, devoid of writing and added to protect sheets on unwatermarked paper with the date 1282. In my own limited experience of the Thirteenth-century material in the Bologna archive, I have noticed several instances of this practice, which is confirmed also by Scianna (*see below*). Inspection of the original tracing in the Briquet archive at Geneva sheds no further light on the matter and likewise Briquet’s diary for his first Italian journey in 1889-90, when he visited Bologna makes no reference to the discovery of a watermark, dubitatively, dated 1282 (*Papiers Briquet*, n. 40). Whatever Briquet traced and dated with an element of uncertainty, therefore, has either been lost or still has to be found (*it is possible that in the century and more between us and Briquet that the document has been transferred to another series*). Of course the great Swiss traveller deserves a slap on the wrist for not giving a more precise reference to the document, but in his defence it is possible that he did not realise its importance when he found it. His exploration of the Bologna archive occurred at an early stage in his vast project and it is likely that he did not as yet have the full picture of the chronology of early watermarks nor understand the significance of that particular find.

As matters stand, therefore, the most reasonable date for the appearance of the first watermarks becomes the second half of the 1280s, at least as far as reliably dated documents are concerned. Scianna’s study did uncover examples of the Greek cross watermark in Bologna documents with slightly later dates. However, these same dates are suspect. One could be dated 1284 and another 1285, but in both cases the sheet of paper was not written on at the time, but functioned as a wrapper for other leaves, so it could have been added at a subsequent moment. Briquet assigns a tentative 1285 to an eight-petalled flower (n. 6584; *not confirmed by Scianna, who does however confirm the other Briquet date of 1294*) and also to a fleur-de-lis (n. 6710, *again not confirmed by Scianna, who does confirm the other Briquet date of 1293*). In both cases, even without locating the items concerned in the Bologna archive, the advanced shape of the watermark suggests that the documents thereon were recopied at a later date. For 1286 Briquet found an example of a letter I (n. 8247, *not mentioned by Scianna*), while for 1287 in the “filigranes indeterminés” he traced a pear-shaped object, which Stevenson in his corrections suggests is a buckle or fastener (n. 16005). The latter is the first example outside the archive at Bologna, since it was discovered in an archive at Torcello in the Venice lagoon. (*What is really required is a more systematic exploration of the unwatermarked sheets of paper in the Bologna archive belonging to the period 1250 ca. up to 1286, since much of it is clearly made with Western rather than Oriental or Arab techniques. To some extent the question of the earliest watermarks has distracted scholars from much more important issues.*)

Some confirmation for the mid-1280s for the first appearance of watermarks comes from another pioneering repertory, which most scholars have missed, Luigi Volpicella’s 1911 listing of watermarked papers up to 1500 in the State archive at Lucca [6e. Tuscany]. He reproduces two watermarks, both a *giglio* or lily, in documents dated 1284 (n. 1) and 1286 (n. 2), and also indicates the archive source as *Estimo*, n. 7. Obviously this is something that could be followed up with profit.

As a digression, and also as an example of willfully wrong-headed analysis of watermark evidence, I mention that in 1953 a palaeographer and local scholar from Cremona, Uberto Meroni, claimed a much earlier example of a watermark in a document dated 1271 [19]. The manuscript concerned was a composite assembly of documents relating to the Benedictine monastery of San Pietro al Po, near Cremona, formed of some 18 separate gatherings. The watermark is found in the first three leaves, which on two pages contain records dated 1271, but elsewhere contain records dated 1365. The watermark (*reproduced in the article*) is a letter "F", similar to several traced by Briquet (nn. 8145-48) in documents dated between 1314 and 1335. Is it really necessary to shout from the roof tops, yet again, that the date of a document written on a piece of paper may have nothing to do with when that piece of paper was made? Not only in this case is the make-up of the document highly suspicious, but the mixture of dates in the same leaves should have induced the strongest of doubts. Rather than argue that watermarks appeared in a fairly sophisticated form as early as 1271 and then disappeared for nearly two decades or, in the case of this particular design, for over forty years, it is much easier to presume that the notes relating to 1271 were recopied at a somewhat later date. Nevertheless the date "1271" has been cited in other studies, such as the small catalogue accompanying the Bernstein bull's head watermark exhibition [35], without questioning the sheer implausibility of the evidence (*and this is the sort of thing that gives paper studies a bad name*).

Watermarks. Names and Shapes, Ups and Downs, Lefts and Rights

Early references to watermarks in Latin define it with the Latin term *signum*. Lists and inventories of Medieval and Renaissance papermerchants also make reference to named watermarks, as a way of distinguishing different sorts of paper, but unfortunately without providing a key for subsequent interpretations.

Twin moulds, and thus twin watermarks, evolved naturally from the practice of having two men, the vatman and the coucher, working together as a team. At some point the practice was established of organising twin moulds as if they were a pair of shoes, with one watermark in the left-hand mould and its twin in the right-hand mould. Historical watermark scholarship has, however, been remarkable for the total disinterest it has shown for this phenomenon, so no solid documentation has been accumulated as to when and where this practice first evolved. One fact about the presence of twin watermarks in any supply of paper, that has troubled some scholars, or made them reluctant to stick their necks out on the matter (*for example, David Woodward*), is that there is no surefire proof. The twin moulds concerned have not survived; all that is left is the paper made on those moulds. The limits of inference in bibliography have often been discussed and there is no room here for a "Papermakers of the mind" conversation. It is largely a matter of common sense. If a document displays a pair of look-alike watermarks, alternately in the right/left halves of their respective moulds, in a reasonable quantity, without other marks getting into the mix, the most sensible and economical assumption is that these are twins. It remains an inference; paper studies, however, are not nuclear physics and the best we can ever do is inference, albeit an inference based on a high order of probability. But the heart of the whole watermark discussion is here. Twin moulds, twin watermarks, the twin little girls in *The Shining* by Stanley Kubrick (1980). Twinship establishes identity and a paper-stock is only identified when both its watermarks are clearly recognised.

How watermarks were shaped from the Middle Ages to the Renaissance is largely a matter of guesswork, since no physical examples have survived; we have only the indentations they have left in countless sheets of paper. The watermarks obviously had to be as similar as possible, since they were marking alternate sheets in the same post, but how similar varies according to the period and the area. If we take the trouble to identify twin watermarks in Medieval rather than Renaissance sheets of paper (*taking the Middle Ages conventionally as lasting at the most up to half-way through the Fifteenth century*), in many cases they are easily distinguished, not just in terms of their placing on the mould, but also in terms of size and shape. It is plausible therefore that the mould-maker allowed himself a certain freedom in bending and shaping the wire. A sort of progression towards uniformity, linked to the increasing complexity of the figures, was inevitable, so that watermarks were increasingly shaped around patterns and thus are ever more difficult to tell apart. Patterns could take the shape of nails in a board or of a form cut into a wooden mould into which the heated wire was forced. Their use was encouraged by the increasing complexity of watermark structures and so by the Sixteenth century the practice seems to have been more or less uniform, requiring an expert eye to distinguish the twins in a pair, unless the scholar is versed in the not particularly arcane skill of telling mould/felt side apart, so that the identification recognises whether the mark is in the left/right hand side of the mould [14]. Of course the same pattern could make dozens of virtually identical watermarks and also be kept for an indefinite period of time. Nevertheless an awareness of the pattern as a 'further level of complexity' does not seem to have impinged on the thinking of most watermark scholars. And this is unfortunate.

An important structural change in many Fabriano moulds (*and related centres*) consisted in putting the

watermark on a supplementary chain-line, which in turn is placed between two more widely-set chain-lines, i.e. if the average distance between chain-lines is about 30-32 mm, the distance between the two chain-lines will be about 50-55 mm, with the supplementary chain-line in the middle, at a distance of 25-27 mm on either side. Though no examples of such early moulds survive, it is unlikely that the supplementary chain-line had a supporting rib beneath it, but it may well have been held in position by a thick wire, as with a tranchefile. This feature is also distinguished by the fact that it did not place the watermark in the centre of one half of the sheet, but shifted approximately a chain-line towards the true centre. The vagaries of observation, since repertoires rarely, if ever, specify the presence of this supplementary chain-line, mean that it is not easy to date this innovation, however it seems to emerge in the last quarter of the Fifteenth century.

One small point needs to be made for descriptive purposes. Over 95% of watermarks have a clearly recognisable *up* and a clearly recognisable *down*. In other words there is an automatic consensus that humanoid figures (*angels, mermaids, pilgrims, etc.*), animals (*dragons, oxen, unicorns, etc.*) and most inanimate objects (*anchors, bells, fruit, hats, etc.*) should be represented with the top at the top and the bottom at the bottom (*is that too complicated?*). There are a few exceptions: the flower bloom watermark, essentially a circle with a surround of petals, common in Milanese incunabula, is possibly the most widespread and is a considerable nuisance in identification terms, especially when one is trying to recognise a pair of twin watermarks. It had a run of well over a century, see the examples at and surrounding Briquet n. 6600, also nn. 6621-22. Likewise the pommelled cross in a circle, typical of Colle Val d'Elsa in Tuscany and beloved of Roberto Ridolfi, does not have a discernible up or down [10]. Yet another example that has brought complaints from filigranologists is the Tudor rose, employed by Britain's first papermaker, John Tate. The simple fact of having an up/down makes the comparison and description of watermarks enormously simpler, though the reason was probably practical. In the paper mill the deckle had to fit both moulds loosely but precisely, and so it was better to put it on always in the same way. Having a clear direction on the watermark visible in the centre of one half of the mould naturally made this simpler. As a corollary it should be added that the watermark is always aligned with the long side of the forme, something that can be useful when trying to identify a complicated format.

Along the same lines, when we start talking about the placing of watermarks, and thus identifying the individual watermarks in a pair of formes, by the by and not unsurprisingly, scholars have been anything but consistent and coordinated in their language. The most belaboured, and contentious, issue has been to decide which side of the sheet the watermark should be described from, which is surprising given that there are only two possibilities. The overall preference – favoured by scholars such as Allan Stevenson, G. Thomas Tanselle, Alan Tyson, and Paul Needham – has been to view the sheet of paper “mould-side upwards”, i.e. the reverse of the layout of the mould, since it is the more convenient for actually seeing, tracing or rubbing, or photographing the watermark. Papermakers were well aware of this fact and therefore when a mould maker inserted letters or a name as part of the watermark, the general, if not invariant practice, was to shape it in mirror writing, so that to read the text the sheet is necessarily viewed from the mould side. A minority, including myself, have felt that it makes better sense to describe the watermark as if the original mould were in front of us, which entails viewing, or at least describing, the sheet “felt-side upwards”, with the inconvenience of tracing words or letters in an Alice-through-the-Looking-Glass fashion (*but it is easy enough to transcribe the text and add the fact that on the mould it appears in mirror writing*). In its quadrilingual standard issued in 2013 the IPH compounds the confusion by advocating the “wire side facing down” (paragraph 3.0.17) in its English, German, and Italian texts, i.e. looking at the sheet from the felt side, and the opposite in the French one (*at least this is how I interpret the phrase: “Il est recommandé de recueillir les données sur la face inférieure (c'est à dire la face de la feuille qui a été en contact avec la forme durant sa formation)”*). Common sense suggests, however, that there is no point in a Swiftian conflict between Big enders and Little enders, since watermark images were conceived and made as reversible, and therefore dictatorial absolutes have no place in their study. Individual scholars ought to apply whichever method suits them best, but simultaneously be very clear about whichever system they are using.

The other related, and likewise important, question has been how to name and distinguish the twin watermarks, sometimes in quite long runs over more than one gathering, especially when mapping out their distribution in a document, usually a manuscript. Three different solutions have been experimented in the discussion about the “1460” Mainz *Catholicon*, in which brilliant pioneering scholarship identified watermark twins in a variety of states [30]. For the sake of clarity, it is easiest to deal with them in reverse order. The formula proposed by Needham (1982) and practised by him in subsequent writings is to describe a watermark placed in the right-hand half of the original mould as “Mould-side Left” (mL), i.e. as it appears in the sheet viewed from the mould side, and one in the left-hand correspondingly as “Mould-side Right” (mR) [10]. This language is self-explanatory, though Needham, as a specialist in printed documents, has not approached the issue of how to map the watermarks an extended document such as a Medieval manuscript.

Eva Ziesche and Dierk Schnitger (1980) on the other hand prefer to view the sheet from the felt side, i.e. as the watermark appeared on the mould, labelling a watermark in the left half as “a” and that in the right half as “b” [10].

A rather more elaborate nomenclature, applied initially to his study of the *Catholicon* (1973), was excogitated by Theo Gerardy [10]. He also employed it subsequently in his book-length study of the watermarks in the archive at Fribourg (*the one in Switzerland, or Freiburg im Üechtland, see [6k]*), in order to describe twin watermarks in documents from the first half of the Fifteenth century (1980). The system envisages a sheet of paper, folded as a folio, with the watermark the right way up, in which the mould-side falls on the verso of the first leaf (*therefore with the watermark positioned in the right-hand side of the original mould, or what Needham calls mL and Ziesche-Schnitger call b*). In this instance the watermark is designated *zugewandt*, i.e. “turned towards”, or, more simply, “Z”. In a sheet from the opposite twin mould the watermark, seen in the same fashion, necessarily falls on the recto of the first leaf (*therefore the watermark was positioned in the left-hand side of the original mould, or what Needham calls mR and Ziesche-Schnitger call a*), and is designated *abgewandt*, i.e. “turned away”, or, equally simply, “A”. In description, therefore, the conjugate leaves that make up the same sheet, in a folio arrangement, are defined as nZ/-Z and nA/-A, where “n” represents the watermark and “-” its absence. This system has also been publicly espoused by Scottish scholar, Roderick J. Lyall, who adds a further twist to the cocktail by indicating sheets in which the watermark is upside-down (*as all too frequently happens*) with asterisk [10]. In a hypothetical example provided by Lyall, involving a regularly quired folio gathering in sixteen, with the sewing at the centre between ff. 8 and 9, the resulting description appears in Figure 1.

Fol.	1	2	3	4	5	6	7	8	centre	9	10	11	12	13	14	15	16
Mark	-A	-A	-Z	nA*	nA*	nA*	nA*	-Z		nZ*	-A	-A	-A	-A	nZ*	nA	nA*

Figure 1. The distribution of watermarks in a hypothetical folio gathering described by Lyall.

This seemingly intricate pattern translates as follows: the said gathering has the expected eight watermarks: six from the mould in which the watermark was in the left-hand half (mR), one the right way up at f. 15, and five upside-down at ff. 4, 5, 6, 7, and 16; two from the sister mould, in which the watermark was in the right-hand half (mL), both upside-down, at ff. 9 and 14. (*It is possibly not a very helpful hypothetical example, since six watermarks are from one twin, two from the other, and only one watermark is the right way up!*) Once the system has been learnt, it is not difficult to interpret, but remains rather hard on the eye.

Fol.			Fol.
1		L*	16
2		L	15
3		R*	14
4	L*		13
5	L*		12
6	L*		11
7	L*		10
8		R*	9

Figure 2. The distribution of watermarks in the same gathering with the system practised by Neil Harris.

On the whole the Gerardy-Lyall annotation seems an over-complicated way of describing something simple, and perhaps hinders the real aim of the exercise, which is to identify the twin watermarks, tell us where to find them, and show their numerical differentiation. It is furthermore a system that might struggle with extremely large gatherings (*in Medieval archive documents up to fifty leaves in the same gathering are not unusual*). In my view, if the gathering is regularly quired, it is superfluous to say that there is no watermark in the other half of the sheet and even the indication that it is upside-down appears an excess of zeal. Applying instead the method I currently employ to map twin watermarks in the Medieval archive of Udine, of which more in the following chapter, the diagram of Lyall's hypothetical gathering appears in Figure 2, in which the marks are distinguished as R [right] and L [left] on the basis of their position in the original mould (*for the sake of argument I maintain the asterisk, though in my own work I do not employ a symbol for upside-down*). The conjugate leaves forming the gatherings are listed in opposite outer columns, with the watermarks in the inner columns related to the relevant conjugate.

The principal objection to this layout is that, in a published form, it is wasteful in terms of space and therefore a more compact solution would have to be worked out. On a webpage, however, or just as a research tool, it has the advantage that information can be taken in at a glance, it is infinitely extendable and thus can accommodate very large gatherings, and the identification of the twin watermarks is immediate and self-explanatory. Likewise, instead of L and R, the system can easily accommodate the mR and mL suggested by Needham.

A further, and potentially unwelcome, complication to any annotation for Medieval watermarks is that well into the Fifteenth century it is quite common to find both marks in a pair placed in the same half of their respective moulds. Since Ziesche/Schnitger and Needham all deal with late Fifteenth-century printed documents, the problem does not pose itself. In his study of the Freibourg archive, covering the years 1402 to 1456, Gerardy employs the locution A I and A II, or Z I and Z II, which is perhaps cumbersome. In the tables written for my ongoing project on the Medieval archive in Udine I simply double the letter for the second watermark to appear, i.e. L and LL, and R and RR.

In descriptive terms, watermarks always subsist in a looking-glass world, so that the seemingly innocuous terms *left* and *right* are potentially dangerous and misleading. Although some sort of general labeling is indispensable, derived from the position in the original mould, when talking about details, it is better on the whole to employ unambiguous terms such as *inner* (i.e. *towards the centre of the sheet or mould*) and *outer* (i.e. *further from the centre of the sheet or mould*). This solution does oblige the user to be constantly aware of where the edge of the sheet is, but is quite workable.

Countermarks, Cornermarks, and Other Extras

In the latter half of the Fifteenth century papermakers around Lake Garda in Italy, in particular in the "Valle delle cartiere" above Toscolano, who in other words were supplying the burgeoning Venetian printing industry, introduced the "countermark" [11]. If we imagine looking at a mould, in which the watermark is in or close to the centre of the right-hand half, the countermark is situated in the lower left-hand corner. (*Rather than "countermark", Paul Needham employs the useful term "cornermark" to describe these early examples; this seems an improvement on the "edgemark" favoured by Allan Stevenson*). This countermark is never large, usually about 40×30 mm, frequently smaller, taking the form of a couple of letters, for instance A-B or Z-A, united by a cross or a leaf-symbol. The rule about the position of the countermark in the corner opposite to the main watermarks seems almost invariable, but I have encountered an exception in the final volume of the 1498 Aldine Aristotle, where an upside-down 'A' is found in some sheets in the corner above the anchor watermark. It is probable, however, that this is a simple placing mistake.

One rather unusual paper-size, something classified by Paul Needham as "Half-median" [see Chapter 4], in which the original sheet measured approx. 255×360 mm, seems to have anticipated the countermark by placing the watermark, a small six-petalled flower, in the corner of the mould. This paper supply is used, for instance, in the already-mentioned mixed format Latin Bible printed in Venice by Franz Renner in 1480 (ISTC ib00566000), where the effective difficulty in understanding the placing of the watermark, especially when the copy has been cut down, has in the past led authoritative catalogues to believe that the sheets concerned were quarters of Royal (GW 4241, IGI 1661). Beginning with Pellechet and Proctor, however, other repertories recognized that the real format of these sheets was folio. In another unusual solution, found in the Super-median sized sheets of the Latin Bible printed in Venice by Paganino de' Paganini in 1495 (ISTC ib00597000), two small five-petalled watermarks are placed in diagonally opposite corners of the moulds.

More data needs to be gathered from Fifteenth-century paper supplies, but it is plausible that these positional experiments were a way of signaling a special sheet size.

The purpose of these early countermarks was obviously to identify the provenance of the sheets of paper: in a few cases, albeit not many, it has been possible to match the initials with a particular family of papermakers. But the system was not intended to be decipherable for the general public; it responded rather to the need of the paper-merchant, who was often a wealthy businessman living in a town close to the papermaking district, while the papermills were spread out over the hills in the surrounding countryside. Since many of these mills were making sheets of paper with the same watermark, something else was obviously required in order to allow the owner, especially if there were complaints about quality, to recognise which mill a particular item came from. Placing a couple of letters in the corner of the sheet meant that the trace left in the paper was easy to see and could be read without going to the trouble of lifting the whole sheet up to the light.

Among the great merits of Briquet is that he is very much alive to the importance of the countermark and is scrupulous about recording its presence (*see, for instance, his entries for Ancre*). He gives the earliest example he knows as 1483, without however telling us where (I, p. 14). I have searched through *Les filigranes*, including its electronic version, without finding the example of the same, which he may therefore not have included. A 2004 discussion of countermarks by Paola F. Munafò and Maria Speranza Storage, however, confirms 1483 as the earliest recorded example found in the Latin Bible printed in Venice by Johannes Herbort (ISTC ib00579000).

The practice of countermarking in the corner of the sheet in the Toscolano district lasted well into the Seventeenth century, but, despite its undoubted utility, did not spread to other areas of Italy or to other countries. For bibliographical purposes countermarks of this sort are an absolute boon, given the right bibliographer. First, since letters of the alphabet have a clear indisputable direction, they make it very easy, as Conor Fahy has pointed out [11], to tell twin moulds apart, i.e. if the letters are A-B, in a mould in which the countermark is in mirror writing in the bottom left-hand corner, the B will be the outer letter; in the twin mould, in which the countermark is in mirror writing in the bottom right-hand letter, the A will be the outer letter. Second, in large and medium-sized formats, otherwise known as folio and quarto, the countermark usefully tells us that the other half of the sheet, the one without the official watermark, still comes from the same mould, or conversely serves to identify *cancellantia* introduced with less than a full sheet. Third, in small formats, such as octavo and less, for printed books it tells us the imposition of the typographical forme, i.e. if the countermark is in one of the first four leaves of an eight-leaf gathering, the scheme is common or centripetal octavo; if it is in the last four, it is inverted or centrifugal octavo. Fourth, and not least, the countermark generally falls outside the part of the leaf obscured by print, and never ends up in the inner margin, so it is often more visible than the watermark true and proper (*there is however the danger of the binder's plough, which sometimes removes it in part or in whole, so it is important to pay attention to the size of the copy*).

In France in the later Sixteenth century legislation required the papermaker to include the family name in the watermark: so French paper of this period generally contains a sort of scroll underneath the symbol with a name. In Italy much the same process occurred spontaneously through the countermark, which, beginning in the last quarter of the Sixteenth century, began to shift to the centre of the half of the mould opposite to the main mark and became correspondingly much larger. The earliest example I have encountered is a large "TC" with the watermark of an angel in the opposite half of the sheet in the *Historiarum de regno Italiae* by Carlo Sigonio, published at Bologna in 1580, but I am sure that systematic research would uncover earlier examples. Again watermark repertories are not as helpful as they might be in documenting the evolution of this process, since the best of them (Briquet) stops in 1600, when the process is only just getting under way, while the others cannot be trusted to provide reliable information in the matter of countermarks. My rather provisory impression is that the consolidation of the countermark, placed opposite the mark in the other half of the sheet, happened in the late 1640s. In some cases the countermark was accompanied also by a cornermark identifying the papermaker.

In the Seventeenth century the initials of the countermark were increasingly transformed into a full family name, which rather curiously took the mark back to its original function as an indication of the making or the provenance. By the Eighteenth century these signs are highly evolved and appear in symmetry with the watermark in the other half of the sheet. Examples are Miliani in Fabriano, Magnani in Pescia or Villa Basilica, and Whatman in England; at times the emphasis falls rather on the name of the mill, such as La Massa at Villa Basilica near Lucca, La Briglia on the Arno above Prato, or the Whatman Turkey Mill in Kent.

From the Eighteenth century to the early Nineteenth the practice of including the date as part of or as the

entire countermark became increasingly common. At times this was obviously a marketing ploy, aimed at showing that the paper was “new”, but these chronological pointers should always be treated with caution, since the seemingly helpful indications can bite the unwary and the ill-informed. Although they establish an unquestionable *terminus ante quem non*, which can nevertheless prove valuable where the date of a document is highly uncertain, at the other extreme, that of establishing a more hypothetical *terminus post quem non*, they can be deceiving. In the first place a mould with a date could remain in use for a longish period of time: it is known that the Whatman mills did take the trouble to update their moulds at the beginning of each calendar year, but they were an exception rather than a rule. In the second place the inclusion of the date sometimes had a different purpose, for instance to benefit from a lower rate of tax, so that mould-makers continued to put that particular year even in later periods: for this reason the date “1742” in French paper and “1794” in English paper should always be treated as suspicious and as having little or nothing to do with the date in which the sheet was really made [12].

By the late Eighteenth century moulds have generally acquired quite a lot of writing and numbers that make watermarks complex and easily recognizable, while the scripts also ensure that it is easy to distinguish the felt/mould sides of the sheet. Unfortunately, however, changes are afoot. Italian papermakers generally stick to the long-standing right/left principle with the texts on the moulds in mirror writing. In Austria, on the other hand, as Alan Tyson shows in his brilliant study of Mozart’s manuscripts (*and by “brilliant” I mean “absolutely brilliant”*) [25], mouldmakers put scripts in mirror writing in only one of the twin formes, so that the sheets are ostensibly much more alike, with the watermark and countermark always in the same relationship, as far as the eye of the casual observer is concerned. The sameness of course means viewing one sheet from the mould side and the twin sheet from the felt side. Until more thorough research is done on twin moulds and on the positioning of watermarks in the moulds, it is impossible to say how widespread the phenomenon was.

As a final *addendum*, or complication, and invitation to keep looking at paper with a critical eye, another feature I have observed in Italian paper of the late Eighteenth century in Tuscany is the inclusion of yet another watermark in order to number the pair of moulds. It takes the shape of a single digit – 1, 2, or 3 – placed in correspondence with the bottom of the central fold of the finished sheet, and therefore it can only be seen in unbound or disbound sheets. Its function was very obviously to distinguish pairs of moulds, especially in large mills with more than one vat, that were otherwise identical. The same number was placed on both the moulds in a pair.

Describing Watermarks

Apart from purely visual methods, numerous studies provide examples of descriptions of paper and watermarks, with very diverse levels of competence and ability. In many instances seemingly elaborate and exhaustive descriptions are furnished by scholars, who have nevertheless failed to understand that watermarks are twins and thus waste time, both their own and – more’s the pity – other people’s. There are also plenty of instances in which the same (*pair of*) watermarks have been counted twice over, since they have been viewed both from the mould and the felt sides of the sheet.

In my humble opinion, the only genuinely effective way to describe a watermark is to procure a quality image. Nevertheless even the best picture should be backed up with written notes, drawing attention to significant features, since even the best image rarely shows all the characteristics of a watermark, while there are often circumstances in which, for reasons of cost or of practicality (*for instance, a small format or a tightly bound book*), in which it is not possible to get a picture and therefore a scholar has to resort to a written description. Attempts have therefore been made to prescribe uniform solutions in the description of paper and of watermarks, albeit with mixed results.

So, without being prescriptive, let’s make some suggestions.

As stated above, it is always a good idea to start by defining the purpose of the description.

If the aim is to label a certain supply of paper, especially in one or more editions of a printed book, where further copies can always be added to the equation, there is sometimes little purpose in going to all the bother of distinguishing twin-watermarks, right- and left-hand side placings, and so on and so forth (*though one should always have these more refined methods available in one’s personal arsenal*). In these situations it is nonetheless important to know about the sheet-size (*or at least provide the measurements of the largest copy encountered*), the type of watermark (*noting any unusual features, such as a cross or a flower above*), the distances between chain-lines and the density of the wire-lines, and eventual other characteristics, such as the presence of countermarks, supplementary chainlines, or tranchefiles.

If, however, it is a matter of identifying the watermarks comprising the twins in a pair, it is important to begin by clearly distinguishing the left- or right-hand moulds (*alternatively one can label the sheets as mirror-image right- or left-hand indentations when the sheet is examined from the mould side*). The next stage is to reconstruct the overall lay-out of the two moulds, i.e. by working out the original sheet-size and calculating the number of chain-lines and the intervals at which they appear. It is also a good idea to measure the average number of wire-lines in a distance of 20 mm. In describing the watermark, apart from its measurements and characteristics, it can be helpful – as Tanselle advocates – to provide indications of the distances between it and the chainlines. If the final intent is to insert the description in a database, it is possible to include the codes and criteria espoused by the IPH in the Bernstein project (*see below*), though these are not always straightforward to employ or to remember.

It should always be remembered however that, as far as recognising any individual pair of marks goes, even a very elaborate description is only a palliative. The only really effective record is the knowledge and understanding applied by whoever is studying a particular set of marks. True watermark scholars are like shepherds, who know every single sheep in the flock.

A word of warning. It happens quite often that in a book or document the inquiry, even if it is conducted properly, finds that there is no way of discriminating the pairs of watermarks. Just to give an example, the edition of the *De Cardinalatu* by Paolo Cortesi published at San Gimignano in 1510 employs, among others, four watermarks containing a fleur-de-lys. They are easily told apart: two are right-hand and two are left-hand; which however goes with which? On the evidence of this one book there is no way of telling. In the long run, but it would take a certain amount of time and trouble, it might be possible to find another book of the same period, in which the paper came from only one of the two sets involved here and so clearly distinguish the pairs. What specialists often seem to fight shy of, however, is the embarrassment of admitting publicly that they do not know and so they tend to skate over the issue, by blithely omitting any mention of the twin relationship. This tacit untruth in reality helps no one. In a situation such as this, it is much better to admit that one does not know. A graceful admission of impotence is much better than a bumbling attempt to disguise incompetence.

Reproducing Watermarks

As in the well-known instance of the Fuolornis Fire Dragons in Brequinda in the Foth of Avalars (*another reference to that book!*), what purposes to be a guide tries to keep up to date (*“purpose” being the operative word*). So, rather than write about reproduction techniques as if they were extant and freely available on the market, I have sought to do something more practical, and even more sensible. In other words to assess, through contacts with the imaging services of major institutions that have produced β -radiographs and analogous material in the past, the actual *status quo* (*in 2016, but things evolve rapidly, especially where obsolescence is concerned*).

The earliest attempts to reproduce watermarks were freehand drawings, which were printed either by cutting the images onto woodblocks or engraving them onto copper plates: the results therefore give only a very approximate idea of the original design. They often excluded any indication of the measurements of the watermark, nor did they provide information about the placing with reference to wire and chain-lines.

The subsequent and most widespread method, still used today, is the tracing, which is economical, fast, easy to reproduce, and thus was the staple procedure of pioneering scholars such as the elder Zonghi, Briquet and Piccard. In his travels Briquet carried with him packets of tracing paper, previously cut up into small rectangles of the appropriate size. Here is his description of how he went about his task: “... lorsque, et c’est le plus fréquent, on doit relever la marque dans un volume relié, on est obligé d’abord de chercher le feuillet où cette marque apparaît de la façon la plus distincte, puis de placer le volume sur une table, près d’une fenêtre, en pleine lumière, à l’ hauteur d’oeil et de soutenir le feuillet choisi par une plaque de verre de dimension convenable. On peut alors calquer commodément et exactement. Il sera bon de dessiner, en même temps que le filigrane, les pontuseaux entre lesquels il est placé et de noter les fils de la vergeure pour juger de leur écartement” [translation: *when, as is most often the case, one has to trace the watermark in a bound volume, one first has to find the leaf where the said watermark is at its most visible, next put the volume on a table, near a window, in full light, at eye level, and hold the leaf concerned up with a piece of glass of an appropriate size. In this way one can make a tracing with comfort and precision. Together with the watermark, it is a good idea to trace the chainlines on either side and to note the wirelines in order to show the distance between them*] (*Les filigranes*, cit., I, pp. xvii-xviii).

Quality tracings require a lot of skill and experience, since it is far less easy than it seems, as classroom

experiences have duly shown, to reproduce accurately a watermark. Tracings have the unquestionable advantage of being the same size as the original (*though some modern reprints of Briquet – the worst example is the 1985 New York edition – have reduced the designs by as much as 20%: I hope that in the special fiery Hell reserved for publishers these people are in for some particular noxious form of eternal perdition*). If they are the work of a genuinely scrupulous scholar, such as Briquet (*funny how that name keeps coming to the fore*), who also records the position of the watermark with respect to wire and chain-lines, not to mention giving the sheet-size, tracings can be extremely useful. On the other hand, the act of tracing a watermark through another sheet of paper reduces visibility, so that even the best scholars rarely record minor details, such as sewing dots, unless they are extremely obvious. In the final count, therefore, tracings are never going to be exact enough to allow us to be certain that we are dealing with the same (*pair of*) watermarks. The other limit of tracings is that, before the advent of digital technology, they have to be redrawn for publication purposes, with a further departure from the original. Here it is worth noting, *en passant*, a remark by Allan Stevenson in the ‘Addenda and Corrigenda’ to the 1968 Jubilee edition, in which he observes that Briquet’s “illustrations of the Tall Crown marks strengthen the general impression that his tracings were often based on rough sketches, or that the drawings for the reproductions were done by a mechanical and unskilled hand. The following are definitely misleading ...” [with a long list] (p. *67).

Where the original sheet of paper is reasonably dense and where the surface has not been disturbed by printing, as an alternative to tracing, an accurate image can be obtained through a rubbing (*frottis*). The principle is identical to that employed to reproduce the blind tooling on bindings or memorial brasses in churches. After identifying the mould side of the sheet, take a piece of thin paper, put it on the leaf (*it is best to have a weight, or a helper to hold it in position*), and shade over the surface with a very soft pencil. The results are useful for the purposes of private study, rather than publication, but the method is used regularly by Paul Needham who has reproduced some examples (*see, for instance, his article in Puzzles in Paper*). Further examples are viewable as digital images in the large collection of images now on the Wasserzeichen des Mittelalters interface of the Austrian Academy for Sciences, lead partner in the Bernstein project, and in the material relating to Dutch incunabula collected by Gerard Van Thienen on the website of the Koninklijke Bibliotheek in The Hague (*both accessible also through the Bernstein website*) [35]. Although the system is less arbitrary than tracing, some detail is lost, and of course (*this is the real down side*) relatively few libraries or archives are willing to allow scholars to do this to the documents in their possession.

Over the course of the last hundred years photographs of watermarks have been published with a certain frequency and Briquet, for instance, includes a selection of examples in his preface, to which Stevenson adds others in his introduction to the Jubilee edition. The big traditional obstacle has always been cost, to which has to be added the fact that it requires a clever photographer, especially in illuminating the sheet, to get a decent result. Another major handicap is that where the watermark is obscured by handwriting or, worse, print, its visibility is seriously compromised: examples tend to be taken from occasional blank sheets or cases in which the watermark coincides with a gap in the writing. Further limits are imposed by the fact that photography rarely overcomes the obstacle posed by medium and small formats, where the watermark falls in the margin or is broken up into different leaves. (*One small mystery, for instance, is posed by the truly excellent photographs displayed in Ridolfi’s 1957 pamphlet, which showed the watermarks in some quarto-format Florentine incunabula, where the watermarks fall in the inner margins. How did he do this? Quite simple, they were his own personal copies and he had them disbound for the purpose! It is nice to be a Florentine Marquis and have one’s own collection of rare Fifteenth-century books.*)

The only paper-published work I know in which all the watermarks in a census or collection are reproduced by photography is that by Jane Roberts for the drawings of Michelangelo (1988), sponsored at the time by Olivetti [24]. In this case the fact that most of the items were separate leaves, as well as the circumstance that the crayon or other materials employed for the drawings hardly obscured the watermarks, meant that good results were obtained. On the other hand the images are not always sufficiently distinct (*not all the photographers involved knew how to capture images of watermarks*) and the repertory fails to indicate the sheet-size, whether the image is taken from the felt or the mould side, and the effective dimensions of the watermark itself.

In the 1950s, as a somewhat unexpected spin-off from the USSR’s nuclear programme, Russian researchers discovered a method, in which images of watermarks were recorded with β -radiography (*basically a low-powered x-ray*). The first article describing the technique in a Western language appeared in 1961 [23]. The operation is relatively straightforward: the sheet or leaf of paper is sandwiched between a weak radioactive source and a photographic negative; where the paper is thinner, i.e. where the watermarks and the chain-lines have left indentations, the radioactive particles penetrate more easily and thus expose the celluloid more fully. The outcome is an image in which the watermark appears as a white shape on a dark ground

(*obviously the contrast can be reversed in publication, although this rarely happens*). The advantage is that the radioactive articles are not affected by writing or printing and so it is possible to capture a clear image even when the watermark is ordinarily obscured by a heavy layer of ink; the disadvantage is that, quite apart from the problem of getting hold of a radioactive source, the procedure requires laboratory facilities and trained technicians, so that the few instances, in which a large number of images have been acquired and published, involve large institutions, such as the Louvre, which has conducted research on the watermarks in its collection of drawings (De la Chapelle) [24], and the Newberry Library, which has published work on its Italian Renaissance map collection (Woodward) [26]. For the revised version of this text an inquiry has been conducted about the availability of this technology and unfortunately it has proved obsolete just about everywhere. The original plastic plates containing the radioactive salts, often made in the 1960s, had a tendency to crack and deteriorate, while in more recent times the special negative paper needed to develop the image is no longer commercially available. Consultation with a number of laboratories, including the Bodleian and the Huntington, also established that the procedure had not been requested by researchers in the last decade, while safety concerns involving the radioactive “wafer” used to produce the β -rays have augmented. It should be noted, however, that major libraries often conserve archive negatives, so it might be worth checking whether the watermarks in a particular document have been acquired by β -radiography in the past.

An analogous procedure, or electron radiography, in which the same basic principle has been applied to obtain images of watermarks in Dutch incunabula, can be viewed in the WILC project hosted by the Koninklijke Bibliotheek in The Hague, accessible also through the Bernstein project [23, 35]. In this case it was the achievement of a librarian, Gerard van Thienen, who managed to convince an important firm working in the field, the Röntgen Technische Dienst, Rotterdam, to construct a machine and to train technicians in order to conduct an in-depth survey of the watermarks in the library's holdings of Dutch Fifteenth-century books. Inquiry to The Hague in 2016 did establish, however, that the collaboration with Röntgen ceased well over ten years ago, once the project had been completed, and that at the present moment the procedure is not available. The website of the project, which includes an excellent step-by-step demonstration of the making of electron radiographs, is not explicit about this fact, so be advised.

Again slightly different, in technical terms, but the same essential procedure, is the Soft x-ray radiography developed in the mid 1980s by Jan van Aken, formerly professor of dental radiology at the University of Utrecht. This method, which provides a high-quality result, has been applied to imaging watermarks in Dutch projects conducted by Theo and Frans Laurentius, as well as in the Bernstein project by Manfred Schreiner at the Academy of Fine Arts in Vienna. At the time of writing in 2017, this procedure is part of ongoing work and is still being used. Since x-ray procedures are demanded by archeologists and art-historians (*for instance, to x-ray mummies or Renaissance paintings*), who have infinitely more *kudos* and wealth than mere paper historians, the imaging services of major galleries and museums do have such services and can provide them on request. So ask (*and if they say no, scream!!!*).

A slightly different approach employs ultra-violet light (*DYLUX method*) and is associated above all with the name of Thomas Gravell [23]. The technique is very similar to those described above: special photographic paper sensitive to UV light is placed behind the watermark and exposed to a fluorescent light source; the image of the watermark is not impeded by ink and so develops clearly. As a method, it is less effective than the x-ray procedures described above and, if the paper has been heavily written on or printed, the results can be poor. Its main application has been in the field of stamp collecting, where the paper is very fine and the watermarks often employ shading or other niceties.

Phosphorescence, infra-red imaging, and analogous methods, relating to the way light or heat pass through the sheet of paper, have been experimented with at different times, without however producing long-term solutions. These techniques give a result, which is inferior to the various x-ray procedures, but nevertheless require basic laboratory conditions.

An extremely interesting new development lies in the application of digital technologies originally conceived in the field of studying Medieval palimpsest manuscripts [23]. Here the problem was to eliminate the upper, more recent, and heavier layer of ink, in order to reveal the earlier, fainter, often partially scraped text on the parchment. The technique consisted in identifying the chemical composition of the ink and removing certain elements of the spectrum, so that the upper layer vanished. It was discovered, almost by chance, that the same trick could be played with paper, although it is necessary first to photograph the sheet with a source of illumination behind it, usually a light-pad with optic fibres if the volume is bound. Subsequently, the ink is exported in a “virtual” fashion, leaving a clear image of the watermark. The method is effective also with printing ink and gives a final result, which aesthetically is more pleasing than β -radiographs. As matters stand, these procedures are jealously guarded by the firms that are developing them and in one tragic case

have been lost on the death of their inventor [23]. Nevertheless the future lies here.

So, to sum up, in 2017 the simplest, quickest, and cheapest way of imaging a watermark is to acquire a light-pad for backlighting and a good digital camera (*or just a cellphone*), and photograph it yourself, if and where allowed. The fundamental fact about watermarks is and remains that they are multiple images, so, if the source is a substantial manuscript or printed book in a plurality of copies, with luck, a blank leaf will pop up with a clear image. The big problem remains, however, those instances in which there are only a few watermarks, or perhaps only a single one, in the chosen source and it is obscured by handwriting or printing. At the present moment the staple methods of Twentieth-century watermark imaging have disappeared, overtaken by “obsolescence”, with the only partial exception of Soft x-ray radiography and the prospect of the conversion of radiography into a digital format; otherwise the hope has to be digital imaging, which has shown that it can be done, with excellent results (*see Fotoscintifica*), but at the moment has failed to provide a simple, easily affordable, widely accessible solution for those instances in which it is necessary to see through a burdensome layer of ink. The technology is there; it is just a matter of getting it to work. Here's hoping.

Nomenclatures and Classifications of Watermarks

These are something of a pain.

When my sweet little sister (*who has now travelled gracefully past fifty*) was just learning to speak, one of the first items in her vocabulary was the word “Hat”, which noun, once mastered, she delivered with great exuberance. One weekend during a jaunt out of town, on the way home the family stopped for refreshment. While we were still ensconced in the café, a large coach drew up outside, discharging a contingent of Women's Institute members in full regalia; they entered in procession, heading for a eager cup of tea, and were greeted with the triumphal chant: “Hat!”, “Hat!”, “Hat!”, “Hat!”, “Hat!”, “Hat!”, “Hat!”, “Hat!”, for what seemed a very long time. The same fundamental problem is faced by any reader opening Briquet for the first time and turning to the entries classified as “chapeau”, which, beginning in 1309, roll on for many a page with only microscopic variation and nary a cup of tea (nn. 3353-3517).

How to call watermarks and what to call watermarks has always been among the chief torments of paper scholars. The problem is that, though these signs might have formed a coherent language for the papermakers and the merchants of the time, for our purposes their meanings are often obscure. At Siena in 1334 a document mentions paper watermarked with the “signo della staffa” (*crook or staff*), while Zonghi cites the register of the paper-trader Lodovico d'Ambrogio at Fabriano who, between 1363 and 1366, notes the sales of some 58 types of paper, all recorded by their watermarks, a system to which the ledger provides no key [21]. Likewise, in a famous document such as the Ripoli diary, or the notebook kept by the overseer of the press which worked in Florence from 1476 to 1484, acquisitions of paper often mention the watermarking: “due lisime di fogli comuni della colollna” (*f. 5v: 1,000 sheets of chancery with a column watermark*), “due lisme di fogli dagli ochiali” (*f. 74v: 1,000 sheets with a spectacles watermark*), “lisime due del segno del guanto” (*f. 78r: 1,000 sheets with the watermark of a glove*), “due lisime di foglie da fabriano del segno del balestro” (*f. 83r: 1,000 sheets from Fabriano with a crossbow watermark*), and “tre lisime di fogli comuni da colle del segno della croce” (*f. 116r: 1,500 sheets of chancery from Colle Val d'Elsa with a cross watermark*) [21]. The mention of the symbol in these generally laconic records presumably had a meaning at the time, in terms of quality and price; unfortunately, we don't know what. By the by, note that these early records all refer to the watermark as a “signum” in Latin or “segno” in Italian; the modern Italian term, “filigrana”, derives much more recently from French.

Out of these early dictions came the working vocabulary of the paper-trade. For our purposes matters are complicated by the overlay with sheet-sizes, which were not consistent in time or place, as well as the introduction of typologies with a specific purpose. The best-known example in English is “foolscap” (*i.e. fool's cap, a piece of headwear worn by a jester*), born as a watermark, which became synonymous with medium quality writing paper (*see examples in the OED*).

Naming brings us to the real problem: arranging.

Repertories of watermarks, especially those aiming at giving a broad picture, always have the problem of how to display the images and thus present the information. Chronologies and geographical distributions for obvious reasons are untrustworthy; sheet-sizes can be misleading and often are not available. Experience of watermarks does teach that recognition is essentially image-based, so, whatever the system, it is best if it is simple. The most practical solution is therefore to confer a nomenclature and follow it. Of course there are problems, beginning with the language in which one does the naming. School-boy and school-girl (*we must*

not discriminate) French takes us as far as “chapeau” in Briquet, but what is the word for “anvil”? (*try “enclume”, nn. 5950-66, if you are really stuck*). Or what about the strange object he denominates a “peson”? (*a weight on a balance for the unenlightened*). But, on the whole, for all its frenchifying, Briquet’s straight-forward alphabetical order works very well. It should be noted, however, that a project such as Watermarks in Incunabula printed in the Low Countries [35] skillfully circumvents the perils of *franglais* by employing the “English Typological Index” added by Stevenson to the 1968 edition of Briquet.

In recent years the IPH has promoted its own “Index of Watermark Classes and Subclasses”, in six languages, included in its 2013 Standard, as well as in the 2002 book by Tschudin (pp. 291-353) [21]. This employs 25 categories linked to a letter-code (*there is no “I”*), as follows:

- A Human figures; men; parts of the body
- B Women
- C Mammals
- D Birds
- E Fish; reptiles; insects; mollusks
- F Mythical figures
- G Plants (general); flowers; grass
- H Trees; shrubs; creepers
- J Sky; earth; water
- K Buildings; parts of buildings
- L Transport; vehicles
- M Defence and arms
- N Tools; equipment; clothing
- O Musical instruments
- P Containers
- Q Miscellaneous objects
- R Insignia of rank; mace, sceptre, jewellery
- S Religious or magic symbols and signs
- T Heraldry; coat of arms; mason’s marks; merchant’s marks
- U Geometrical figures
- V Numbers; numerals
- W Individual letters
- X Monograms; abbreviations with letters
- Y Names; words
- Z Unclassifiable watermarks

Any and every classification theory denies that categories can be set aside for objects, things, or concepts that fit in nowhere else (*and here there are two such: Q and Z*), so some sort of reservation has to be expressed. Briquet, to my mind, puts things better, when in his pioneering article on the watermarks in the archives of Genoa (1888), he includes a category for ‘Signes dont le sens nous échappe’ (p. 114). Some of the identifications in the examples provided by Tschudin are also dubious: what he calls a “messenger, traveller” (p. 292) is identifiable by the staff as a “pilgrim” (*as Briquet recognises and classes as “Homme. Pèlerin”, nn. 7563-7607*), while his “acorn” (p. 317) is really an “oak-leaf”. One also wonders why the classical gods, such as Mercury and Neptune, are included in the human category (A) rather than in the “Mythical figures” (F), and so on. Just to return to one aspect of nomenclature, which has already been mentioned, if we follow Briquet’s labeling of a certain watermark as “main” (Fr.) or “hand” (Eng.), we classify it as category A, i.e. the human figure; if however we follow Renaissance sources, such as the Ripoli diary,

and decide that it is really a “gant” or a “glove”, it shifts into category N, i.e. clothing. So all in all some guesswork is involved. The IPH system has been applied in some small-scale projects, most notably David Woodward’s 1996 book on the watermarks in Italian Renaissance maps [26], but otherwise has not gained wide-spread acceptance.

More recently, in 2012, the Bernstein project has published on its website an impressive glossary of ‘Watermark-Terms: Vocabulary for Watermark Description’, in seven languages: English, French, German, Italian, Russian, Spanish, and Hungarian (*just Google*), which is also being applied in a number of projects. Its most important application has been to the Wasserzeichen Informationssystem, which brings together various German institutions, beginning with the 90,000 odd tracings collected by Piccard and left by him to the State Archive in Stuttgart [18]. The structure is very hierarchical: for instance, the principal motifs are: “Figures, anthropomorphic” (*i.e. human beings*), “fauna”, “fabulous creature”, “flora”, “mountains/luminaries” (*don’t really see the connection*), “artefacts”, “symbols/insignia”, “geometrical figures”, “coat of arms”, “marks”, “letters/digit”, “undefined mark”, and “work in progress”. So again, there are two categories for things we can’t really identify.

The discussion therefore remains open, but is unlikely ever to be satisfactorily resolved.

Chapter 6

Briquet and Switzerland's Contribution to World History

Charles Moïse Briquet was something of a genius. He smashed the long-cherished fallacy that early paper was made from cotton rags, systematically visited a hundred archival deposits on the Continent, organized 60,000 tracings by subjects, types, and dates, and, growing blind from his Herculean endeavours, brought the four volumes of *Les Filigranes* to publication in 1907.

Allan Stevenson, 'Paper as Bibliographical Evidence', *The Library*, s. V, vol. 17 (1962)

As we turn from the articles and monographs that Briquet wrote, mainly in preparation, to his *magnum opus*, to the consummation itself – words almost fail us; but admiration never. So comprehensive is this dictionary of watermarks, so well-balanced in its coverage of every region and decade within its defined limits, so accurate its tracings and its annotations of time and place and meaning, so plentiful its historical accounts of mills and master papermakers, so selective and yet abundant its provisions for future use and study [...] But words (I said) fail us. [...] Countless students and scholars have tasted the book, and some have used it. Recently a number of critical evaluations of Briquet and his great work have been printed in *The Briquet Album* (1952) [...]; and thus I need hardly praise what has been amply praised. Except for one personal remark: after a good many years of use, I am still finding in *Les Filigranes* the answers to problems that suddenly for me are new, or, more often, material whereby I may search out fuller answers than Briquet had opportunity to provide. Briquet evokes the detective instinct that is in all of us.

Allan H. Stevenson, 'Briquet and the Future of Paper Studies', in *Briquet's Opuscula* (1955)

What, finally, is the significance of twinship? Stevenson did not "discover" the twinship of moulds. Hand papermakers had always known, and continued to know, about twins. Twin moulds are listed in scattered business records of paper mills, and their use is described in various eighteenth-century accounts of papermaking. The great historian of paper Charles-Moïse Briquet wrote with precision of twin moulds, and reproduced several examples of twin marks. Even in Greg's classic study of "False Dates" there is clear reference to twinship, derived from Briquet, and yet Greg manifestly failed to see its application: ". . . technical evidence goes to show that a pair of frames could perhaps be made to last two years . . ." (p. 121). It was Stevenson's achievement to see that twinship had a methodological point: a paper stock is only defined when both its twins can be identified.

Paul Needham, 'Allan H. Stevenson and the Bibliographical Uses of Paper', *Studies in Bibliography*, vol. 47 (1994)

In the film *The Third Man* (1949), based on a script by Graham Greene, appears probably the most famous insert made by an actor to a screenplay in the history of cinema. The mysterious, elusive Harry Lime – played by Orson Welles – unforgettably links evil and creative genius, when he says: "In Italy for thirty years under the Borgias they had warfare, terror, murder and bloodshed but they produced Michelangelo, Leonardo da Vinci and the Renaissance. In Switzerland, they had brotherly love; they had five hundred years of democracy and peace and what did that produce? The cuckoo clock". However memorable, the interpolation is disturbingly inaccurate on two separate counts. First, although its origins are obscure, the cuckoo clock was not invented in Switzerland, but in southern Germany: the earliest examples go back to the

Seventeenth century, but production really took off in the Black Forest area after 1740. (*After the film came out, Wells said that he had received polite letters from Switzerland, correcting his mistake.*) Second, at least as far as paper historians are concerned, it makes no mention of Charles-Moïse Briquet (1839-1918) [18].

Charles-Moïse Briquet. A Personal History

To say that Briquet is Switzerland's most famous son might be an exaggeration, since William Tell and Roger Federer both stake strong claims to the title. On the other hand, instead of spoiling a perfectly good apple or beating hell out of innocuous tennis-balls, Briquet has given us something truly *aere perennius*. Over a century has passed since the first publication of *Les filigranes* in 1907 (*and with all the ridiculous centenaries that we have had to suffer of late, it is a shame that this one event passed unremarked*), the physical importance of these four tomes for scholarship is well-known to rare-book librarians, if only for the frequency with which they send them for rebinding.

Briquet was not a professional scholar. He was Swiss and too respectable for that.

He was instead a business-man, whose interests included a stationary firm and a small publishing house, specializing in producing lithographic views of the Swiss scenery, but he also came from a long tradition of papermakers and paper merchants. In *Les filigranes*, after his wife and the memory of his father, he dedicates the work "à l'honneur des *Industries du livre* (papeterie, imprimerie, reliure, librairie) exercées dans ma famille, dès 1687, à Châlons-sur-Marne et à Genève, par sept generations successives". As a young man, he was employed in the family business, but also took a year out to work in the papermaking mill, La Bâtie, on the river Versoix, near Geneva, which ceased production in 1880 and today is little more than a ruin. He was curious about early documents and palaeography and, according to his own account, first became interested in watermarks in 1878, when he undertook to give a picture of paper production in Switzerland in the Middle Ages, discovering that there were hardly any previous studies in what should have been an important field. It was only ten years later, however, when he retired from business, that he set in earnest to creating his famous repertory.

Briquet's great, unquestionable quality, which raises him head and shoulders above all scholars of paper before and since, is his mobility. After retiring on 1 January 1887, at the youthful age of 47, he departed – accompanied by his wife and presumably a servant or two – for six months at a time, staying in good hotels and using the newly created European railway network to move with comfort and probably a fair amount of luggage (*especially compared to today's aggravating Ryan Air standards*). Each journey was planned in scrupulous fashion. He wrote ahead to the directors of archives and libraries, advising them that he was coming and describing the sort of material he desired to see. Considering that at the time he was known at best as the author of a few articles, he obtained a surprising amount of collaboration (*or the archivists and librarians of the time were more receptive and helpful than their modern-day counterparts*). Obviously there were some places he didn't go: Great Britain, Spain, the Scandinavian countries, some bits of Eastern Europe, and Russia all remained off the map, but since up to his cut-off point in 1600 hardly any of the paper used in these outlying areas was produced domestically, this was no great loss. Even in important countries a few towns were missed: Arezzo in Tuscany is one notable absentee, Ferrara in Emilia-Romagna is another, and he also for the most part steered clear of centres such as Fabriano, which had already been mapped or where others were working. But on the whole the depth and extent of his coverage of the territory was and is extraordinary.

The rapidity and the comprehensiveness with which Briquet constructed his masterpiece comes however at a sort of price, which it is needful to understand, if his endeavour is to bear proper fruit. Unfortunately this does not always happen. *Les filigranes* is not in the situation of Richardson's *Clarissa* or De Tocqueville's *De la démocratie en Amérique* in being a book that everybody knows and hardly anybody has read, since it was never intended to be read in its entirety; on the other hand, most people who use it, even use it quite frequently, treat it as a picture book with captions. Quite apart from the fact that it is a heinous sin not to read Briquet's eminently concise introduction, anyone needing to know the history of a particular design should at least peruse the summary placed at the beginning of each lexical heading. It is a very good idea moreover to hunt out and read carefully Allan Stevenson's superb preface or re-introduction to the 1968 Jubilee edition, which explains how to make Briquet your friend and helper.

According to the introduction in *Les filigranes*, in just under twenty years of ceaseless effort, Briquet, covering the length and breadth of Europe (*almost*), visited 235 archive and manuscript collections, as well as libraries for about a thousand printed items. In the said travels he examined 30,840 volumes, as well as 1,432 documents in unbound form, in particular letters, from which he made a total of 44,000 tracings and

recorded 65,000 references to the same. The original tracings made by Briquet on his travels were fiddly and too fragile for continuous use, so after his return he recopied the designs onto more robust pieces of paper, which now form a sequence of twenty-four ring folders in the Briquet archive at Geneva (*Papiers Briquet*, nn. 51-74). This working material was supplemented by freehand drawings of watermarks, where tracing had proved impossible, and items copied from other previously published sources. When published after twenty years of intense labour, the final work reproduced 16,112 designs and for its geographical sweep and historical depth remains one of the great all-time works of scholarship. The whole of Briquet has now been put online in a splendid project, guided by Ezio Ornato and the Laboratoire de Médiévisique Occidentale de Paris (LAMOP), hosted inside the 'Bernstein Memory of paper' website of the Austrian Academy for Sciences [35]. The Bernstein interface makes it possible to interrogate Briquet in topographical and chronological fashion, though of course the reversal of a paper repertory into an electronic archive involves a number of pitfalls, such as multiple entries when Briquet gives a range of dates for the same watermark. Nevertheless, it is simple, friendly, convenient to use, and I like it a lot. Were I to venture a criticism, it might be to say that a note field is required for updates and additions, beginning with the thousand or so 'Addenda and Corrigenda' added by Allan Stevenson to the 1968 Jubilee edition (pp. *55-*86).

After Briquet's death in 1918, his heirs donated his working archive to the Bibliothèque Municipale et Universitaire in Geneva (*which in 2006 was renamed, more simply, the Bibliothèque de Genève*). Although the collection is devoid of personal papers, in particular the correspondence, study of the same reveals much about Briquet's method and how he constructed his repertory. While travelling, he made his tracings on small rectangles of transparent paper, measuring approximately 120×95 mm. All the images, both used and unused, received a number in red ink, which refers back to the sequences of documents in the archives and libraries he visited. These same numbers, again in red ink, are introduced, probably after his return home, into the travel diaries, where the original record was written in pencil, as well as into the descriptions in the working archive in ring-folders. Once the final selection had been made for publication in 1907, after their return from the printing shop, the 16,112 published images were numbered, as in the repertory, for the first thousand or so in a green ink with an underlining; afterwards, up to about n. 8000, with red ink in a circle, and finally with black ink in a circle. Subsequently, they were grouped thematically in yellow-paper envelopes and placed in the three boxes designated *Papiers Briquet*, nn. 75-77, in the archive. These images constitute the primary references, i.e. the image is reproduced and the source of the document is cited. The unused images were ordered in a separate sequence in boxes designated *Papiers Briquet*, nn. 78-82. The official total of the unpublished series is 29,728 tracings, arranged according to watermark typologies, thus forming a parallel, still imperfectly known, visual repertory (*the total number of tracings therefore works out at 45,930, i.e. close enough to Briquet's own indication*).

In the late 1990s, under the aegis of the Gravell Watermark Archive, coordinated by Daniel Mosser, the collection of Briquet's unpublished tracings was reproduced digitally with the intention of carrying forward a project to publish them online. Although the online catalogue of the same has lagged and is far from complete (*see below*), these same digital copies can be viewed on a terminal in the Rare book reading room of the library at Geneva and copies of single sequences, or of the entire series can be purchased (*at a negotiable price, i.e. in Swiss francs*). As can be seen from what does appear online on the site of the Gravell Watermark Archive, the digital technology of only two decades ago leaves an increasing amount to be desired, nevertheless the whole enterprise is an important step forward. A brief survey of the unpublished images inevitably discovers that in many cases the tracings are imperfect or incomplete, so that Briquet for obvious reasons discarded them, while a fair number are after his chronological limit of 1600. More important for any future study is the fact that the majority of these images, as we shall see, are present in the 1907 repertory as secondary references, for which Briquet gives the place of use and the date, but not the name of the archive nor the precise identity of the document.

A Tramway Called Udine

Just to give an example of how swiftly and effectively Briquet worked, his short visit in 1898 to Udine, the capital of the Friuli area in North-east Italy (*where I have a university job*), provides a fascinating test case. A first exploration of the same was provided in a thesis by Isabella Garlatti presented in 2005 at the University of Udine, which all-importantly included comparison with a selection of the original tracings conserved in the Briquet archive at Geneva. Albeit a small, quiet provincial backwater, Udine was home to inventor Arturo Malignani (1865-1939), who two years previously had sold his light-bulb brevet to Thomas Edison and whose genius meant that Udine was the third city in Europe, after London and Milan, to have electric civic lighting. Ten years after Briquet's visit it would also become one of the first cities to have an electrified tramway system.

Following his pioneeringly famous incursion into Italian filigranology, with the publication in 1888 of a lengthy article with the watermarks of Genoa, Briquet had already undertaken another two large-scale Italian journeys, the first in 1889-90, in which he travelled through Sicily, visiting Messina, Catania, Syracuse, Agrigento, and Palermo, before returning to Naples by boat and, after visits to Amalfi and Salerno, travelling up the peninsula, with stays in Rome, Fabriano, Florence, Lucca, Bologna, Venice, and Brescia (*Papiers Briquet*, n. 40); the second took place from December 1890 to April 1891, in which he visited Milan, Siena, Pisa, Pistoia, Modena, Parma, Padua, Treviso, Vicenza, Verona, and Bergamo (*Papiers Briquet*, n. 41). Unfortunately, neither diary is specific about the exact dates nor the length of the stay in the cities along the way, though it might be possible to establish something from his correspondence, where it has been conserved by the archives and libraries he visited. From 1895, however, and his journey through Eastern and Northern France (*Papiers Briquet*, n. 44), Briquet recorded his movements in greater detail. His next journey involving Italy, albeit briefly, was mostly conducted in Germany, Austria, and Czechoslovakia. The stages are meticulously recorded in a small black notebook (*Papiers Briquet*, n. 45), showing that the trip began at Kempten on the 13th June 1898 and ended at Würzburg on the 2nd November (*though presumably he got back to Geneva a few days later*). Midway through the trip, he came to Udine on Monday, 15th August from Klagenfurt in Austria, whence he returned on the following Tuesday, 23rd August. These dates are confirmed by the letters he sent at the time to the city librarian at Udine, Vincenzo Joppi, announcing his arrival and asking for material to be made ready for him. The four pages of the diary dedicated to Udine include a long list, neatly written in pencil, of the manuscripts he looked at, or wanted to look at.

Inevitably, the most fascinating part of the process is just this, to go back into the archives visited by Briquet and to look at the same documents in order to understand how he worked, what the choices he made were, and, equally significantly, what were the things he chose to ignore. Briquet's principal objective in Udine, and most important source for the watermarks he included in his repertory, was the *Annales*, which is a huge continuous sequence of documents, running from 1347 up to the end of Venetian rule in 1797 (*the record does actually continue till 1805*), containing the records of the city council (*Concilio maggiore*). As with the rest of the Medieval archive, it is held in what today is the Biblioteca Civica "Vincenzo Joppi", named after the librarian who in 1898 materially assisted Briquet with his research. The diary entries list volumes 1 to 66, i.e. from the Medieval beginning up to 1602, which had already been established as the cut-off date for his repertory. The Medieval part of the archive was originally formed by large unbound gatherings of paper, which were only brought together in volume form in the late Seventeenth century by the chancellor in charge of the archive, Andrea Brunelleschi. Briquet's primary references cover volumes 1 to 42 of the *Annales*, ending in 1514, which he certainly therefore consulted. In terms of the primary references, some volumes are not included, but, from the unpublished material, it can be shown that they were nevertheless looked at: for instance, volume 2, covering the years 1353-60, is not mentioned by Briquet in the primary sequence, but four of its tracings in the unpublished archive were reproduced by Mošin-Traljić in 1957 (*nn. 250, 4632, 6456, 7103, therein, see below*). Likewise, the unpublished part of the archive, partially available through the Gravell Watermark Archive, shows a more extensive chronological progress, since references appear as far as volume 59 and the year 1574. Altogether some ninety primary references were taken from the *Annales*, with the prize for the greatest use, no less than fourteen, going to volume 35, covering the years 1476 to 1482. Next in order of importance were the *Acta*, or the deliberations of the *Concilio minore* (*in modern parlance the Giunta*), comprising 92 volumes from 1490 to 1799, of which Briquet in his diary entry records 1-29, covering the period 1490 to 1599. The primary references get no further than volume 8 and the year 1519; again, however, the unpublished tracings visible in the Gravell Watermark Archive reach volume 26 and the year 1587. Eleven primary references from this source were later included in *Les filigranes*. Third comes the sequence of *Camerari*, or account books, less complete in their coverage, for which Briquet lists in his diary 18 volumes, from 1297 to 1420, and again saw them all, since he cites volume 17 in his main sequence. Seven primary references were taken from here. The rest is made up with a miscellany of 23 manuscripts, in some cases single letters, in others documents from the notary archive, which furnish a total of another twenty primary references.

When Briquet returned to Geneva and sorted out his travelling notes, the documents in the Udine archive recorded in the diary were numbered from 8981 to 9025 (*though, as explained above, the usual colour is red, in this particular case the numbers are in black*), keeping the final two numbers for the most important sequences, i.e. 9024 for the *Annales*, and 9025 for the *Acta*. It is important therefore to understand that the figures present also on the unpublished tracings are indexed to the archive series, so that the same number can appear on multiple images taken from the same source. To sum up, in seven days, considering travelling time, in high midsummer (*albeit before Italians discovered that sun-bathing is the height of hedonism and thus became permanently out of the office*), Briquet viewed something in the order of 130 manuscripts, most of them bulky, composite volumes, and collected 131 tracings for which Udine provided in most cases the

earliest known instance of a design and 144 others, which were not included in the final repertory, but for which Udine is given as a secondary reference. This total of 275 items is less than the full count, since further tracings, albeit not a large number, were wholly discarded in the sorting and selection phases, while the secondary references frequently cover groups of images (see *below*).

As has already been mentioned, information about Briquet's papers in the library at Geneva is available on line on the website of the Thomas L. Gravell Watermark Archive at the University of Delaware, coordinated by Daniel Mosser, which can also be interrogated through the Bernstein catalogue interface (*Google and thou shalt be answered*). The project for the archive itself goes back to 1995, as part of the build up to the important Roanoke conference the following year (*collected in the volume Puzzles in Paper*). No precise chronology is furnished, but from indications in the entries themselves, input happened in a series of tranches between about 2007 and 2013, so that at the time of writing in 2017, according to the interface of the site itself, the total of digital images and entries amounts to 5,547 items. Despite the fact that more recently the project seems to be languishing in financial and motivational doldrums, it should be clear that this is a magnificent resource and, were it completed, it would be extraordinarily useful. But there are matters for complaint that require serious consideration.

First, the website has software issues. When I first used it extensively, in 2015, searching for the "Repository name" among the "Artifact fields" refused to work and I had to experiment a variety of methods to get a result (*I add that criticism about this feature of the website appears elsewhere, so for once I am not the only griper*). The problem appears now to have been resolved, but glitches pop up quite frequently in other searches.

Second, the cataloguer, or cataloguers, presumably native English-language speakers, seem to struggle in deciphering Briquet's handwriting, which is not especially bad, by the standards of its time (*I have seen and coped with far worse*). So, all too often, and far too often, information in the tracings is erroneously transcribed or not transcribed at all. It is unkind, perhaps, to expect international researchers, who have little or no knowledge of French and want to use this resource, to have to struggle with what is written on the tracings, when it could easily be provided and interpreted. Most annoyingly, every reference to the archive or book shelfmarks is ignored. For instance, a shield watermark in the library at Udine, n. 3850 in the online resource, is catalogued as "1570 (?)", but the tracing itself tells a more complex story: first of all, the doubt about the date is Briquet's, since he writes "Annal. 57 58", followed by "59 de 1575", at the top of the tracing and "Udine 1570?" at the bottom, with "feuilles de garde" and "1574?" immediately above. What does this mean? It signifies that he found this same watermark in three separate volumes of the *Annales*, belonging respectively to 1570, 1574, and 1575, queried the date to himself, and in the end excluded this mark from the published version. Quite rightly so, since the sheets involved, being endpapers, are from the end of the Seventeenth century, when the *Annales* were bound up in volume form (*admittedly the Gravell Watermark Archive cataloguers could not have known this last fact, but the reference to endpapers provides a clue for anybody who knows anything about bindings*). Anyone using the Gravell Watermark Archive as a resource to explore Briquet's unpublished marks for a particular provenance or period should take note therefore that these features are not always fully or properly identified in the catalogue, and consequently that the chronological or topographical references to a certain year or place in the search engine may not be complete. Again, just to give a couple of casually chosen examples, the entry for a 1457 anchor watermark from the Archives Municipales in Dijon, n. 4860, fails to record where the document was written, i.e. Arc-en-Barrois in the Haut-Marne; likewise, another anchor watermark, this time in the collection at Udine, n. 5224, is dated as "1572", but Briquet writes a "7" in French fashion, with a crossbar, so that the correct date is 1512. Other examples abound, even in a fairly superficial reading, but space is at a premium.

Third, no explanation is provided about the Briquet numbers on the tracings, though they are included in the catalogue entry, albeit sometimes mistranscribed, as though they were part of some greater sequence. As explained above, they are instead the key to Briquet's archive sources and also to his journeys, so that a single number, as in the instance of the Udine *Annales*, i.e. 9024, can either cover a hundred and more tracings, or alternatively refer to a single document. Correctly interpreted and compared to Briquet's travel diaries, these numbers not only make it simpler to identify the precise source of the document, but also allow us to know when Briquet made the tracing, i.e. numbers 8981 to 9025 belong to August 1898 and his trip to Udine, and so on. Surely, this is information worth including?

Fourth, and most important, it is not sufficient, to my mind, just to throw the image into the internet with a minimum of catalogue description and hope for the best. As will shortly be demonstrated, the majority of the images in the unpublished part of the Briquet archive form the corpus of secondary references and, with a modicum of extra effort, can be endowed with significant meaning as such.

Just to give a very specific and entirely practical example (*or go for the jugular*), of what can be done with

this material, when one makes an effort. A search for the Biblioteca Civica in Udine, as a repository, in the Gravell Watermark Archive threw up 86 records (*matters are not entirely helped by the fact that the library there is designated the “Biblioteca Comunale [sic!] (Udino [sic!])”*). Just for the record, Briquet does not provide an index of the archives and libraries he visited, though the omission is remedied in the 1968 Jubilee edition, pp. *87-93, but he knew the Udine library as the “Biblioteca Comunale”; however “Civica” is the more modern and actual nomenclature). For reasons I won’t go into here, I chose to focus on the single instance of what Briquet terms a “Basilic”, but according to the Gravell Watermark Archive, n. 6530, is a “Dragon” (*I go with the latter, while leaving Harry Potter dragonologists the task of deciding whether the species is a Hungarian Horntail, a Ukrainian Ironbelly, or something different altogether*). This design of a fiery beast is characteristic of Fabriano and Pioraco, where the records published by Aurelio Zonghi in 1884 tell us that bales of paper with the watermark of a “dragho” were sent to the Tuscan port Talamone by Lodovico d’Ambrogio between 1364 and 1366. Briquet’s tracing, of which the original is held at *Papiers Briquet*, Box 78, Envelope 22 [Figure 1], refers to volume 14 of the *Annales*, covering the years 1400 to 1402, which in *Les filigranes* supplies primary references for two other watermarks, i.e. nn. 3175 (*Cercles deux*) and 9933 (*Licorne*). At the bottom of the drawing Briquet notes the sheet-size in cm “30/44”, and the date and place: “Udine 1402”. At the top, in a second moment, he adds a further: “17 [originally 16, cancelled] de 1408”. The oscillation in the dates, i.e. 1402 or 1408, makes it easy to identify a secondary reference in the published sequence for “Basilic” in *Les filigranes*, i.e. entry n. 2638, which reads: “**Marseille**, 1410. A. BOUCHES-DU-RHÔNE, B. 1945: *Cptes*. Var. ident.: **Udine**, 1402-08; **Calais**, 1403; **Provence**, 1407-10”. Here it is unusual that Briquet did not reproduce Udine as the earliest image in the group.

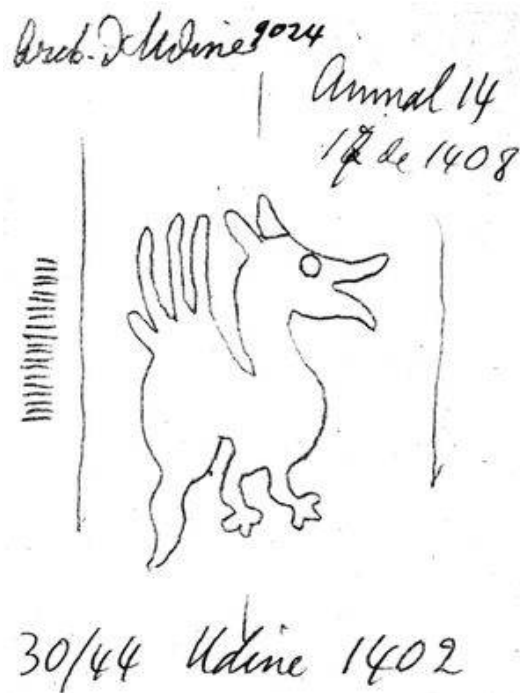


Figure 1. Charles-Moïse Briquet, Tracing in Geneva, Bibliothèque de Genève, Papiers Briquet, Box 78, Envelope 22. Image by courtesy of the Bibliothèque de Genève.



Figure 2. Left-hand (MsR) watermark from Biblioteca Civica "Vincenzo Joppi", Udine, Archivio Comunale Antico (ACA), *Annales*, vol. 14, f. 382r. Backlit photograph from the mould side. Image by courtesy of the Biblioteca Civica "Vincenzo Joppi".

Figure 3. Right-hand (MsL) watermark from Biblioteca Civica "Vincenzo Joppi", Udine, Archivio Comunale Antico (ACA), *Annales*, vol. 14, f. 352v. Backlit photograph from the mould side. Image by courtesy of the Biblioteca Civica "Vincenzo Joppi".



Figure 4. Left-hand (MsR) watermark from Biblioteca Civica "Vincenzo Joppi", Udine, Archivio Comunale Antico (ACA), *Annales*, vol. 17, f. 119v. Backlit photograph from the mould side. Image by courtesy of the Biblioteca Civica "Vincenzo Joppi".

To take things just a step further (*given that in Udine the Biblioteca Civica is only a short distance from the university*), a first-hand examination of *Annales*, volume 14, discovered the dragon watermark in the gathering forming ff. 352-385. The said volume covers the years 1400-1402, albeit with a few entries for 1404 and 1405 in the final leaves, while the gathering with the fiery reptile design specifically relates to the period 29 July to 18 September 1402. The seventeen sheets of the gathering in volume 14 have twin right-hand and left-hand watermarks, both mounted on supplementary chainlines, distant 29-30 mm from the surrounding chainlines, which are more widely set at 38-39 mm, while Briquet's measurement of the sheet-size, allowing for the distortion of the binding, is absolutely correct. The marks are easily told apart: in the eight examples of the left-hand watermark (MsR), the thin-necked, narrow-mouthed dragon straddles the supplementary chainline [Figure 2]; in the nine examples of the right-hand watermark (MsL), the thick-necked, wide-mouthed dragon has both legs in front of the supplementary chainline [Figure 3]. Comparison shows that Briquet traced the left-hand watermark (MsR) from the felt side of one of the four blank leaves in which the sign is extremely clear and not impeded by writing (ff. 379, 382, 383, 384). The other chronological reference in the tracing puzzled me, until I understood that it was an indication about the reappearance of the watermark in volume 17 of the *Annales*, containing years 1408-09, where a search uncovered a group of one right-hand (MsL) watermark at f. 103, and three left-hand (MsR) watermarks at ff. 107, 108, 119, most of them obscured by handwriting. Deciding whether these were the same marks, albeit somewhat aged, or different marks, albeit with the same provenance and shaped on the same pattern, required lengthy scrutiny and comparison: the one clear image at f. 119 shows a thick-necked, wide-mouthed dragon, in the left half of the mould (*i.e. the inverse of the situation six years previously, though of course it did happen that marks were taken off the moulds for cleaning and reattached in reverse*) [Figure 4]. On the whole, however, there was a sufficient slight diversity of elements to conclude that the watermark was not the same, although it was certainly shaped on the same original pattern. A further singleton right-hand (MsL) watermark is found at f. 220 and differs more markedly with respect to *Annales* 14. So, if *Les filigranes* is taken, as it should be, as a repertory of watermark designs, the reference to volume 17 is acceptable; if, on the other hand, it is to be interpreted as a repertory of individual marks, Briquet is wrong, albeit understandably so, and this ambiguity is central to understanding the man and his method.

To sum up, the application of new technologies to old problems offers exciting new possibilities, but also requires a more rigorous and active method. Most importantly, an accurate reconstruction, taken from Briquet's original materials, of the libraries visited and the documents inspected, as well as a first-hand analysis of his unpublished tracings, should be able to decipher most, if not all, of the secondary references in *Les filigranes*, which could thus be acquired by the said databases. It would be an epic undertaking, but the exercise performed here shows that it is perfectly feasible and worth attempting.

Using Briquet for the Better

Briquet is a system. Briquet is a way of thought.

The most common and banal failure in subsequent scholarship is not to understand that his great work is not in any way a repertory of watermarks, but of watermark designs. His objective at all times is to give the earliest known date at which a certain design, or variant in a design, first appeared, and it is rarely possible to improve on him in this respect. For this reason, there is an undoubted prejudice in favour of the Thirteenth and Fourteenth centuries, to which has to be added the fact that every time he came to a new archive he asked first to see the oldest documents; those from the Fifteenth and Sixteenth centuries were viewed only if, and when, he had time to spare.

Three things that Briquet did not do are: first, he never tells us whether the tracing is taken from the mould or the felt side of the sheet. In the small sample of examples analysed by myself in the archives at Lyon and at Udine, where the original mark has been compared to the tracing, mould-side prevails, but this is probably due to the general fact that the watermark is more visible from the mould side than from the felt side. The tracings in the Geneva archive also reveal that in the final printed version images were sometimes turned around, so that the designs were almost all facing the same way (*a small point, but it does enormously facilitate comparison*).

Second, he doesn't say whether the mark is in the right or left-hand side of the mould (*nor does any other major repertory*). This is actually a matter of some importance, especially when the objective of research becomes to identify twin watermarks. One fact, for instance, about which no data has been gathered, is when the right/left alternance became the prevalent system. A quick survey of the *Annales* at Udine shows

that the situation was decidedly variable in the middle of the Fourteenth century. In volume 1, covering the years 1345-53, for instance, except for one slender gathering containing a single mark, all the gatherings contain distinct pairs of watermarks, presumably made in North-Eastern Italy or at the furthest Fabriano, with designs of a towered gate, bells, cross-bows, a key, an eagle, a weight, and a unicorn's head. In five instances both watermarks were placed in the left-hand side of the original moulds, in four in the right-hand side, and in three alternately in the left- and right-hand sides. The sheer amount of variance shows that no one system was in place and that the positioning of watermarks was left up to individual mould makers. The Udine archive is a remarkable example of a single run of paper over nearly five centuries and, with further exploration, could certainly provide a preliminary answer to the question about the placing of left- or right-hand watermarks. Although acquired on a much more random basis, my experience of Fifteenth-century Italian paper in printed books suggests the alternate system prevailed more or less universally by the second half of the century. It was interesting to note however, in the Archives Municipales at Lyon, that in French Fifteenth-century paper it is still not unusual to find both watermarks in the same half of the mould. For instance, the anchor watermark from ms. CC.74, containing "Taxes perçues au nom du roy" in 1454, has twins both placed in the left-hand (MsR) of their respective moulds, and they are so alike that it is extremely difficult to decide which one Briquet traced for his n. 401. Likewise in Gerardy's 1980 study, describing the paper in the archive at Fribourg in Switzerland [6k], covering the years 1402 to 1456, a summary count shows that in 27 instances the twins are both in the left-hand side (MsR) of the moulds, in 16 they are in the right-hand side (MsL), and in 59 they are in alternate left and right sides. While both in the left or both in the right side dominates at the beginning of the century, along the chronological time line the alternate method increasingly prevails. Though much more work is needed, it seems therefore that the system of placing twin watermarks in opposite halves of the relative moulds was introduced at different times in different geographical areas, becoming uniform by the end of the Fifteenth century.

Third, as Stevenson observes in his great study on the *Missale speciale*, Briquet does not always pick up on changes of state in the life-span of the same watermark, so that in some cases the same figure appears twice, albeit in one instance in its youth and in the other in extreme old age (*but then how many of us are recognisable in our teenage photos?*).

Furthermore scholars have voiced perplexity about the way in which Briquet treats look-alike or very similar watermarks. His classification employs three grades of diminishing closeness: *identique*, in which the watermark appears exactly the same; *divergente*, in which some small difference is discernable; and *similaire*, in which the distinction is more marked (*to be honest, the phrasing of his formulation, see below, is ambiguous and it is not entirely clear whether similaire or divergente represents the greater degree of variance. It is of little real importance, since the latter term is hardly ever used*). In particular, in his 1968 introduction to the Jubilee edition of Briquet, Allan Stevenson furnishes the following criticism 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" (p. 18*).

There is a touch of unfairness in this remark and, if the truth be told, elsewhere, for instance in the introduction to Briquet's *Opuscula* in 1955 and in the Kansas lecture of 1961, Stevenson shows a much better understanding of the limits and practicalities of his precursor's working method, making the – to my mind – all important point that Briquet had little or no way of telling where twin watermarks were involved. Since this criticism surfaces in other writings about paper – for instance, it is cited in the presentation on the Gravel Watermark Archive – by scholars who perhaps have a lesser comprehension of the matter, it is worth clarifying this particular judgement once and for all, also because Briquet himself makes a very misleading claim.

In the *Avant-propos* to *Les filigranes*, written and completed after the completion and printing of the rest of the work, Briquet seeks to establish chronological parameters for the dating of watermarks, as follows: "Nous nous sommes demandé s'il n'y aurait pas un autre moyen d'évaluer le temps écoulé entre la fabrication d'un papier et son emploi, en se servant dans ce but des *filigranes identiques*. Entrons ici dans quelques détails nécessaires: chacun sait que dans l'ancienne manière de faire le papier on se servait de deux moules ou formes que l'ouvrier plongeait alternativement dans la pâte. Le papier produit, portait donc par parts égales

l’empreinte de chacune des formes employées et ce mélange se voit dans chaque rame et dans chaque main de ce papier. Ces deux variétés du filigrane sont parfois *identiques* au point qu’on ne les distingue que par la place un peu différente que chacune d’elles occupe sur la feuille de papier. Parfois les deux variétés sont *divergentes*, voy. *coupe* (nos. 4542 et 4543), *couronne* (nos. 4791 et 4792), *croix grecque* (nos. 5525 et 5526); le plus souvent elles sont *similaires* n’offrant entre elles que des différences légères de forme ou de dimension, voy. *pot* (nos. 12.893 et 12.894), *serpent* (nos. 13.801 et 13.802), *tête de bœuf* (nos. 14.388 et 14.389)” (vol. I, p. xix) [translation: *we have asked ourselves whether there might not be another way of establishing the amount of time that passed between the making of paper and its consumption, using for this purpose the identical watermarks. Here some technical detail is necessary: everyone knows that in the old way of making paper, two moulds or formes were employed that the vatman dipped alternately into the pulp. The paper so produced bore therefore, in equal proportions, the imprint of each of the two moulds employed and this alternation is to be seen in every ream and gathering of the same. These two variant watermarks are sometimes identical to the point that they cannot be told apart, except for the different position they have on the sheet of paper. Sometimes the two watermarks are divergent, see coupe (nos. 4542 and 4543), couronne (nos. 4791 and 4792), croix grecque (nos. 5525 and 5526); more often they are similar, showing only small changes in shape and size, see pot (nos. 12,893 and 12,894), serpent (nos. 13,801 and 13,802), tête de bœuf (nos. 14,388 and 14,389)].*

What Briquet unequivocally states here is that all his indications of *identique*, *divergente*, and *similaire*, should be taken as identifying twin watermarks; the claim, however, is not just implausible, it is impossible. As has already been shown in the previous chapter, the identification of twin watermarks is a matter of inference and depends on finding a consistent nucleus of paper, in which the same two watermarks are present in approximately the same quantity, without the intrusion of other sheets containing analogous marks to create uncertainty. If the said watermarks are furthermore separable in terms of right and left, so much the better. Briquet’s indications of *identique*, and so on, rarely if ever refer to the same original document, which, as he himself makes clear in the passage quoted here, is the essential prerequisite for identifying twin watermarks; almost invariably the reference is instead to documents in different collections, sometimes visited years apart in time, and therefore it is unthinkable that he could have established twinship with the quantity and the quality of the information he had gathered. Likewise, none of the tracings I have so far encountered in the Briquet archive make any reference to twinship.

It is worth taking a better look at the six examples, or twelve watermarks, Briquet himself cites in the passage quoted just above. In reality and with sublime irony, these are perhaps the few instances in which Briquet deliberately provides references to twin watermarks, albeit not quite, and excepting those cases in which he didn’t really intend to. For two of the entries, the *Coupe* in 1431-39 and the *Serpent* in 1479-85, the source is the archive in Geneva, Briquet’s home town, where obviously he had time for a longer and more leisurely scrutiny than those permitted in his travels. Likewise, for the *Croix grecque*, again a Geneva watermark from 1408, in the double-bracketed entry he writes: “Filigr. posés presque au centre de la feuille ... Ces deux figures se trouvent toujours ensemble et paraissent être produites par une seule paire de formes” [translation: *watermarks placed almost in the centre of the sheet ... these two figures are always found together and seem to have been made by the same pair of moulds*]. As far as I am aware, this statement is almost unique in *Les filigranes*, while the unusual placing of the mark makes it probable that he is right. For the *Pot* and the *Tête de bœuf*, respectively at Angoulême in 1550 and Lautrec in 1444-47, the coincidence of dates and the archive source make twinship highly probable, though if someone were to have a look, that would be nice. The *Couronne* mark makes reference, however, to two Fifteenth-century printed books, both published in 1484 in Harlem by Jacob Bellaert, and generates a weird little, or perhaps not so little, situation. The *Seelentrost* published on 9 August 1484 is ISTC is00361000, where an immediate link is provided to the wonderful *Watermarks in the Low Countries* (WILC) online repertory, which duly reproduces the twin crown watermarks in the edition with very clear electron radiographs [23]. Briquet 4791 does not take the watermark immediately from the incunabula, but from a previous essay on watermarks in France published in 1868 by Etienne Midoux and Auguste Matton. The marks concerned are nn. 239 and 240, which in the earlier article are reproduced in lithograph with their position with respect to the chainlines, albeit without reference to the wirelines or the measurements. Even more curiously, as far as Briquet’s treatment of these marks is concerned, is that Midoux-Matton give as their source the archive in Laon, without making any mention of Dutch incunabula, and further have nothing whatsoever to say about twin watermarks. It goes without saying that the various passages have not improved the accuracy of the tracing, but n. 239, or Briquet 4791, corresponds approximately to the left-hand (MsR) watermark, WM I 1112, in WILC (*which designates it as “right”, seen from the mould side*). The other watermark traced by Briquet, i.e. 4792, taken from Midoux-Matton, n. 240, is not the twin, or the right-hand watermark (MsL), in WILC. The latter corresponds instead to WM I 1395 (*designated as “left”, seen from the mould side*), in all respects almost

identical to its sister mark. Briquet 4792 does not appear anywhere in the 1484 *Seelentrost*; it does surface, however, in the other title he cites, the *Boeck des gulden throens*, translated into Dutch from the German original of Otto van Passau, published on 25 October 1484, or ISTC io00125000, which again has a link to WILC (*when technology and genuine research interact, it can be quite engaging!*). The twin Crown watermarks here, WM I 692 and 693, albeit generically similar, really do not match the image in Briquet. Certainly, before drawing any definite conclusion about either of these watermarks, it would be best to return directly to the source of Midoux-Matton, held in the beautiful city of Laon and published a long time ago in 1868.

How much credence should we give therefore to Briquet's claims about twin watermarks? None whatsoever is probably the best answer. Without, however, in any way diminishing Briquet or the greatness of his achievement. It is necessary, however, to understand the very serious limitations posed by the accuracy of tracing as a method on the one hand and by the extreme rapidity with which Briquet worked on the other. His terminology is an accommodation to these two uncomfortable facts. Very simply, Briquet did not have time, nor the technology, nor the desire to chase twin watermarks. When he departed for one of his archive-and-library-visiting trips, a journey which could last up to six months, using the relatively new-fangled European railway network, it is implausible that he took with him his entire working archive; it necessarily stayed in Geneva, since, quite apart from the risks of the journey, 60,000 records constitute a notable mass of material. Once he returned from his travels and began the task of classifying and matching up the new harvest of tracings, which would obviously be several thousand in every journey, Briquet had to face several questions about the relationship between his new data and what he had already garnered, sometimes ten to twenty years earlier.

Was it the same watermark?

Was it the same watermark at a different stage of its earthly existence?

Was it the same watermark, attached differently to the mould, or to another mould?

Was it the twin watermark from the sister mould?

Was it the twin watermark in an earlier or later state?

Was it a mark from a different pair, but shaped around the same pattern?

Was it another mark altogether, but still fairly look-alike?

The answer to all these questions is that he could not know, because all he had for the comparison were two tracings (*even Stevenson, when he correctly evaluates the limits of Briquet's method, makes the mistake of assuming that Briquet compared at least a watermark with a tracing, but this is clearly unlikely*). Now of course the easiest way to compare two tracings is to superimpose them in order to establish whether they are indeed the same shape and size. If they are, it is what I think Briquet intends by *identique*, but the recognition can go no further. Our exploitation of what he provides must therefore take a full and proper account of this uncertainty.

More significantly, the whole discussion around twin watermarks has constantly begged and largely ignored a more important issue, i.e. the pattern on which the watermarks were shaped [see Chapter 5]. These were simple objects, a pencil drawing on a small piece of wood, nails hammered in at key points, after which the wire was bent round the nails to form the watermark. A single pattern, however, potentially produces an infinite number of watermarks of the same size, which can be attached to successive moulds over an extended period of time. This simple fact signifies that to say "watermarks are twins" is already a considerable simplification: the family unit is often much more extended and may include sisters and brothers of every kind.

My own experience of Medieval and Renaissance paper has regularly found that identifying twin watermarks is splendid in theory and far from straightforward in practice. Just to take an example, manuscript CC.105 in the Archives Municipales at Lyon, is made up with a series of gatherings, in folio format, written in 1488 and 1489. Briquet looked at it over a century ago and traced a "main", probably from the felt side of f. 206 (n. 11548), and a "soleil", probably from the felt side of f. 234 (n. 13917). He does not appear to have manifested any interest for the third watermark found therein, a "roue dentée", similar to nos. 13447-52, even though a clear image, unencumbered by ink, is visible at blank f. 317, but it is quite possible that the tracing ended up in the collection of discarded images (*where I still have to look for this particular item*). Following in his footsteps, I inspected this volume in a stay at Lyon a few years ago, courtesy of the Musée de l'Imprimerie. There are two separate groups of hand, or glove, watermarks. The larger, comprising the sixty sheets ff. 41-84, 87-136, 187-206, was made on a pair of moulds, in which both watermarks were placed in the right-hand

half of the mould (MsL). As quite frequently happens and as my notes duly show, my initial impression was that there were three, possibly four, different watermarks, so that it took the best part of a day before the distinguishing traits of the twins were clear in my own mind. Another set of hand or glove watermarks supplied ff. 137-186: here the sheets are quite thick and the images are faint, so, apart from noting some differences between the two moulds, I did not persist. The sun watermark appears in a gathering containing only six leaves, ff. 234-239: unfortunately, all three watermarks are from the same mould, where the mark was placed in the right-hand side (MsL), so the twin is not available. In my opinion this is a manuscript of medium complexity. Many are simpler, providing left-hand and right-hand, or sometimes both from the same side, watermarks that are easily recognised as twins. There are however plenty of more complicated situations, in which the twin marks are virtually indistinguishable or there are four or six similar watermarks and no way of telling the pairings apart. Where Briquet flicked rapidly through the manuscript, selected the images he wanted, and made his tracings in a matter of minutes, anything more thorough, especially the identification of twins, involves a fifty-fold increase in the amount of time and effort. Briquet made his choice and today we have *Les filigranes* as a finished work.

Of course, there is an acceptable solution to this dilemma. If you really desperately need to know whether the watermark recorded by Briquet is the same as that in the document that interests you, you only have to get on a plane, a train, a bus, and follow the trace back to the library or archive where Briquet first found it. Indeed, if the source is a printed book, most often an incunable, the task is simplified by the fact that a library near you might hold a copy. Though awkwardnesses can arise with the brevity of the indication (*as we have seen with the "1282" watermark at Bologna*), or if the reference is a secondary one, Briquet is generally scrupulous (*and on the whole much better than other watermark scholars*) in the way he lists his sources, at least as far as the primary references for his tracings are concerned. Even a century later most of the collections he visited are still extant and librarians and archivists are usually able to put their hands on the documents concerned (*as proved to be the case both in the Archives Municipales at Lyon and in the Biblioteca Civica at Udine*).

But some modern scholars, not necessarily paper historians, although perfectly willing to criticise, appear strangely averse to the idea that they should get up off their chairs and go and look at some real watermarks. In the course of over a century the only researcher systematically to have followed in Briquet's path, for at least a small part of the way, has been Allan Stevenson. In his wonderful introduction to the 1968 Jubilee edition, he provides some cogent examples of Briquet watermarks which he had traced back to their source, for instance, a pair of unicorn marks in the blockbook of the *Canticum Cantorum* in Dutch, attributed on the basis of the paper and other evidence to Bruxelles and the year 1466. Here is the story he tells: "The British Museum impression [IB. 16; BMC I, 6] contains just one paper, marked with twin prancing Unicorns: Br. 9991 and 9993! If I had my doubts, I resolved them at Metz through making photocopies and sketches, both showing sewing dots. What is notable is that Briquet here gives us both members of a pair: twins. This happened because he found one Unicorn in the departmental archives at the Prefecture and the other in the municipal archives across the road from the Bibliothèque, and failed to recognise them as twins because the first is a copied document. Actually the marks date from 1465 rather than 1466 [Briquet actually suggests "1463?" for n. 9991, which he notes is a copy of a document of an original of a slightly earlier date, and "1466" for n. 9993]" (p. *26). In the plates following p. *36, Stevenson provides two excellent β -radiographs of the said twin unicorns, albeit without telling us more (*for instance, which is left and which is right*), making it possible to compare quality photographs with Briquet's images. As an example of method, and how Briquet should be approached, it is absolutely perfect, especially in demonstrating that even when the great filigranologist included twin watermarks, it was probably quite unintentional. The only regret is that Stevenson never did it on a larger scale.

Briquet's Followers and Imitators

The example of Briquet, even following his first pioneering article in 1888, was obviously huge and every watermark repertory published subsequently has been immensely in his debt. Some works, however, follow particularly closely in his footsteps, even to the extent of using the same material, and so merit close scrutiny.

The most explicit continuation and extension of Briquet's repertory, whose importance and significance has been missed by just about everyone, including myself in the first version of this text, which is strange, since the book concerned is easily found on the shelves of rare-book rooms (*and thus confirms that paper historians are not good at browsing*). The title in pure, idiomatic Serbo-Croat might, on the other hand, have proved off-putting, as well as the initial impression of a survey of watermarks in the archives and libraries of what at the time was Yugoslavia. The work is the *Vodeni znakovi XIII. i XIV. vijeka*, by Vladimir A. Mošin

(pronounced *mo-shin*) and Seid M. Traljić (pronounced *trig-lich*), published in Zagreb by the Jugoslavenska Akademija Znanosti i Umjetnosti, Historijski Institut, in 1957. Fortunately, the work has a parallel title in French, i.e. *Filigranes des XIIIe et XIVe ss.*, also regarding the publisher, which is the Académie Yougoslave des Sciences et des Beaux Arts, Institut d'histoire. It reproduces 7,271 watermark designs ordered in Briquet fashion, with references to further instances of "identiques" and "similaires" that are not shown. A little over eighty images are simply reproductions of Briquet's published corpus and as such provide little or nothing that is new; many others, however, approximately 40% of the repertory (*at a rough guess*), are taken straight from Briquet's unpublished archive at Geneva, cited as "BI" or "Briquet inédits", and therefore constitute a major extension of the same. (*Rather frustratingly, the introduction is laconic about the use made of Briquet's materials, in particular about how the tracings were obtained and reproduced. Since the originals are present in today's archive and it is improbable that they were loaned, the most likely explanation is that they were retraced, with an inevitable loss of detail and accuracy.*) Other material is taken for the most part from original documents in archives and libraries, in what at the time was the wrong side of the Iron Curtain, though in most instances the paper was of Italian origin.

Just to give some examples of what the Mošin-Traljić increment involves, let us stay with the test-case of the Medieval archive of the city of Udine. Without taking account of the addition of further secondary references, Mošin-Traljić add 21 images from Udine to the 131 primary references published by Briquet. The first volume of the *Annales* covers the years 1347 to 1353 and is actually a composite volume, bound up in volume form in the Seventeenth century, containing thirteen gatherings of differently watermarked paper. In *Les filigranes* Briquet published only the unicorn's head, n. 15772: one of a pair of right-hand marks (MsL) in the final gathering of the volume (ff. 391-436). Mošin-Traljić remarkably recover no less than four images from the same volume. What they cite, without explanation, as the Briquet number, i.e. 9024, as we have already shown, is really the numeral conferred on the whole *Annales* sequence in the *Papiers Briquet* of the Geneva archive. It should be added, moreover, that they pay no attention to the other already-mentioned complexity, i.e. the fact that three out of the four marks can be identified among Briquet's secondary references. So, as follows:

- Mošin-Traljić, n. 76: a rather bedraggled, one-headed eagle watermark, which is a right-hand (MsL) singleton found once at f. 264: "28×42r. 1350, Udine (BI 9024: A., Annal. 1)", which Briquet traced from the felt side and cites as a secondary reference in *Les filigranes*, n. 77: "AIGLE à une tête. 29×45 r. Longwy, 1349. Var. ident.: Udine, 1350". The original tracing is found in *Papiers Briquet*, Box 78, Envelope 2, n. 139, also in the Gravell Watermark Archive, n. 4536, and confirms the identification;
- Mošin-Traljić, n. 237: a crossbow watermark found in the 23 sheets at ff. 44-89: "28,5×43 r. 1347, Udine (BI 9024: Bibl., Annal. 1)", where the left-hand watermark (MsR) is traced from the felt side. The original tracing of the 1347 mark is found in *Papiers Briquet*, Box 78, Envelope 7, n. 44, also in the Gravell Watermark Archive, n. 5510, and confirms the identification. Briquet cites this design as part of a grouped secondary reference in *Les filigranes*, n. 705: "ARBALÈTE 31×43 r. Gênes, 1345. Var. simil.: Udine, 1347-56". The other watermark Briquet refers to is published as Mošin-Traljić, n. 250: "30×46. 1356. Udine (BI 9024: Bibl., Annal. 2)", while the image itself is given as "1356 (1350-7)", also in the Gravell Watermark Archive, n. 5523;
- Mošin-Traljić, n. 6796: a "peson" or weight for scales, described as "1350, Udine (BI 9024)". Here the source is a pair of left-hand watermarks found in nine sheets in ff. 246-266. The tracing is taken from the mould side of the mark numerically present six times at ff. 246, 255, 259, 260, 262, and 265. The source of the image is certainly f. 265, which is not only devoid of writing, but in which the supplementary chainline supporting the watermark is not very visible, so that Briquet failed to notice its presence. Again this design is recognisable as a secondary reference in *Les filigranes*, n. 12404: "Gênes, 1351. Var. du groupe: Udine, 1350". The original tracing is found in *Papiers Briquet*, Box 81, Envelope 13, n. 7, and confirms the identification;
- Mošin-Traljić, n. 7191: a "tour crenelé", where the image is of the only instance of the left-hand (MsR) watermark at f. 8: "1375, Udine (BI 9624 [sic! for 9024]: Bibl., Annal. 1)". It is traced from the said blank leaf on the felt side, whereas the two examples of the right-hand mark (MsL) at ff. 4-5 are partially obscured by handwriting. The four-sheet gathering concerned (ff. 2-9), i.e. the first in *Annales*, volume 1, is dated in the original only by a reference to the XIII indiction, or the Medieval system of chronological cycles, which for the Fourteenth century corresponds to 1315, 1345, or 1375. In the margin on f. 2r a later hand, probably Sixteenth-century, has inserted "1345" and for this reason the gathering was placed at the beginning of the volume, when the *Annales* were assembled and bound up in their actual form in the Seventeenth century (*the second gathering is correctly dated 1347*). As the original tracing in *Papiers Briquet*, Box 81, Envelope 13, n. 62, duly shows, Briquet found and annotated the date 1345, but suspected its veracity, since he also wrote on the same: "Certainement copié post ou erreur de date", and therefore chose not to use it.

Interestingly, a subsequent conservator of the library in Udine, Giovanni Battista della Porta, during the first quarter of the Twentieth century, has inscribed a pencil note on the flyleaf, arguing on the basis of internal evidence that the year concerned must be 1375. So Briquet was right to doubt, though at the moment it is not known how or why Mošin-Traljić also made the right correction.

Just to complete the picture relating to volume 1 of the *Annales* in Briquet, an unused tracing in *Papiers Briquet*, Box 79, Envelope 6, n. 99, not recovered by Mošin-Traljić, but now available in the Gravel Watermark Archive, n. 8514, shows the watermark of a key. The image matches the left-hand watermark (MsR), one of a pair in the fourth gathering (ff. 90-131), dated 1348, which Briquet traced from the felt side and to which he makes a secondary reference when citing a list of variant designs in n. 3813 as “Udine, 1346-54”. One of these designs cited in this secondary reference is the unpublished key watermark, dated 1354, from *Annales*, volume 2, in *Papiers Briquet*, Box 79, Envelope 6, n. 103, also in the Gravel Watermark Archive, n. 8518. A more thorough exploration of the still unpublished collection of tracings, since what I have done so far is a mere sample, might add something more.

Vladimir Mošin pursued his re-elaboration of Briquet with two more thematic publications. The first in 1967, in collaboration with Mira Grozdanović-Pajić, brought together from numerous previous repertories the images of the *agnus paschalis*, or Easter lamb, from 1327 to 1817 [18]. If in the total of 338 entries most of the pre-1600 items have been previously published, mostly in Briquet, the Seventeenth-century material and later is taken mainly from archives in what at the time was Yugoslavia. The paper, however, was mostly Italian in origin and the repertory is especially valuable for the attention it pays to countermarks and other additional signs. His subsequent collection of *Anchor watermarks*, published in English in 1973, lists and reproduces 2,847 watermark designs from 1376 to 1832, organized by design families on a chronological basis. If on the one hand it involves the duplication and expansion of large extant series, such as Briquet, nn. 345-593, and Zonghi, nn. 1583-1642, it does include examples from less known sources, such as Ferdinando Ongania’s history of printing (Venezia 1894), and adds much new exemplification taken directly from manuscripts and printed books in the collections of Eastern Europe.

Another repertory which deserves mention, *en passant* and perhaps more, is that by Johann Lindt for the history of papermaking in Berne published in 1964 [6k]. It includes 787 numbered tracings (*in reality* 788), covering the period from 1465 to 1859, mostly comprising a bear. Where it is significant is that in many cases the tracings are for twin watermarks, which are linked together in the index. Obviously this is a major step forward in the identification of paper stocks, though some gripes are also possible, for instance, there is no information about which side of the mould each watermark is positioned, and so on.

The other great watermark resource in printed form, which is commonly found, alongside the master himself, on the shelves of rare book rooms, is the series of seventeen *Findbücher*, in 25 tomes, by Gerhard Piccard (1909-89), published from 1964 to 1997, containing some 92,000 reproductions of tracings [18], so almost six times larger than *Les filigranes*. The method is essentially that of Briquet, albeit with some minor differences, so it is worth examining this immense work of scholarship in the light of what has already been said in this chapter. Piccard covers a significantly longer time-scale than Briquet, albeit with variations from volume to volume, but generally up to the end of the Seventeenth century and at times into the early Nineteenth, thus covering much or most of the handmade paper period. The geographical area is perhaps more restricted, concentrating for the most part on the course of the Rhine from Germany to the Netherlands, but with significant incursions into Northern Italy, while France is relatively neglected. On the other hand, there are drawbacks, both in method and in execution, since on the whole Piccard appears less skilled than Briquet in his tracings, which were redrafted for publication purposes by redrawing the original pencil trace in India ink, and in his ability to recognise marks. It has been observed by Paul Needham in his 1985 study of the paper in the Gutenberg Bible, for instance, that in *Wasserzeichen Frucht*, nn. 1147-1160, Piccard reproduces the twin grape watermarks found therein a total of fourteen times (p. 318). This signal failure to recognise that these are the same pair of marks does not induce confidence. In the first three volumes of the series, moreover, the watermarks were not reproduced according to their original sizes and the indications about wire and chain-lines were removed, presumably for “aesthetic” reasons, though these faults were subsequently remedied. A further weakness in Piccard’s approach is the omission, in numerous instances, of the countermark accompanying the watermark. Since the presence of a countermark tells us that the paper almost certainly comes from Venetian territory, in particular in the mills on and around Lake Garda, the exclusion is a serious deficiency.

For the purposes of our detailed analysis, let us look at the by now familiar and friendly matter of dragon watermarks. Piccard describes them in his tenth *Findbuch*, published in 1980, containing mythical creatures, so also griffins and unicorns. Compared to Briquet’s 109 entries (nn. 2618-2726), Piccard provides 764 images, a seven-fold increase (nn. 201-964), but with relatively few secondary references. The descriptive

entry indicates the placing of the watermark on the chainlines, the number of wirelines covered by the watermark, the place of origin of the document, and the date of the same. Unlike Briquet, no information is given about the measurements of the sheet and nothing is said about where the document is presently held, and these are both important omissions. The other significant, and innovative, feature is that some watermarks are indicated as being pairs or twins, i.e. "Bei der Produktion ursprünglich zusammen gehöriges Formen – bzw. Papierzeichen Paar" (p. 16), with a designation "A" and "B". For instance, nn. 372 and 373, found in documents written at Ferrara in 1400 and at San Pietro in 1401, are indicated as twin watermarks; sometimes, however, differences in design lead to separation, such as n. 375 in a document from Parma in 1431, which is the A twin associated with the B twin at n. 419, with the same origin and date. The usefulness of this feature is impaired somewhat by the lack of ancillary information, i.e. whether the tracings are from the mould/felt side, whether the marks are placed in the right/left hand side of the original mould, and whether the identification of the twins is based on a significant quantity of paper.

One obvious and important question was whether the pair of dragon watermarks from *Annales*, volume 14, in Udine, were recognizable among those described by Piccard. Some are certainly very close, for instance, nn. 280 and 283, given as twins in documents written in Utrecht in 1401, obviously on paper imported from Italy. They share the characteristic that n. 280 has its back leg in front of the chainline and n. 283 behind, a feature found in other pairings, such as nn. 275 and 285, on documents written in Xanten in 1403. On the other hand there is a sufficient number of differences, for instance the missing horizontal wire on the front ear, to show that they are different marks, albeit probably all from the same original pattern. Apart from the limitations of tracing as a surefire method of recognition, the failure of the repertory to say where the documents are held formerly made it nigh impossible to check the originals: the publication of Piccard's tracings online does not, as yet, include nn. 280 and 283, although it does tell us that nn. 275 and 285 came from the Stiftsarchiv in Xanten.

The other very important aspect of Piccard's research is that his huge archive of published and unpublished drawings has taken on new being in one of the most significant and innovative projects in the field of watermark studies on the website of the State Archive in Stuttgart, as the "Digital Publication of the 'Piccard' Collection of Watermarks"; this in turn forms part of an even bigger project, or the Wasserzeichen-Informationssystem (WZIS), involving other institutions in the German-speaking world, which can be accessed directly or viewed through the portal of the Bernstein 'Memory of Paper' project [35], where it is honoured with first place in the list of repertories. The information-technology side of the operation and the quality of the images available for interrogation is absolutely superb; the explanation of what the project actually involves, on the other hand, especially as relates to the Piccard archive, is very unclear and even downright mystifying. So here is an attempt to unravel it. The Piccard material on the Stuttgart Archive site is formed by 37,000 supposedly "unpublished" images; at the time of writing in 2017 WZIS has a total corpus of 133,872 items and continues to grow at a steady rate. It is a sophisticated interface, which takes a while to master, but is worth the trouble. One very useful feature is that the sources for the tracings have been indexed and listed, meaning that individual localities can be checked or studied in depth, with reference directly to the original manuscripts: for instance, I was intrigued and pleased to find 568 entries relating to Udine, albeit not to the Biblioteca Civica visited by Briquet in 1898, but to the State Archive (*and about which something will have to be done*). What about the images in Piccard's published volumes? Well, they are also available on line, with exception of volumes 1-2 (*comprised in 4 tomes*), in a project entitled *PPP-Piccard Print Online*, on the site of the Austrian Academy for Sciences, which is not searchable through the WZIS or Bernstein interfaces (*obviously, the long-term plan is to integrate these images, but in the short term a few words of explanation might prove very helpful*). It is nevertheless a very convenient resource, also for the excellence of the download of individual images.

Let us again see what happens with a practical example, focusing again with dragons. Beginning with the Stuttgart website, when asked in 2017 about *Drache* in German, the answer was 222 fire-breathing reptiles; asking WZIS the same question (*which can also be posed in English or French*), the answer was 354. The "unpublished" Piccard entries, called up by both inquiries, are significantly better in at least one respect with respect to the published version, in that they include Piccard's annotation of the archive source, which WZIS also transcribes. But there is a small structural problem. Let us take a scaly worm at random, n. 123930 (*WZIS allows for searching by reference number, i.e. on the first page click "Extended Search", followed by "Reference number" in the "Search Watermarks" opening, in order to call up this individual beastie*). Scrolling through the dragon/Drache entries on the Stuttgart site, one discovers that this particular flaming lizard appears on a document written in Florence in November 1392 and held by the Datini Archive in Prato; if, on the other hand, the starting point is WZIS, the entry provides a further link to the online published version, identifying the said fiery worm as n. 323 in the printed repertory, where it faces in the opposite direction and has been provided with an eye which is missing in the tracing. So the unpublished images are quite

often published, which is – to put it mildly – confusing. If we further take the trouble to go to the printed volume and to consult the index therein, we discover that n. 323 is a singleton without the tracing of a twin (p. 22). To sum up, as far as the Piccard archive is concerned, a single watermark may be described in three different sources of information, none of them entirely complete, i.e. the “unpublished” images of the tracings on the Stuttgart Archive site, which give the source of the original document, but fail to say whether the document is also in the published repertory; the link between the same and the “published” images in WZIS, which can vary in matters of detail; and the original print document, which does not tell us where the document is held, but is the only one to say which watermarks belong together as twins (*to be fair, WZIS does include the “A” and “B” labels, but without saying what goes with what, so the paper repertory still has to be verified*). To ask an impecunious, struggling watermark scholar to puzzle all this out on their own is somewhat cruel (*it took myself a good day and a bit, and plenty of trial and error*). These defects which are commonsensical, rather than conceptual or practical, rather mar the pleasure to be taken in an absolutely extraordinary on-line cutting-edge resource, and it is to be hoped therefore that in coming years they will be overcome; until that day comes, please pay careful attention to the explanation given here.

Returning to more traditional procedures, in the field of Greek codicology, important work has been done to document and trace pairs of watermarks in manuscripts written in the Renaissance, mostly in Northern Italy. In the first volume (1974) of their *Wasserzeichen aus griechischen Handschriften*, Dieter and Johanna Harlfinger reproduce some 300 pairs of watermarks from manuscripts in European libraries, for the most part in Germany and Italy; the second volume (1980) added another 300 examples [18]. Subsequent work by American classicist, Mark L. Sosower (1949-2009), limited to Sixteenth-century manuscripts in Spanish libraries (2004), most of them however written in Italy, adds another 760 pairs of watermarks, albeit with the odd singleton [18]. As contributions, they are impressive and anyone grappling with the problem of identifying and describing twin watermarks should be aware of them, since the presentation of tracings of the twins on the same page makes it very easy to recognise differences. At the same time the “Harlfinger method”, common to both repertories, is inadequate in several respects and omits basic evidence: no measurements of the sheet-sizes are provided, no information is given about the placing of the watermarks in the left/right side of the mould, and we are not told whether the watermarks are viewed from the mould or felt side of the sheet. It is yet another instance of hard, meritorious work not achieving its goal through a failure to talk to scholars with parallel experiences in other fields. Just to give an instance, Sosower provides a lengthy discussion of countermarks, without realizing that they are circumscribed to Northern Italy and in particular Lake Garda, with one example he transcribes as “3M”. It is easy to guess that this is “ZM” and almost certainly stands for “Zuan Maria” [11].

As a final aside on Briquet’s epigones, a number of repertories have been published with the explicit intention of extending his work into the Seventeenth and Eighteenth centuries, and consequently are much known and cited, without always being looked at with a sufficiently critical eye. The earliest of these by William Algernon Churchill (1865-1947), published in 1935 [18], surveys watermarks produced in North-Western Europe, including England and Holland, which were in the process of becoming major producers of paper. It is a valuable historical treatise, but the tracings of 576 watermarks, which fail to include the chain or wirelines, are not well executed. A larger and more impressive repertory, published in 1950 [18], was that of Edward Heawood (1863-1949), geographer and librarian of the Royal Geographical Society, comprising tracings of 4,078 watermarks. Again, the emphasis falls mainly on watermarks of Northern Europe, many of them taken from maps and printed books. A correction of this imbalance, albeit limited to France, came with a book by Raymond Gaudriault in 1995 [18]. It contains 4,328 tracings, most of them, however, reproduced from previous repertories, with a consequent loss of accuracy and detail.

For other watermark repertories, produced on a more regional basis, see [6].

Chapter 7

Time-frames, Case Books, and the Value of Paper as Evidence

Perhaps the slight nuance of contempt that the student of paper is aware of arises partly from a recognition that some collectors and publishers of watermarks seem not to have known clearly why they went through these motions. As E.J. Labarre has sometimes admonished me, only Briquet was a professional.

Allan Stevenson, 'Paper as Bibliographical Evidence', *The Library*, s. V, vol. 17 (1962)

L'informazione immediatamente accessibile di una filigrana è perciò, per nostra sfortuna, assai inferiore a quella di quella che ci offre l'etichetta di una bottiglia di vino, sulla quale compaiono, oltre al nome e all'indirizzo del produttore, l'anno di vendemmia e il numero di identificazione della bottiglia stessa.

Ezio Ornato [et al.], *La carta occidentale nel tardo medioevo* (2001), I, p. 109.

We have learnt a lot (*if you are still there, that is*). Has it been worth it?

Well, we have discovered above all that a sheet of paper is a moulded object and that signs are placed on the mould which allow us to identify it as an individual or as one of a pair of individuals. The matter is complicated by the existence of twin moulds; but twins taken together have a greater individuality as a couple than a single mould taken on its own. So the fact that we are dealing with twin moulds paradoxically improves our chances of making a positive identification.

In every assessment and description of the material object, whether of the sheet in its entirety or just of the watermark, it is important to remember, as with printing type, that what we describe is not the original object, but the impression it left on the surface of quite another object. Paper shrinks on drying, so that the original was larger than the trace it has left; depending on the make-up of the fibres and the thickness of the sheet, paper does not shrink uniformly, so that sheets from the same mould may differ somewhat in dimension and shape.

If we can recognise the idiosyncratic features of each pair of moulds in sheets of paper made thereon, and tie them into other sheets of paper made on these same moulds, we have acquired a powerful, but not necessarily easy to use, instrument for bibliographical research.

But don't get carried away.

The Lifetime of a Pair of Moulds was ... ?

How long did a mould last?

And how sure can we be in making a watertight identification of a pair of moulds?

Briquet, who as a young man worked in a papermaking factory, puts the duration of a set of moulds as being not more than a couple of years ("sa durée moyenne ne dépasse pas deux ans"). Gaskell cites evidence from the archives of the Whatman mill, which bought "an average of 10 new pairs of moulds a year for the six vats of Turkey and Loose Mills in 1780-7, giving an average life per pair of moulds of just over seven months" (*New Introduction to Bibliography*, cit., p. 63). Of course, put in this way, the statement is ingenuous, and even misleading, since the introduction of new moulds does not mean that older ones were immediately discarded. (*To get a perspective, try asking a serious Marathon runner how many pairs of shoes they get through in a year? There is no simple answer. In the first place how many marathons are they running, and in the second they might have new shoes that are being broken in, an in-use pair kept for the races and more testing runs, and an older pair used for short training runs, and perhaps yet another reserve pair in the house at the seaside, so as not to have to remember to take one's regular shoes, and so on. So, although a new pair may be bought every year, three or four pairs might be on the go at the same time, while a particular, lesser-used pair might last for years.*)

The assessment of between one and two years seems reasonable for a pair of moulds undergoing a daily wear-and-tear at the vats. This indication therefore can be taken as true, where Renaissance paper is concerned, for Chancery-size (*i.e. what the Bologna stone calls reçute*) moulds; if however the moulds are making larger sizes, such as Median and Royal, for which there was less request, they were used less often and therefore they lasted much longer, maybe even generations. How many sheets of paper might a pair of moulds make in this time? Again there are variables: mould construction techniques, in which the wires became finer and more closely set, undoubtedly improved over time, and much probably depended on the skill of the individual mould maker. Nevertheless, a rough calculation can be made along the following lines: if a pair of moulds is used constantly at the vat for two years, three hundred days each year, with a ten hour day, producing 150 sheets an hour, the total is 900,000 sheets of paper, or 1,800 reams. So the individual mould is responsible for 450,000 sheets and 900 reams. How much of that paper has survived in today's books and archive documents? Hardly any at all.

A stock of paper, after it was made, had to go through a series of further processes and would only go on sale several months after its fabrication. At this point it was subject to a variety of practices, especially in printing shops, so the analysis never rests on paper alone. It always has to take account of all available data.

In the employment of paper as bibliographical evidence, especially in the study of printed editions, three basic situations nevertheless occur with a certain frequency and it is worth describing them in order to chart the relevant research procedures.

In the first scenario we are seeking a pair of watermarks, or several pairs of watermarks, in order to establish the relationship between them and the watermarks found in other books. Most often the purpose is to give a date to an undated printed book, or a book in which the date furnished by the printer is open to challenge; sometimes it is also a question of discovering where it was printed.

The principle was set out with exemplary clarity and simplicity by the Italian scholar Roberto Ridolfi in 1957 [10]: if we have a dated book from a known press and an undated book from the same press and we find the same watermark (*or, better, pair of watermarks*) in both, the same date can be assigned to both imprints. If we take account of the time-frame represented by the life of the watermarks in the papermill, the period is a couple of years; if, however, we consider the fact that paper was bought and used by a printing shop in terms of its immediate needs, the two books are probably printed at much the same time. The whole hypothesis of course requires much caution. Without venturing into the labyrinth of "printers of the mind", early shops often had several books going at the same time with significant overlaps in production; the same shops were also using considerable quantities of paper for ephemera and other materials that have not survived. The best known example of this principle, which furthermore identifies different states in the lives of several different pairs of watermarks, is Stevenson's superlative 1967 study of the Constance *Missale Speciale*, believed on the basis of its typography to be possibly anterior to the Gutenberg Bible, but which the paper evidence unequivocally assigns to c. 1473 [30]. Another is the demonstration, begun by W.W. Greg, continued by Stevenson, and more recently rounded off by Carter Hailey, that a group of Shakespearian quartos, variously dated 1600, 1608 and 1619, printed by William Jaggard for Thomas Pavier, and thus known as the "Pavier Quartos", were all printed together in 1619 [30].

In the second scenario it is not necessary to spot individual watermarks or pairs of watermarks. It applies in a more general fashion the principle that printing shops expended something between 50% and 70% of their budget for a book on the purchase of the paper and therefore tended to buy only enough for the work in hand. Papermills were generally placed out of town, in hilly areas of difficult access, so printers bought from a middle-man, the paper merchant, who obtained his supplies from several different sources. In the press output therefore it is common to find different lots stratified by their watermarks, because each time a supply of paper was obtained the source changed. Since mould sizes, as we have seen, were more or less standard, there was no problem in matching up supplies of paper from different sources and in any case, as the printer knew perfectly well, any small discrepancies would be evened out by the binder's plough.

Every analysis and description of the distribution of the paper structure inside a printed edition must be done with as many copies as the bibliographer can get their hands on and therefore takes time and plenty of shoe leather. It is not to be undertaken by the hasty, the imprudent, and the impatient. A single sheet, showing a different watermark, in one copy may be a genuine anomaly revealing some change in the presswork, but – as Stevenson warns on many an occasion [29] – it might just be a remnant from an earlier job slipped into the new run. Only the extensive comparison of multiple copies can establish the true pattern.

The third scenario involves the recognition of *cancellans* sheets or leaves printed to make a correction or a substitution in the text of a book at a later stage. Quite often a different paper supply is employed, though the evidence always has to be assessed with care. A *cancellans* may however take the form, especially in

middling and small formats, of a half or a quarter sheet, which leaves the rest of the unit intact. In this prospect paper evidence comes into its own with a vengeance, though collecting it and interpreting it may not be a simple matter. Again the information garnered from the first copy to happen to hand will not give a complete picture; only the examination of a large number of copies allows the bibliographer to build up a full portrait, which means travelling to look at them. A *cancellans* of this kind, involving any unit less than a full sheet, constitutes a physical disturbance in the structure of the same. On the basis of this fact, discovering its presence is a straightforward matter of mathematics and probabilities. If the substitution involves a half-sheet of paper, there is one likelihood in two, even if the supply of paper is the same, that the watermark will either be duplicated or vanish, i.e., assuming that the sample of copies reflects the distribution of the original, 50% of copies will appear normal, 25% will present two watermarks in the said gathering, and 25% will be without a watermark (*or present two countermarks, or some more intricate equation*). It is also worth, where one suspects that a disturbance has taken place, attempting a more complex level of analysis and identifying, with the help of a raking light, the distinction between the mould and felt-side of the sheet [14]. Again a partial substitution of a sheet has one probability in two of disturbing the original relationship. (*Given that we are here explaining bibliographical wizardry, the third trick, which does not directly involve paper, in recognising a physical anomaly is to spot the difference – again it is a good idea to employ a raking light – between the “first” and “second” formes in the printing, wherein the latter pushed the first indentation back the other way. Once more a substitution has a 50% probability of being different from the original. The method does however require a certain amount of bibliographical savoir faire and it is better to attempt it on a copy in pristine condition, which has not been excessively pressed and hammered in rebinding.*)

The “Runs and Remnants” Principle

Our understanding and application of dating on the basis of finding the same watermark in two different books from the same press has, however, to be tempered by Allan Stevenson’s brilliant definition of the principle of “runs and remnants” [29].

For reasons of cost, early printers tended to calculate the amount of paper required for any job very precisely and to order an exact quantity from their supplier. Most of this paper is used up in the printing of the same and constitutes the “run”. Often however there are residues, perhaps of slightly damaged or imperfect sheets, perhaps recovered from the “cassie” quires, which are set aside for proofs or other usages, such as *cancellantia* or sheets reprinted to make up a short-fall in the original press-run. Sometimes these random sheets or “remnants” will drift into later books and thus appear as isolated witnesses, perhaps even years after acquisition of the original supply.

Stevenson expounded the principle several times in different writings. Here is how he memorably put it in 1962: “These observations lead me to point out a pair of fallacies concerning longevity and time-lag, the first of which Briquet himself falls into, as many have fallen since. We note that most of his tracings were gathered from manuscript sources, often from individual letters or short documents. Now, it is obvious that some scribes or accountants or notaries might use a supply of paper over a period of years, especially if the paper were of large size or high quality. Ordinary small paper would be used up faster. But a printed book differs in its manner of using paper. When a printer secures a supply of paper (from publisher, author, merchant, or mill) for the printing of a book, and then prints an edition of (*say*) 250 or 1,250 copies, he *tends* to use that supply up before going on to the next. The consequence is that we often find *runs* of a single paper for many gatherings; or perhaps a rhythm of two papers when two presses have been used. And then the printer proceeds to runs of other papers, usually papers of similar quality. After study of many such runs, in the light of warehouse or printing records such as those of William Bowyer, I suggest that it can be inferred that the paper was *usually* bought expressly for the printing of the book and probably not long after manufacture. In early days paper was such a costly commodity in terms of the economy that it cannot have made sense to buy bulky bales of it years ahead. As a corollary it needs to be pointed out that the *random* occurrence of a particular watermark in a book may represent some *remnant* of stock used for an earlier book and possibly overlooked in the printer’s warehouse for a matter of years. Here is a reason why a Pot watermark dated 1598 can turn up in the second quarto of *Hamlet* dated 1604 or 1605: once in the Huntington copy, twice in the British Museum copy. *Running paper* is highly relevant to the dating of a book; *random paper* is unreliable for the purpose. This I call the Principle of Runs and Remnants. Scholars should no longer assume that printed books use paper in the manner of pieces of manuscript or that an intrusive paper is as significant as a main stock”.

Just for the Record: Some Case Studies

These are all useful little tricks. How do they work in practice?

Every manuscript, or printed edition, on paper from identifiable moulds is a law unto itself, so there are no fixed rules, only previous experiences.

Learning about paper as bibliographical evidence took myself a long time, and the process is far from over, but on many occasions it has proved to be the rabbit that pops out of the conjuror's hat. Here therefore is a little summary of items from my own personal casebook. This display might well seem, and certainly is, narcissism to the *n*th degree; on the other hand none of these books and articles declare in their titles that they have anything to do with paper evidence (*to be honest, they use lots of other kinds of evidence as well*), and so they have been wholly ignored by repertories such as the IBP [0]. (*Such blindness even in state-of-the-art bibliographical resources is anything but rare: I recently noted that extraordinarily high-powered databases such as Medline, and its sister resource in nursing sciences, both ignore an excellent bibliographical article by Victor Skretkovicz on the early printing history of Florence Nightingale's Notes on Nursing, first published in 1859 and kept in standing type for well over twenty years. Why? No proper reason, or simply because the journal concerned, The Library, in 1993 is not among those regularly considered by their sources. Notes on Nursing, however, even a century and a half after its first publication, is still a cornerstone of the profession, and an enjoyable read, if you ever pick up a copy, while 'History of Nursing' is part of the MESH Tree String [K01.400.608]. In bibliography parameters are never a simple issue, but outreach, or the ability to go off the beaten track and find minor material, rather than the standard well-known monograph is the most precious part of the discipline. End of sermon.*) The other reason for these potted summaries is that all these items have been written and published in Italian, which I do not think it reasonable to presume all the readers of the present text to have mastered.

An early instance, in which the paper analysis provides part of the answer to a bibliographical mystery, is the 1472 Venetian edition of Boccaccio's *Filocolo*. This substantial folio has a curious and at first sight puzzling feature: the very last page, which should be blank, has a text printed upside-down from an earlier part of the book. Finding a correct explanation of the phenomenon obviously requires a study of the text, but paper-analysis is the key to showing that the book was printed on a one-pull press, i.e. a primitive version of the process only able to execute the equivalent of one folio page at a time [28]. During the composition of the text of a gathering in the middle of the book, a mistake was made: half-way through the setting of the page, the compositor turned a leaf too far forward in his manuscript copy-text without noticing and thus jumped three pages forward instead of one. Since only the first of the sheet's four pages had been printed, when the mistake was noticed, the ruined paper was set on one side to be used for proofing and other operations. Towards the end of the edition, however, the printer found himself short of paper (*and probably of money*); rather than spend for a new supply, he had the crafty idea of recovering the waste sheets by turning them upside-down, so that the first page became the last (*a bit like our modern habit of reusing photocopies for drafts and such like in the home printer*). As well as the spoiled sheets, in at least one copy an uncorrected proof sheet, containing the page from a different part of the *Filocolo*, was recycled in this strange manner. The edition employed six different paper supplies, stratified in the surviving copies, with the recycled sheets clearly recognizable as "remnants", while the bibliographical analysis also reveals that copy was divided in half, with one compositor starting at the beginning of the book and the other starting in the middle, with the printing being done simultaneously on different presses.

The first book printed in the shadow of the towers of San Gimignano (*very metaphorically speaking*), the folio 1510 *De Cardinalatu* by Paolo Cortesi, takes the Oscar for the most nightmarish collational formula ever written [30]. Just for reference purposes, it has recently been expressed as: $\pi^2 a^{10} A-E^8 2F^6 F-H^8 I^{24}$ [i.e. $I^8(I5+<I6.7.8.9.10.11.12.13>^{16})$] $K-L^8 M^8(-M1; -M2.7, +<M1>.7)$ N^{14} [i.e. $N^6(N3+<N3.4.5.6>^8)$] $2N^8 <O3.4>^4$ $p^2 P^8 Q^8(-Q6,7,8) <Q6.7.8.9.10>^{10}$ $q-r^6$ [s]1,2 (=Q7,8) R^{18} [i.e. $R^8(R3+<R4.5.6.7.8.>^{10})$] $S-X^8$. Which, unless you are an experienced analytical bibliographer, is going to ruin your day. Establishing the precise nature of the book's structure depended a great deal on the paper evidence acquired in the examination of over a dozen copies. The most valuable contribution paperwise came through defining the relationship between the original gathering Q and the two unsigned leaves that followed on from gathering r, which are denominated [s] in the collational formula. By matching up the position of the watermarks and the relation of mould/felt sides in the various copies, it was demonstrated beyond all reasonable doubt that [s]1 and [s]2 were originally printed as Q7 and Q8. A very large insert, consisting in the elimination of the original leaf Q6 and its substitution with the ten leaves of $<Q6.7.8.9.10>$, followed by the twelve leaves of gatherings q-r, shifted the original Q7 and Q8 into quite a different place in the book. Although this fact could have been suspected on the basis of the typography, proof (*that marvellous word!*) came through the paper evidence. In other circumstances it is necessary to extend research on paper to all the editions printed by a particular

press in a certain period, hoping always that its output will not be too large! Again the principle involved rests on the assumption that a printer will exhaust one supply of paper before buying in a new one. One instance in which the paper evidence provides an important part of the answer to a bibliographical conundrum involves the first edition of Francesco Berni's *rifacimento*, or rewritten version, of Boiardo's *Orlando Innamorato* [30]. The *princeps* of the work, to all intents and purposes a new poem, is known today in a double issue: one from the Giunta family in Venice dated October 1541 and the other from Andrea Calvo in Milan dated 1542 (*with the date 1 January in the dedication*). The difference between the issues lies in the fact that the preliminaries, the first gathering of the text and the last gathering of the same, including the colophon, are in two different settings; otherwise the body of the book is all from the same setting of type. Internal evidence shows that the main part of the book was printed in Milan and that the Venetian issue was necessarily predated. Paper analysis, especially the systematic comparison with all the other editions printed by the Calvo shop in the period 1539-42, as well as modifications to the italic type used in the Milan shop, show that the edition had really been executed a couple of years earlier, at the end of 1539 and beginning of 1540, by Francesco Calvo, who, due to illness, later handed the running of the firm over to his brother Andrea. The delay in publication and the reissue of the edition in this strange guise was the result of the declared enmity of Pietro Aretino towards his enemy Berni.

Another nice little instance of Renaissance publishing jiggery-pokery occurred in Venice in 1551, when Gabriele Giolito reissued a number of copies of the Italian and Latin poems of Agostino Beaziano, originally published by Bartolomeo Zanetti in 1538 [30]. The edition was an octavo: in order to substitute both the title-page and the colophon Giolito ran off two half-sheets, i.e. A1.4.5.8 and N1.4.5.8. The paper analysis of some ten copies, assisted by the circumstance that the sheets included both a watermark and a cornermark, duly showed that the two halves were printed together as part of the same full sheet and subsequently divided. The accumulation of the data even made it possible to show the imposition of the two formes involved. Although perhaps not terribly important from a bibliographical viewpoint, in this instance the paper evidence gave a result that could not have been reached by any other means.

Something very similar occurred in Venice in 1600 for the publication of the *Vaticinia* by Girolamo Giovannini [30]. In quarto format, it was decided to insert a half-sheet *cancellans* in the first gathering and to add an analogous two-leaf index at the centre of the second gathering. The two half-sheets were printed together: quite apart from the fact that, due to a mistake in signing, the binders often placed the whole sheet at the centre of the first gathering, watermark evidence incontrovertibly shows that in any one copy the two halves came from the same original sheet.

An even more cogent example of the utility of paper evidence, in the absence of any other sort of typographical proof, comes from the first edition of Alessandro Manzoni's *Promessi sposi*, published in three volumes, in octavo format, in Milan in 1825-26, though actually put on sale only in June 1827 [30]. It just happens to be the most important novel in the history of Italian fiction – an equivalent of all Jane Austen and all Dickens rolled into one – and so has attracted a corresponding amount of critical and bibliographical attention. In 1970 an example was noticed of the survival of a two-leaf – i.e. quarter-sheet – *cancellandum* in a single copy in the Brera library in Milan. Between 2003 and 2006 the Centro Nazionale di Studi Manzoniiani organised a large-scale collation, in which 68 copies were compared on a McLeod collator. The research – conducted with exemplary patience by Emanuela Sartorelli – did not discover a significant number of press-variants (*but certainty on this point is always a positive result*); however, as well as confirming that the previously-identified *cancellandum* was the only extant example in gathering 9 of the first volume, it uncovered another instance of a *cancellandum* in gathering 10 of the same volume in a copy in the Ambrosiana library. The problem evidently lay in the efficiency with which the quarter-leaf substitutions had been introduced by the printer and subsequently by the binder (*bibliographers much prefer the binder in particular to be inefficient or, better still, lazy, so that examples of the cancellandum survive in a certain number of copies*). It was a plausible hypothesis therefore that in the sample there were *cancellantia* in other gatherings, which had been introduced in *all* 68 copies and thus were invisible, as far as mere textual comparison was concerned. Paper-evidence is more truthful on the other hand. The watermark of the paper of the edition comprises an eagle set over the letters GFA, which stand for Giovanni di Faustino Andreoli, founder of the Toscolano mill that supplied the paper. The eagle and the said letters are placed in mirror writing in a corner of the mould – the following table indicates whether the G or the A is the outermost letter – in other words the position occupied by a Renaissance countermark, while the ubication of the watermarks in the gatherings, almost always in the first four leaves, showed that the imposition of the typographical forme was of the type denominated “common octavo” by Gaskell. Now the law of averages suggested that the substitution of two conjugate leaves in order to introduce the *cancellans* had a one in four chance of generating an anomaly, i.e. either the presence of two watermarks in the same gathering or their absence. So checks began. For reasons of space, the full table of the watermark distribution in the three volumes of

the edition and in the nearly thirty copies verified is not given here. Instead, just as a simple demonstration, the table shows what emerged in the first volume in the first four copies looked at in libraries in Bologna and Florence, which immediately confirmed the workability of the hypothesis (the second column nevertheless indicates all the *cancellantia* that were eventually discovered).

gathering	cancellans	Copy 1	Copy 2	Copy 3	Copy 4
1	3.6 4.5	2A	2A	-	-
2		2G	1G	1G	4G
3		4A	3A	4A	1G
4		1A	1G	1G	2G
5	3.6	4A	2G	4G	4G
6		2G	1G	3G	1G
7		2G	2G	4G	4A
8		2G	3G	3G	4A
9	1.8	1G+2G	2A	2G	1G
10	1.8	4A	3G	-	2A
11		1G	2A	3G	4A
12	3.6	1G+3A	-	-	1G
13		3G	4G	2G	4G
14		3G	4G	1G	4G
15		3A	4G	3G	3A
16	3.6	2A	1G	2G	-
17		2G	4G	4G	4G
18		4G	2G	3G	4G
19		1G	1G	1G	3G
20		2A	3A	2A	1G
21		2A	4G	1G	2G
22		-	2A	1A	1G

Figure 1. Distribution of the corner-placed watermarks four copies of volume 1 of Alessandro Manzoni, *I promessi sposi*, Milan, Ferrario, 1825-26.

What does this signify? Well, although we already knew about the *cancellantia* in gatherings 9 and 10 from the survival of the *cancellanda*, it was nice to obtain a confirmation from the paper evidence. The sample unquestionably showed that a previously unsuspected *cancellans* had been introduced in gathering 12, since two watermarks appeared in the gathering in Copy 1, while the absence of watermarks in two copies in gathering 1 and in one copy in gathering 16 pointed to something going on. A more extensive check, comparing a further 23 copies, raised the total of identified *cancellantia* in this volume to seven (*eight were subsequently discovered in the second volume and none in the third*). This same evidence made it clear that the first gathering contained not one, but two separate *cancellantia* (*three copies emerged with three watermarks in this gathering*), and identified a further example in gathering 5, unrevealed in the first assay. But a word of warning, there is a rogue card in the pack. The unwatermarked sheet in gathering 22 in Copy 1 is perfectly whole and genuine, i.e. sheets of paper without a watermark can creep in and upset any system that tries to be too rigid about the way it evaluates the data. It should be emphasised yet again, therefore,

how much good paper evidence in analytical bibliography depends on the study of multiple copies of the same book, with all the trekking around libraries that that involves. The other intriguing information, thrown up by the analysis of the paper, was the existence of a proof-copy, printed on a different paper-stock, presumably to allow the printer to follow the progress of the edition and eventually intended to be thrown away at the end of the operation; instead it was taken over by the author and used as a canvas for the definitive 1840 edition.

In all these instances the watermark and paper evidence gave a result that might have been suspected, but otherwise could not have been obtained.

Chapter 8

Bibliographical Annotations and Orientations

The Red Queen shook her head, "You may call it 'nonsense' if you like," she said, "but I've heard nonsense, compared with which that would be as sensible as a dictionary!".

Lewis Carroll, *Through the Looking Glass, and What Alice Found There* (1871)

With this excellent start one might have supposed that watermarks would have been accepted as a proven aid in bibliographical detective work. But it has not quite worked out that way. No doubt their seeming complexities have frightened off some would-be users. Others, assuming that the main use for watermarks must be that of establishing dates, and finding some difficulty or ambiguity in using them so, did not try further. The fault has lain partly in a tendency to assume that problems involving papermarks may be solved simply by opening *Les Filigranes* at the proper page. Enthusiasts have claimed too much; old-time skeptics have sniffed at watermarks as the toys of dilettantes; and no group has been willing to undertake the basic study of the nature of handmade paper.

Allan H. Stevenson, 'Briquet and the Future of Paper Studies', in *Briquet's Opuscula* (1955)

As computers become ubiquitous adjuncts to research in the Humanities in general, and to bibliographical work in particular, we're going to see time and again the stale made fresh, the forgotten discovered anew, the expensive turned affordable, the outdated transformed into the contemporary, and the marginal allotting [*sic!*] a place in the mainstream. This, I think, finally marks the so-called computer revolution as a development of the first rank, and as one from which there is no turning back: the technology's power to revitalize and transform everything it touches.

David Gants, 'Pictures for the Page: Techniques in Watermark Reproduction, Enhancement and Analysis' (1994), on the website of the Bibliographical Society of the University of Virginia.

So what do we recommend?

Writings on paper are numerous, and often a complete waste of time, so the present listing derives from the first instance from what I have on my working bookshelf and some other items that I have discovered on other bookshelves.

Of course, asking any major catalogue or a search engine for "paper" or "papier" or "carta" is to get a mass of replies as meaningful as jabberwocky. My procedure on the whole has been to browse through what can be found on the shelves of major libraries, among the most helpful being the Salle des livres rares at the Bibliothèque Nationale de France and my own personal stamping ground, the Biblioteca Nazionale Centrale di Firenze (*but I admit that I have not experimented the joys of Leipzig*). Such collections tend nevertheless to be eccentric in their choice and arrangement of volumes, and one ought also to remember that books about papermaking are in one place, watermark repertoires in another, and decorated papers ... well, they are together with the writings about bindings, so be patient, thorough, and browse properly. On the other hand, if there is a better way of doing it, I have not been told what it is.

To put the problem in a nutshell, when I compare the bibliography of paper with the other field in which I have assembled and written an analogous guide, that of analytical or material bibliography, the most striking feature is the lack of a single central text, such as Bowers' *Principles of Bibliographical Description* (1949), flanked by the manuals of McKerrow (1927) and Gaskell (1972), which collectively establish a method and around which other writings rotate or to which at least refer. The bibliography of paper is vaster and more wide-ranging, but in many cases banal, limited, or too locally inclined. There are plenty of bulgy, glossy tomes by cultural journalists, with nice photographs of pretty watermarks, and information culled mostly from second or third-hand sources, as well as infinite articles about single papermills in outlying regions, or the

distribution of watermarks in a manuscript or printed book, some of which show only the barest cognizance of Briquet and none whatsoever about how to use Briquet. The same holds true for the plethora of websites.

But here are some pointers.

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Bibliography

Bibliographical guides through the labyrinth are available in a certain quantity and of a certain quality, beginning with Briquet himself, and continued in E.J. Labarre, 'A Short Guide to Books on Watermarks', Hilversum, The Paper Publications Society, 1955, reprinted in *The Nostitz Papers. Notes on Watermarks found in the German Imperial Archives of the 17th & 18th Centuries, and Essays showing the Evolution of a Number of Watermarks*, Hilversum, The Paper Publications Society, 1956, pp. xxxvii-xlii, issued also in German with the title: 'Bücher über Wasserzeichen. Eine Bibliographie', *Philobiblon*, vol. 1 (1957), pp. 237-251, and very confusingly also in *Imprimatur*, vol. 1 (1957), pp. 233-251. Likewise valuable is the 'Select Bibliography of the Literature of Paper History and Watermarks published since 1907' by J.S.G. Simmons, introduced into the 1968 reprint of Briquet's *Les filigranes* (pp. *37-*53).

Irving P. Leif, *An International Sourcebook of Paper History*, Hamden, Archon, 1978, with 2,185 entries, integrated with Kate Frost, 'Supplement to Leif. Checklist of Watermark History, Production, and Reproduction Research', *Direction Line*, 8 (University of Texas, Spring 1979), pp. 33-56, is a compilation by a scholar who assembled bibliographies in a variety of fields, but provides a good overview of the state of play in the English-speaking world at the time.

Bibliographical summaries relating to paper also crop up in more general guides to bibliography and/or the history of the book, beginning with Horst Meyer's self-published annual *Bibliographie der Buch und Bibliotheksgeschichte (BBB)*, which ran from its first launch in 1982 up to its demise in 2003, and always contained a section on 'Literatur zur Papier'. More specifically related to the German-speaking world is Erdmann Weyrauth, *Wolfenbütteler Bibliographie zur Geschichte des Buchwesens im Deutschen Sprachgebiet 1840-1980*, München-New York, Saur, 1990-98, 3 vols., who likewise provides information about writings on paper and paper-history. Albeit with an overt bias in favour of English-language writings, an equally useful synthesis is G. Thomas Tanselle, *Introduction to Bibliography. Seminar Syllabus*, which over the years has progressed through nineteen revisions. The most up-to-date version, published by the Book Arts Press, Charlottesville, University of Virginia, 2002, is available online on the site of the Rare Book School (www.rarebookschool.org) and dedicates part 5, pp. 181-193, to paper, with a particular eye to the bibliographical applications. A good place to remedy the language imbalance, especially in order to root around for articles and treatises in lesser-known tongues, is the Dutch *Book History Online* (i.e. *the electronic development of the ever useful Annual Bibliography of the History of the Book*), published by Brill, which can however only be viewed in a library with a subscription to the data-base.

Several of these secondary bibliographical repertoires have been brought together in a compilation entitled the *Internationale Bibliographie zur Papiergeschichte (IBP)*. *Berichtszeit: bis einschließlich Erscheinungsjahr 1996*, München, K.G. Saur, 2003. The principal editors were Elke Sobek and Frieder Schmidt, and it is to all extents and purposes a catalogue of the holdings of the Deutsche Bibliothek and the Deutsches Buch- und Schriftmuseum der Deutschen Bücherai in Leipzig, with the inclusion in the entries of the press-marks of the copies in these two institutions (*which is useful if you live in Leipzig, but not so useful if you live anywhere else*). The first two volumes are made up with the 20,000 bibliographical entries (*how German to have precisely 20,000 entries!*) in a very exact organised structure. The remaining two volumes are a massive set of indexes, for author, title, just about everything that can be imagined, including concordances for several of the previous bibliographical resources mentioned above, in particular Leif, without however the supplement by Frost, which appears to have been missed; Pulsiano; Meyer's BBB, and Weyrauth. As is commonplace with Saur volumes, the cost is prohibitive, so the work is only to be found on the shelves of large libraries, but it is an amazingly comprehensive resource and repays thoughtful perusal. Given its origin, this bibliography is weighted in favour of German and Eastern European writings (*no bad thing*), and also has the merit of having thoroughly indexed many of the more obscure and difficult to find journals in the field, such as *Papiergeschichte* and *The Paper Maker* (*one of the banes of paper studies is the proliferation of hard-to-find periodicals with extremely important material, so this is excellent*). Having praised this work and highly recommended it, it should be said that, as often happens nowadays when material is translated from a database into a printed format, the layout is hard on the eye. Work has also moved forward, since the Leipzig database is now available as the 'Bibliography' in the Bernstein 'Memory of Paper' project on the website of the Austrian Academy for Sciences with a total of 31,000 entries [35]. Unfortunately the demise of EEC

funding for the project means that it has not been updated in the last five and more years (*the inability of Eurobureaucrats to see the uselessness of funding research without providing long-term continuity is infuriating ... after all, it is our money they are wasting*). Furthermore, though in many respects the Bernstein project is an exciting and innovative resource, it is abominable at explaining itself and completely fails to tell the unwary user that what it presents as a 'Bibliography' is in fact the IBP (*it was not until I discovered the paper version that I was able to decipher the cross-references to other bibliographical resources, or understand the significance of the press-marks in the Leipzig libraries*). At the end of the day, however, even 31,000 entries are anything but comprehensive and many of the items described in the following pages do not appear in the IBP. Some of them of course are post-2009 and the cut-off for the project's funding; others are in journals that they seem to survey only intermittently, such as the Italian *La Bibliofilia*; but the principal obstacle to their coverage is that important information about paper and paper-evidence, especially in a more bibliographical application, often appears in articles or books that do not declare this content as such through a title, and therefore the only way to find them is to read the damn thing! Some random checking suggests that about a third of the items described here, including all my own writings (*modesty!*), are not known to the IBP.

As ever, with compilative, or enumerative, bibliographies, the other big problem involves what we might call hierarchy. Thirty-thousand odd bibliographical citations constitute an impressive mass; nothing therein, however, tells us what is important and what is trivial, what is good and what is bad, what is boring and what is innovative and exciting. (*This is an obstacle the pure sciences resolve through citation indexes and bibliometrics, showing how often a single article has been cited by others and thus obtaining a grading of its importance and utility, but to apply any such parameter to paper studies would be unthinkable, or would merely serve to confer superstar status on a certain Briquet, C.M.*) Readers and users of the present *oeuvre* should therefore keep the IBP or the Bernstein resource at hand for browsing purposes, but understand that the principle followed here is the exact opposite. While not handing out Michelin stars, value judgements abound, and if something is not mentioned, it might not be worth the trouble of going and looking at it; on the other hand I might be completely wrong!

In particular, the emphasis is on reading. I have generally read, sometimes reread, tried to read, or at least glanced over, more or less all the items described here, and so there are plenty of adjectives, some flattering, some scathing, providing evaluations that should help you as reader to make your own choices. Of course, my judgements may be unfair, misleading, or simply wrong, but at least they are there and, if you prefer to think differently, well, that is your business.

Differently from the IBP, orientated primarily towards the modern period, my interests are in Medieval and Renaissance Italian paper, so this listing does display an unwarranted prejudice in favour of works on this area (*well, you probably do not know enough about Medieval and Renaissance Italian paper, which is a fascinating and complex subject, so here is a chance to close the glaring gap in your education*). As an alternative to what is suggested here, a bibliography orientated towards learning about paper in a more general way is provided by John Bidwell for his course at the Virginia Rare Book School in Charlottesville (*see website*).

[1]

General Introduction

Among general histories of the book, the one that stands out for the chapter it dedicates to paper, entitled 'La question préalable: l'apparition du papier en Europe', is the famous *L'Apparition du livre* by Lucien Febvre and Henri-Jean Martin, Paris, Albin Michel, 1958, pp. 25-51, reprinted as a paperback edition: 1971, with a further issue in 1999 (*in reality a reprint of the 1971 setting with the addition of a 'Postface' by Frédéric Barbier*). As is well-known, the work was originally commissioned from Febvre (1878-1956) in the early 1930s as a companion volume to *Le journal* by Georges Weill (1934). Febvre procrastinated and eventually involved Martin (1924-2007), at the time a "young librarian" at the Bibliothèque Nationale, who became to all effects and purposes the real author of this seminal volume. It was translated into English in 1976, but the version which merits real attention is the one in Italian, first published in 1977, containing an extraordinary preface by Armando Petrucci in the guise of a palaeographical Marxist Devil's advocate (*if you think that is impossible, try reading it*). Readers familiar with Italian will likewise still find helpful the beautifully printed book by Anne Basanoff, *Itinerario della carta dell'Oriente all'Occidente e sua diffusione in Europa*, Milano, Cartiera Ventura, 1965, better known in its 1977 reprint by Il Polifilo in Milan. (*I have never understood why this last work, written by a curator at the Bibliothèque Nationale, who contributed to the Febvre-Martin, L'Apparition du livre has never been available in French, but this is one of the many mysteries of paper*

studies).

If you have any intention of learning anything about papermaking methods in an enjoyable fashion, the best starting point is the figure and the writings of one of history's most versatile and creative multitaskers, Dard Hunter (1883-1966), one of the few people to be able to boast that they personally conducted every phase in the making of a book, i.e. writing the text, making the paper, printing the book, and even selling the copies. His several writings on papermaking, issued mostly under the aegis of the Mountain House Press, are *Old Papermaking* (1923), *The Literature of Papermaking 1390-1800* (1925), *Primitive Papermaking* (1927), *Old Papermaking in China and Japan* (1932), and *Papermaking in Southern Siam* (1936), and even at the time were expensive collectors' items. Nowadays therefore they are wildly unaffordable for impoverished paper scholars. A synthesis of all his previous research, however, flowed into his master work: *Papermaking. The History and Technique of an Ancient Craft*, New York, Alfred A. Knopf, 1943. This first edition includes two examples of leaves of handmade paper, one laid and one wove, missing from the reprints. As with all his works, it sold out at great speed, so a second edition, revised and enlarged, was published in New York, again by Knopf, and in London by Pleiades Books, in 1947. The increment is a considerable one, not just in the addition of two extra chapters, but above all in the illustrations, which more than double in number. (*When the second edition went out of print, it was reprinted in 1978 in New York by Dover editions, of which plenty of copies, some of them at absurdly low prices, are available in Abebooks*). This one work has over the years become a bible for people passionate about paper and papermaking. Hunter's greatest merit is that his several investigative journeys, to Fiji and Samoa (1926), Japan, Korea, and China (1933), Siam (1935), and India and Nepal (1937-38), captured photographically traditional, thousand-year old processes of papermaking, just before they disappeared with the onset of modern civilization (*there might be a better word*). Not only the diagrams and the photographs, but also the original artefacts related to papermaking, that he obtained and took back home, are thus a permanent and precious record of techniques and methods that since have been lost. On the other hand, for all its greatness and charm, his work is inconsistent in scholarly and bibliographical terms: he was only slightly acquainted with Medieval and Renaissance European paper, and the problems posed by serious bibliographical research, for instance, the twinship of moulds and watermarks, hardly impinge on his consciousness. In his own lifetime, he further published *My Life with Paper. An Autobiography*, New York, Alfred A. Knopf, 1958, again with leaves illustrating varieties of handmade paper tipped in, and valuable photographic illustration, although he is sometimes imprecise about the details of his own life. Otherwise, see the thoroughly-documented book, based almost entirely on research in the extensive Hunter family archive, by Cathleen A. Baker, *By his own Labor: The Biography of Dard Hunter*, New Castle, Oak Knoll Press, 2000, as well as the websites dedicated to him and his descendants, who continue his many activities at the Dard Hunter Studios in Chillicothe, Ohio. Dard Hunter also founded a museum dedicated to paper at the Massachusetts Institute for Technology in 1939; in 1954 it moved to the Institute of Paper Science and Technology at Appleton, Wisconsin, and moved again in 1989 to the Georgia Institute of Technology in Atlanta, where it is now part of the Robert C. Williams Paper Museum (*see website, which has plenty of useful links*) [33].

For those able and willing to cope with German, a robust introduction to the study of watermarks is Karl Theodor Weiss, *Handbuch der Wasserzeichenkunde*, bearbeitet und herausgegeben von Wiso Weiss, Leipzig, Fachbuchverlag, 1962, reprinted by Saur, 1983. The book was actually begun by Weiss (1872-1945) during the First World War, but remained unpublished until it was brought out by his son nearly twenty years after his death. Albeit dated, it remains pioneering in its treatment of issues such as twin watermarks. Again in German (*albeit now also available in Italian*) is a carefully expounded and extensively documented overview of the history of papermaking by Peter F. Tschudin, *Grundzüge der Papiergeschichte*, Stuttgart, Hiersemann, 2002. Coming from a line of paper scholars, the author is the ex-president of the International Association of Paper Historians and ex-director of the Basel Papiermuseum and so has an encyclopaedic knowledge of the subject. The result is an authoritative survey of the history of papermaking and it is especially good on the economic and industrial development of the industry in the modern period. From the viewpoint, however, of scholars, bibliographers, or cataloguers, trying to exploit paper as a source of physical information for books or documents of the Medieval, Renaissance, or Early modern period, it is a disappointing book, with some surprising inaccuracies, for instance the Bologna stone is twice mentioned with the date "1308" instead of 1389 (*pp. 95, 100, in the German original; pp. 98, 101, of the Italian translation; and unfortunately the mistake is being repeated by other scholars, for instance, in the Bull's Head and Mermaid catalogue of the Bernstein travelling exhibition in 2009, p. 14*). Likewise, the fact that watermarks are twins, due to the use of paired moulds at the vat, receives only a cursory mention and names such as Roberto Ridolfi, Allan Stevenson, and Paul Needham, never appear in the text nor even in the haphazardly-assembled bibliography (*wherein, for example, L'Art de faire le papier by Lalande is confused with the Encyclopédie*). The recent Italian translation is bettered by the inclusion of an introduction,

which is excellent on watermark repertoires, especially Briquet, by Ezio Ornato, see 'Prefazione all'edizione italiana', in Peter F. Tschudin, *La carta: storia, materiali, tecnica*, a cura di Federica Peccol, Roma, Edizioni di storia e letteratura; Passariano, Centro di catalogazione e restauro dei beni culturali, 2012.

The category of coffee-table histories of paper, with geographically sweeping titles, is of course a large one (*in all senses*). Here are a few examples. Reasonably brief is Michel Vernus, *La fabuleuse histoire du papier*, Yens-sur-Morges (Suisse), Cabédita, 2004. Also in French is *Le papier: 2000 ans d'histoire et de savoir-faire*, Paris, Imprimerie Nationale, 1999, by cultural journalist Lucien X. Polastron, who is overfond of big-sounding issues (*in 2004 he published a work with the title Livres en feu. Histoire de la destruction sans fin des bibliothèques*). This book is magnificently illustrated and I suspect that those of us who teach courses on paper will nick a lot of its images; otherwise it has nothing new to say. Another highfaluting tome, but disappointing in its use of sources and attention to detail, above all in the knowledge it displays of the papermaking process, is Lothar Müller, *Weißer Magie*, München, Carl Hanser Verlag, 2012, trans. *White Magic. The Age of Paper*, Cambridge-Malden, Polity Press, 2014. The latest general overview in the English-speaking world is Alexander Monro, *The Paper Trail: An Unexpected History of the World's Greatest Invention*, London, Allen Lane, 2014. It is nicely written, by a journalist and writer, who has lived a lot in China and thus dedicates two-thirds of the volume to the Far and Middle East, but it is more about the "book" (*in a Febvre-Martin sense*) than about "paper". The text is also littered with small, but annoying, errors of detail: it is incorrect to say that "it was not until 1276 that the first significant Italian paper mills were set up in Fabriano" (p. 221: see below **6e. Marches**); there was not a "second printing" of Copernicus in Nuremberg (p. 268); Milton did not visit "Galileo in prison" (*same page*); the original *Encyclopédie* was not published from 1750-55 (p. 302); and so on and so forth. Most significantly perhaps, there is no real sense that sheets or leaves of paper have been looked at as material objects, while a subject such as "watermarks" does not even merit a mention in the index.

On the basic process of paper-making at the vat, the clearest and most concise introduction in English remains that by Philip Gaskell, *A New Introduction to Bibliography*, Oxford, at the Clarendon Press, 1972, corrected reprint 1974 (*and numerous further reprints*), pp. 57-66. Almost all bibliographies on paper, especially of the potted kind, cite this chapter, deservedly so. It should, however, be noted that not all the details in Gaskell's account are borne out by other sources, or by direct observation of paper-making, and some are self-evidently wrong. The principal cause is his reliance on the account in Chamber's *Cyclopædia* (1728) [5], without consulting the more extensive, and probably trustworthy, descriptions in Lalande and in the *Encyclopédie*. For instance, he limits the retting process of the rags to "four or five days" (p. 57), though he does also say that the "pounding took place in two or three stages, separated by pauses for further rotting". Other sources are more generous in their indication of time: in his brief account of the process in 1494 Grapaldo says eleven days, in 1591 Rocca says fifteen days, while in the Eighteenth century the *Encyclopédie* says two to three months [5]; clearly the procedure varied enormously, according to the sort of rags, environmental conditions, temperature, etc., but Gaskell's time-span seems too short. Likewise he states that the Hollander beater "did not pound but minced the rags into pulp with revolving knives" (p. 57): in reality the blades on the revolving drum are blunt and the cutting, if any, is done by a plate with teeth on the floor under the drum. He describes the material in the vat as having the "consistency of liquid porridge" (p. 57): such would be suitable for making cardboard; when paper is involved the appearance is more like very diluted milk. In explaining the work at the vat, he says that the "maker then lifted the deckle and slid this first mould along a board to the coucher, from whom he received the second mould of the pair in return" (p. 58): in fact the maker usually places the first mould on a support on the edge of the vat for the water to drip, while it is the coucher who slides the second mould back along the board and subsequently lays a new felt on the post. The same book also provides an excellent brief description of the technical developments in mechanical paper-making at the beginning of the Nineteenth century (*Gaskell is always better on machinery than on people*).

As an alternative, or integration, to Gaskell, I highly recommend the essay by John Bidwell, 'The Study of Paper as Evidence, Artefact and Commodity', in *The Book Encompassed. Studies in Twentieth-century Bibliography*, edited by Peter Davison, Cambridge, Cambridge University Press, 1992, pp. 69-82. Likewise worth scrutiny are three more recent, appositely written, short pieces by scholars active in paper research, albeit in the latter two cases mostly applied to English Renaissance texts: Timothy Barrett, 'Papermaking, History and Practice', in *Teaching Bibliography, Textual Criticism, and Book History*, edited by Ann R. Hawkins, London, Pickering & Chatto, 2006, pp. 142-148; R. Carter Hailey, 'The Bibliographical Analysis of Antique Laid Paper: A Method', *ibid.*, pp. 149-154; and the chapter by Mark Bland, 'Paper and Related Materials', in *Idem, A Guide to Early Printed Books and Manuscripts*, Oxford, Blackwell-Wiley, 2010, pp. 22-48. Though these items are necessarily concise, all three know what they are talking about and incorporate original research.

Given the importance of the subject, a large number of works with a purpose to systemize knowledge dedicate entries to paper and to the history of paper, including the successive editions of the *Encyclopaedia Britannica* and other national encyclopedias. This category includes collective works specifically dedicated to the field of book history and library studies, wherein the most recent example is by Daven Christopher Chamberlain, 'Paper', in *The Oxford Companion to the Book*, edited by Michael Suarez S.J. and H. R. Woudhuysen, Oxford, Oxford University Press, 2010, I, pp. 79-87 (*which, however, gets a smack on the wrist for giving the introduction of papermaking into Italy as 1276*). This essay is also available in *The Book. A Global History*, eds. Suarez-Woudhuysen, Oxford, Oxford University Press, 2013, pp. 116-129.

There are also several miscellaneous publications, either conference acts or collections of essays, that are worth thumbing through. A largish volume of conference proceedings is *Produzione e commercio della carta e del libro secc. XIII-XVIII. Atti della "Ventitreesima Settimana di Studi"* [of the Datini Foundation in Prato], 15-20 aprile 1991, a cura di Simonetta Cavaciocchi, Firenze, Le Monnier, 1992. This gets negative points for the lack of an index and for the fact that most of the contributions are hotch-potch summaries of what people have written elsewhere; on the positive side are the discussions after the papers, which contain some exhilarating transcription mistakes! Two well-constructed English language collections, containing a number of items with genuine bibliographical purport, are the *Essays in Paper Analysis*, edited by Stephen Spector, Washington, The Folger Shakespeare Library; London and Toronto, Associated University Presses, 1987, and *Puzzles in Paper: Concepts in Historical Watermarks*, edited by Daniel W. Mosser, Michael Saffle & Ernest W. Sullivan II, New Castle, Oak Knoll Press; London, British Library, 2000, which publishes papers from the Roanoke conference of 1996. Markedly francophone, but with some interesting accounts of individual research experiences, are the acts of the conference held in Paris in 1998, see *Le papier au Moyen Âge: histoire et techniques*, édité par Monique Zerdoun Bat-Yehouda, Turnhout, Brepols, 1999. A useful and wide-ranging collection of short articles is: *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, Ottawa, Canadian Conservation Institute, 2001 (*the original is not easy to find, but the volume is available in pdf. on the website of the CCI*). A deserving set of essays in Italian, churned out by the paper restorers of the Istituto Centrale per il Restauro e la Conservazione del Patrimonio Archivistico Librario (*this absurdly long title substitutes the earlier Istituto Centrale per la Patologia del Libro, which was already a mouthful*), is *Gli itinerari della carta. Dall'Oriente all'Occidente: produzione e conservazione*, a cura di Carla Casetti Brach, Roma, Gangemi editore, 2010. As well as items on Chinese paper, Japanese paper, and Arab paper (see below), it has a perceptive round up of the history of papermaking in the West by Simonetta Iannuccelli, 'L'Europa della carta', pp. 95-148. Two substantial, mainly German language (*entirely in the second case*), collections are *Papier im mittelalterlichen Europa: Herstellung und Gebrauch*, edited by Carla Meyer, Sandra Schultz, Bernd Schneidmüller, Berlin-München-Boston, Walter de Gruyter, 2015, and *Wasserzeichen, Schreiber, Provenienzen: neue Methoden der Erforschung und Erschließung von Kulturgut im Digitalen Zeitalter, zwischen wissenschaftlicher Spezialdisziplin und Catalog Enrichment*, herausgegeben von Wolfgang Eckhardt, Julia Neumann, Tobias Schwinger, und Alexander Staub, Frankfurt am Main, Vittorio Klostermann, 2016, which publishes the acts of a conference held 6-8 October 2014. The many annual meetings of the International Association of Paper Historians and of the British Association of Paper Historians also bring together numerous short items dealing with every aspect of paper history [34]. The contents are listed on the respective websites, though, since these volumes are mostly self-published, they can be difficult to find in libraries. For the papers from the many conferences held at Fabriano, see [6e. **Marches**]. References are frequently made to the essays contained in these collections in the paragraphs that follow.

Anyone looking for an inspiring way into the interaction between paper studies and bibliographical analysis should start with the personal testimony and *apologia pro vita sua* of Allan Stevenson, *Observations on Paper as Evidence*, Lawrence, University of Kansas Libraries, 1961. This is the text of a lecture, the seventh in an annual series on 'Books and Bibliography', delivered on 6 November 1959 and issued in the form of this pamphlet (*just out of curiosity, the sixth lecture, given less than a year previously on 14 November 1958, was the likewise seminal The Bibliographical Way by Fredson Bowers*).

[2]

China and Far Eastern Paper

The "classic", and easily by far the best, account, at least as far as English-language readers are concerned, is by Tsien Tsuen-hsuei (1910-2015), who was professor of Chinese literature and library science at the University of Chicago (*it is a Chinese name in which Tsien indicates the family*). His absolutely admirable

synthesis is a book, entitled *Paper and Printing* (1985), which forms volume V: *Chemistry and Chemical Technology*, part 1, of Joseph Needham's vast, vast *Science and Civilisation in China*, Cambridge, Cambridge University Press, 1954-, so far issued in seven volumes and 27 separate books, and still expanding. On the down side, it is a nuisance not having Tsien's volume as a separate item; on the plus is the fact that the collective work can be found on the shelves of most major libraries. An excellent anthology of thirty early Chinese texts about papermaking, with versions both in Mandarin and in French, is *Le papier dans la Chine Impériale. Origine, fabrication, usages, textes présentés, traduits et annotés* par Jean-Pierre Drège, Paris, Les Belles Lettres, 2017.

At the time of the publication of Tsien's book, the oldest known paper was believed to be some scraps discovered in a tomb at Pa-chhiao, near Sian in Shensi province, belonging to the Han dynasty and datable between 140 and 87 B.C. The said items apparently show the imprint of fabric on the surface, showing that the earliest process was indeed with a floating mould, something that Dard Hunter suggested, but was unable to demonstrate, see *Papermaking*, 2nd edition, cit., 78-84; Tsien, *Paper and Printing*, cit., p. 38, with further bibliography and references to Chinese sources. In 1986, however, a tomb excavated at Fangmatan, near Tianshui in Gansu province, dating from the early 2nd century B.C., unearthed a fragment of a map, which today is considered the official oldest surviving document on paper (*for an image of the same, ask Wikipedia*), see Xumei Yi-Xiuwen Liu, 'The Calligraphy and Printing Cultural Heritage of Gansu. The Development of the Engraved Printing Process and Papermaking: an Archeological Approach', in *The History and Cultural Heritage of Chinese Calligraphy, Printing and Library Work*, edited by Susan M. Allen, Zuzao Lin, Xiaolan Cheng, Jan Bos, Berlin, De Gruyter-Saur, 2010, pp. 45-70: 64.

A well-documented summary of the information on the centuries-long debate about Cai Lun (*or Tsai Lung*) and the origins of paper is available in Józef Dabrowski, 'Remarks on the Invention of True Paper by Cai Lun', *IPH Congress Book*, vol. 16 (2006), pp. 5-16, with ample bibliography (*on the IPH website*). A synthesis of the archaeological debate, with a powerful denunciation of the attempts of the Chinese Ministry's attempts to fix the historical version, is Pan Xixing, 'Review on the Debate of Paper History during Recent 30 Years in China', *Paper History*, vol. 15, issue 2 (2011), pp. 6-12 (*on the IPH website*). A further article relating to archaeological discoveries is Guilhem André, Jean-Paul Desroches, Jean-Pierre Drège, Véronique Rouchon, 'L'un des plus anciens papiers du monde récemment exhumé en Mongolie: découverte, analyses physico-chimiques et contexte scientifique', *Arts asiatiques*, vol. 65 (2011), pp. 25-39.

A more general survey in French is Monique Zerdoun, 'Le papier, de la Chine à l'Occident, un passionnant périple', one of an interesting collection of short items making up the catalogue of an exhibition at the Louvre, June-September 2011, with the title: *Le papier à l'oeuvre*, sous la direction de Natalie Coural, Paris, Louvre éditions, 2011, pp. 29-43. An overview in Italian is available in Yirong Ma, 'L'Oriente e la carta', in *Gli itinerari della carta*, cit., 2010, pp. 13-28. The same volume includes an essay on Japanese paper-making techniques: Silvia Sotgiu, 'La carta giapponese', pp. 29-58.

The discovery of the Library in the Mogao cave complex was described by Aurel Stein, *Serindia. A Detailed Report of the Explorations in Central Asia and Westernmost China*, London-Oxford, Clarendon Press, 1921, 5 vols., in particular in vol. II, while for the booty carted back to London, see Lionel Giles, *Descriptive Catalogue of the Chinese Manuscripts from Tunhuang in the British Museum*, London, Trustees of the British Museum, 1957, containing 8,102 entries, without however considering a further 3,000 fragments. The paper artefacts in the collection were subjected to analysis at the time by one of the major experts of the time, see R.H. Clapperton, *Paper: An Historical Account of its Making by Hand from the Earliest Times down to the Present Day*, Oxford, Shakespeare Head Press, 1934, pp. 1-26. Pelliot gave his account of the find in *Les grottes de Touen-Houang*, Paris, Geuthner, 1920-24, 6 vols., especially valuable for their photographic documentation, and likewise the Japanese mission published a descriptive catalogue as *Monumenta Serindica*, Kyoto, 1958-63, 6 pts. The *membra dispersa* are being brought together in a huge state-of-the-art project, promoted by the British Library, christened the International Dunhuang Project (IDP), which sets out to reconstruct the contents of the Library cave in a digital environment. The project also includes extensive information taken from the collection of Aurel Stein's papers in the Bodleian Library, Oxford, comprising photographs of his seven dogs called Dash. The Diamond Sutra (British Library, Mss. Or. 8210/P.2), in particular, is described in Frances Wood-Mark Barnard, *The Diamond Sutra. The Story of the World's Earliest Dated Book*, London, The British Library, 2010. It is also discussed in depth in the *IDP Newsletter*, n. 38 (2011-12) (*available on line, including a digital copy of the original document*). A reader-friendly account of the discovery of the Library cave is also provided by Munro, *The Paper Trail*, cit., 2014, pp. 65-75.

The archive of documents dating from 722 A.D. on Chinese paper found at Mount Mugh is now held by the Institute for Oriental Studies, Academy of Sciences, in St. Petersburg. A catalogue of the same was published in Russian in the same city (*called however Leningrad*) in 1934. Further bibliographical

information, albeit without particular reference to the physical support, is available in Frantz Grenet-Nicholas Sims Williams, 'The Historical Context of the Sogdian Ancient Letters', *Studia Iranica*, vol. 5 (1987), pp. 101-122. Reproductions of these early papers are helpfully available in the important book on the history of Arab paper by Jonathan Bloom [3].

The bibliographical problem posed by Chinese printing with woodblocks, which lasted up to comparatively recently and is still extant in more traditional contexts, is that, as with stereotype printing in the West, multiple impressions can be taken off the same blocks over a long period of time, often with small variants of state or issue. Individual copies therefore can present complex variants and, unlike books on Western paper, there is no help from paper or watermarks. For an example, see the 'Chinese Books' section of the website of Cambridge University Library, which includes digital copies of many items, including the famous *Shi zhu zhai shu hua pu*, or *Ten Bamboo Studio Collection of Calligraphy and Painting* by Hu Zhengyan (1584-1674), famous as the first book printed with polychrome xylography, on which see Thomas Ebrey, 'The Editions, Superstates and States of the *Ten Bamboo Studio Collection of Calligraphy and Painting*', *East Asian Library Journal*, vol. 14 (2010), pp. 1-119.

The earliest European account of papermaking in China is found in the famous volume of *Arts, métiers et cultures de la Chine, représentés dans une suite de gravures, exécutées d'après les dessins originaux envoyés de Pékin, accompagnés des explications données par les missionnaires français et étrangers, pensionnés par Louis XIV, Louis XV, et Louis XVI*, Paris, Neveu Libraire, 1814-15, which includes twelve hand-coloured plates showing the various stages of the process. The text on papermaking follows an analogous treatise on lacquer and lacquer making. Digital copies are easily found on the internet, but the sequence is also reproduced in Polastron, *Le papier*, cit., pp. 33-35.

As far as more recent times go, a portrait of a Chinese papermaking community still using traditional methods is Jan Jacob Karl Eyferth, *Eating Rice from Bamboo Roots: the Social History of a Community of Handicraft Papermakers in Rural Sichuan, 1920-2000*, Cambridge (Mass.), the Harvard University Asia Center, 2009. Likewise, the interaction of American papermaker, Elaine Koretsky, with traditional Chinese communities, is documented in her *Killing Green. An Account of Hand Papermaking in China*, Ann Arbor, The Legacy Press, 2009.

On papermaking in Korea, documented in the 1930s by Dard Hunter, see Aimee Lee, *Hanji Unfurled. One Journey into Korean Papermaking*, Ann Arbor, The Legacy Press, 2013.

The history and materials of papermaking in Japan are described in a successful and well-known book by Timothy Barrett, *Japanese Papermaking. Traditions, Tools, and Techniques*, with an appendix on alternative fibers by Winifred Lutz, New York, Weatherhill, 1983; reprinted Floating World Editions, 2006.

A precious testimony of traditional papermaking in Kashmir is recorded in a collection of 86 gouache paintings, showing local trades and crafts, brought together in an album made by an anonymous native artist some time between 1850 and 1860, acquired in 1904 by the Library of the British Museum (*now obviously British Library*). Early datings of the pictures, singly numbered Add. Or. 1660-1745, based on a mistaken belief about their provenance, attributed them to some time previous to 1830; more recent work argues that they belong instead to the decade 1850-60. The image showing papermaking at Add. Or. 1699 is reproduced in Polastron, *Le papier*, cit., p. 105 (*mistakenly indicated as f. 40r in the manuscript*). The same work interestingly relates it to a collection of 23 photographs taken at Srinagar in Kashmir in 1917 by William Raitt, who was a pioneer in the introduction of mechanical papermaking using bamboo pulp in India, now held by the Science Museum (*viewable online*). The gouache painting and the photographs are eerily similar. On papermaking in India in a wider sense, see the ample volume by Alexandra Soteriou, *Gift of Conquerors: Hand Papermaking in India*, Chidambaram, Mapin publishing, 1999 (*not difficult to find in Western libraries or on the internet*).

[3]

Medieval and Modern Arab Paper

The bibliographical discussion begins with an article, based principally on the archaeological discoveries in Egypt, by the Vienna palaeographer and papyrologist, Joseph von Karabacek, 'Das arabische Papier. Eine historisch-antiquarische Untersuchung', in *Mitteilungen aus der Sammlung der Papyrus Erzherzog Rainer*, vols. 2-3 (Vienna 1887), pp. 87-178, followed by 'Neue Quellen zur Papiergeschichte', vol. 4 (1888), pp. 75-122. His study for obvious reasons centres on the material discovered in the archeological sites in Egypt acquired by Archduke Rainer and now held by the National Library in Vienna. The first of these articles

enjoyed a wide circulation as an offprint and is available in English as *Arab Paper*, translated by Don Baker and Susy Dittmar, London, Archetype Publications, 1991, reissued in 2001. The other fundamental Nineteenth-century article on the subject is inevitably Charles-Moïse Briquet, 'Le papier arabe au Moyen âge et sa fabrication', *L'Union de la papeterie*, (avril-septembre 1888), with a separate offprint: Berne, Imprimerie Suter & Lierow, 1888, reprinted in *Briquet's Opuscula. The Complete Works of Dr. C.M. Briquet without "Les filigranes"*, Hilversum, the Paper Publications Society, 1955, pp. 162-169, which discusses Karabacek's work, but also upholds the priority of his own studies on the absence of cotton fibres. Useful also for the secondary bibliography, which includes references to modern criticism in Arabic, is Adam Gacek, *The Arabic Manuscript Tradition. A Glossary of Technical Terms and Bibliography*, Leiden-Boston-Köln, Brill, 2001. In terms of the background history, the brief mention of waterpowered triphammers to produce pulp for papermaking appears in the *Kitab al-Jamahir fi al-jawahir (On the Knowledge of Gems)* by Medieval Arab scholar al-Bîrûnî (973-1051), and is discussed in particular in Donald R. Hill, *A History of Engineering in Classical and Medieval Times*, London, Routledge, 1984, pp. 169-171.

Though the matter of paper is treated on the edge of other subjects, a discussion well worth scrutiny for its intrinsic intelligence is formed by the early articles of French palaeographer, Jean Irigoin (1920-2006; *for a bibliography of his writings, see the website of the College de France*). In his first published work he provided a thumb-nail classification of the characteristics distinguishing Arab and Western paper, see 'Les premiers manuscrits grecs écrits sur papier et le problème du bombycin', *Scriptorium*, vol. 4 (1950), pp. 194-204, reprinted in *Griechische Kodikologie und Textüberlieferung*, herausgegeben von Dieter Harlfinger, Darmstadt, Wissenschaftliche Buchgesellschaft, 1980, pp. 132-143. In this same article he draws attention to ms. Vat. Gr. 2200, attributed to c. 800 A.D., as probably being the oldest surviving manuscript on paper in a Western script. Irigoin also furnishes an excellent explanation, with diagrams, of the difference between the flexible and the rigid mould in 'Papiers orientaux et papiers occidentaux. Les techniques de confection de la feuille', *Bollettino dell'Istituto Centrale per la Patologia del Libro*, vol. 42 (1988), pp. 57-79. This last article is partially repeated and amplified in Idem, 'Les papiers non filigranés. État present des recherches et perspectives d'avenir', in *Ancient and Medieval Book Materials and Techniques*, Erice, 18-25 settembre 1992, a cura di Marilena Maniaci e Paola F. Munafò, Città del Vaticano, Biblioteca Apostolica Vaticana, 1993, I, pp. 265-312. Further useful information about Arab paper in a codicological context is provided in the acts of the conference held in Paris in 1988, see *Le papier au Moyen Âge*, cit., 1999. Also valuable and informed is Geneviève Humbert, 'Papiers non filigranés fabriqués au Moyen-Orient jusqu'en 1450. Essai de typologie', *Journal asiatique*, vol. 286 (1998), pp. 1-54, and Idem, 'Le manuscrit arabe et ses papiers', *Revue des mondes musulmans et de la Méditerranée*, nn. 99-100 (2002), pp. 55-77 (*available on line*).

One feature of Medieval "Arab" paper whose purpose has remained obscure, to the puzzlement of scholars, are the zig-zag marks, seemingly made by a sort of comb while the freshly made sheet is still resting on the mould, that characterize Medieval Spanish and some Italian paper. See in particular: Ulman Schulte, 'Einige Bemerkungen zu den Zick-Zack-Linien in frühspanischen Papieren', *Papiergeschichte*, vol. 12 (1962), pp. 7-9; Paul Canart, Simona Di Zio, Lucina Polistena, Daniela Scialanga, 'Une enquête sur le papier de type «Arabe occidental» ou «Espagnol non filigrané»', in *Ancient and Medieval Book Materials and Techniques*, cit., 1993, pp. 313-393; Marie-Thérèse Le Léannec-Bavavéas, 'Zigzag et filigrane sont-ils incompatibles? Enquête dans les manuscrits de la Bibliothèque nationale de France', in *Le papier au Moyen Âge*, cit., 1999, pp. 119-133, who draws attention in particular to ms. Arabe 2291 at the Bibliothèque Nationale, where the paper exhibits both zig-zags and a watermark, strange though it might seem.

In the English-speaking, non-palaeographic universe, contributions by Don Baker (1932-94) have provided a system of classification that allows for a better periodisation and also geographical placing. Although Baker published little in his lifetime, his work has been continued and is summarised in Helen Loveday, *Islamic Paper. A Study of the Ancient Craft*, London, Archetype publications, 2001 (*one could wish, however, that the photographs were of better quality*). This is admirably complemented by a large and beautifully produced book by Jonathan M. Bloom, who is professor of Islamic and Asian art at Boston College, Massachusetts. His *Paper before Print: The History and Impact of Paper in the Islamic World*, New Haven and London, Yale University Press, 2001, is perhaps more of a cultural history of the influence of paper on the Islamic world, which also does some useful debunking of Western preconceptions. It also begins with a useful survey of the Chinese and Far Eastern precursors of Arab papermaking. Traditional Arabs texts about papermaking, ink, and calligraphy, are assembled and translated in Jamâl Abarrou, *L'Art du livre et sa fabrication au XI^e siècle en Occident musulman et en Europe du sud. Encres, papiers, colles, enluminure, reliure et calligraphie*, Reims, Jamâl Abarrou, 2015.

One well-worn legend relating to early Egyptian papermaking, with ghoulish overtones, involves the recycling of linen-wrappings taken from mummies. The source for the story is the Medieval philosopher Abd al-Laṭîf al-

Baġdādī (1162-1231), who in his Kitāb al-Ifāda wa-'l-i'tibār (*Book of Information and Consideration*) says that in Egypt the tomb-raiders sold the linen and hemp from the mummies to the papermakers. It has further been claimed that in the middle of the Nineteenth century large quantities of rags, taken from mummies, were imported from Egypt to feed the demands of the American paper industry, see Joseph A. Dane, 'The Curse of the Mummy Paper', *Journal of American Printing History*, vol. 17 (1995), pp. 18-25, reprinted in Idem, *The Myth of Print Culture. Essays on Evidence, Textuality, and Bibliographical Method*, Toronto, University of Toronto Press, 2003, pp. 170-185. While Dane's approach is to debunk the myth, in 2010 "Mummy scholar" S.J. Wolfe in a conference reported on line has drawn attention to a broadside printed at Norwich, Connecticut, in 1859, which specifically declares that it is printed on paper made with rags from imported mummies at the Chelsea Manufacturing Company of the same town (*so it is true and they are coming to get you . AAaaaaargghhhh.....!!!*).

The Geniza documents recovered from the Cairo Synagogue by Solomon Schechter at the end of the Nineteenth century and now at Cambridge University Library are being put on line in a cutting-edge technology project by the Taylor-Schechter Geniza Research Unit (*see website*). It repays thoughtful browsing. They also issue a newsletter *Geniza Fragments*, which up to October 2016 has produced 72 numbers. As yet, relatively little attention has been paid to the paper as a physical support of the countless fragmentary texts, but fibre identification in the future might be able to provide valuable information.

From the Middle Ages and increasingly up to the beginning of the Nineteenth century, paper used in the Islamic world and exported down into Sub-saharan Africa was made in Italy: according to Bloom, *Paper before Print*, cit., 2001, p. 56, fig. 24, the earliest known copy of the Qur'ān, on Western paper with a crossed-key watermark, dates from about 1340. Italian papermakers from the Sixteenth-century onwards even went to the extent of designing a special three-crescent moon watermark, designating paper for export to the Islamic world (*the reasons behind the mark are not known, but plausibly they involved the animal collagen used for the sizing and possible religious objections*). Of course, in pure capitalist fashion (*remember Japanese motor-bikes in the 1970s?*), the consequence was to destroy the older local industry, see Leor Halevi, 'Christian Impurity versus Economic Necessity: A Fifteenth-century Fatwa on European Paper', *Speculum*, vol. 83 (2008), pp. 917-945. For later periods an excellent overview is available in Terence Walz, 'The Paper Trade of Egypt and the Sudan in the Eighteenth and Nineteenth Centuries and its Re-export to the Bilād as-Sūdān', in *Modernisation in the Sudan. Essays in Honour of Richard Hill*, edited by M.W. Daly, New York, Lilian Barber Press, 1986, pp. 29-48, now updated and republished in *The Trans-Saharan Book Trade: Manuscript Culture, Arabic Literacy and Intellectual History in Muslim Africa*, edited by Graziano Krätli and Ghislaine Lydon, Leiden, Brill, 2011, pp. 73-108. The same Brill volume also includes Ghislaine Lydon, 'A Thirst for Knowledge: Arabic Literacy, Writing Paper and Saharan Bibliophiles in the Southwestern Sahara', pp. 35-72, which is more about books than paper, but nevertheless contains some valuable snippets of information. Also revealing for the paradoxical Islamic attitude to paper documents is the same author's 'A Paper Economy of Faith without Faith in Paper: A Reflection on Islamic Institutional History', *Journal of Economic Behavior & Organization*, vol. 71 (2009), pp. 647-659 (*available on Ghislaine Lydon's page at the History Department of UCLA*).

[4]

Medieval Western Paper

The origins of Western paper are full of controversy, misleading data, unpublished data, too many failures to read what has been previously published, and equally many failures to challenge what has been previously published. So here are some issues that might be considered.

Paper most likely "came" to the West through Islamic Spain, where the primitive mills associated with Arab techniques were famously concentrated in the city of Játiva (*or Xátiva*), near Valencia, whose territory was overrun by Christian forces in 1244. Though it has been asserted that both stamping mills and the metal-based mould first appeared in Spain rather than in Italy, there is no reason to think that the invasion brought about innovation in traditional Islamic methods. Solid, and above all sceptical, assessments are provided by one of the most authoritative scholars of Medieval Spanish history, Robert I. Burns, S.J., in articles such as: 'The Paper Revolution in Europe: Crusader Valencia's Paper Industry – A Technological and Behavioral Breakthrough', *The Pacific Historical Review*, vol. 50 (1981), pp. 1-30; Idem, *Society and Documentation in Crusader Valencia. Diplomatarium of the Crusader Kingdom of Valencia: The Registered Charters of Its Conqueror Jaume I, 1257-1276. Part I*, Princeton, Princeton University Press, 1985; Idem, 'Paper Comes to the West: 800-1400', in *Europäische Technik im Mittelalter 800 bis 1400: Tradition und Innovation*, herausgegeben Uta Lindgren, Berlin, Gebrach Mann Verlag, 1996, pp. 413-422. In this last article, in

particular, Burns demolishes the claims made by Oriol Valls i Subin't, who "has popularized a version of that thesis, in which Christian paper mills multiplied marvelously along the Catalan rivers 'from Tarragona to the Pyrenees' from 1113 to 1244. His many articles and two books, valuable for such topics as fiber analysis in medieval paper, continue to spread this untenable and indeed bizarre thesis ... these were all in fact cloth fulling mills" (p. 415). For an overview of the history of milling technology, see Adam Robert Lucas, 'Industrial Milling in the Ancient and Medieval Worlds: A Survey of the Evidence for an Industrial Revolution in Medieval Europe', *Technology and Culture*, vol. 46 (2005), pp. 1-30. The Spanish Medieval industry survived up to about 1350, when it disappeared due to the competition with Italian imports, and this fact confirms the probability that it had not mastered mechanical beating nor introduced the metal-based mould. One important archive to have survived and to have provided important information for paper historians is that of the Kings of Aragon in Barcelona, see Carme Sistach, 'Les papiers non filigranés dans les archives de la Couronne d'Aragon du XII^e au XIV^e siècle', in *Le papier au Moyen Âge*, cit., 1999, pp. 105-117, where analysis shows that the fibres in the earliest sheets were lightly beaten, suggesting that the action was hand-powered, and that the sizing was done with vegetable starch.

The earliest dated Western document on paper, written in Sicily in 1109, is held by the State Archive in Palermo, Tabulario di San Filippo di Fragalà, n. 9, and was discovered by Giuseppe La Mantia, *Il primo documento in carta (Contessa Adelaide, 1109) esistente in Sicilia e rimasto sinora sconosciuto*, Palermo, Stab. tip. A. Giannitrapani, 1908. A photograph of the document can also be seen in the *Enciclopedia italiana di scienze, lettere ed arti*, vol. IX (1931), tav. LV. It was restored in 1995: for fuller information, see Domenico Ventura, 'Sul ruolo della Sicilia e di Amalfi nella produzione e nel commercio della carta: alcune considerazioni in merito', in *Alle origini della carta occidentale: tecniche, produzioni, mercati (secoli XIII-XV)*. Atti del convegno, Camerino, 4 ottobre 2013, a cura di Giancarlo Castagnari, Emanuela Di Stefano, Livia Faggioni, Fabriano, Fondazione Gianfranco Fedrigoni-Istituto Europeo di Storia della Carta e delle Scienze Cartarie ISTOCARTA, 2014, pp. 95-119: 104-105. After the Norman conquest of Sicily, the use of paper, which seems to have been common under the previous Arab administration, was discouraged and important documents were recopied on parchment. The text of the order by Frederick II in 1231, according to which all official documents on paper are to be recopied is published in the *Constitutiones Regni Siciliae*, Liber I, titulus LXXX 'De instrumentis conficiendis', Naples 1786, reprinted Messina, Sicania, 1995, also in Giancarlo Castagnari, *L'arte della carta nel secolo di Federico II*, Fabriano, Pia Università dei Cartai, 1998, pp. 16-17. The fact does show that paper, albeit mistrusted in terms of durability, was freely available. Paper subsequently lived alongside parchment up to the advent of printing, albeit with an initial parallel use of animal skin in a large number of early editions, including a third of the surviving copies of the Gutenberg Bible. The vast increase in the quantity of material required and the complexity of printing on parchment, however, ensured the triumph of paper. This transition is skillfully charted by Paul Needham, 'Book Production on Paper and Vellum in the Fourteenth and Fifteenth Centuries', in *Papier im Mittelalterlichen Europa*, cit., 2015, pp. 247-274.

The whole issue of describing and interpreting Medieval "Western" paper, or what followed on from the technical and technological revolution at Fabriano [6e. Marches], has been dominated by the question of the watermark. Obviously this is to some extent misleading, since from the late 1220s to the late 1280s paper was being produced that had all the relevant characteristics, excepting the watermark. This material, which is inevitably rare and difficult to describe, has not so far received all the attention it deserves, but see the already cited article by Jean Irigoien, 'Les papiers non filigranés', cit., 1993, I, pp. 265-312. A further bibliographical round-up, comprising basically the Irigoien period, is Marie-Thérèse Le Léannec-Bavavéas, *Les papiers non filigranés médiévaux: de la Perse à l'Espagne. Bibliographie 1950-1995*, Paris, Editions du Centre National de la Recherche Scientifique, 1998.

One much debated question in Medieval paper is sizing, or the issue of when the partial impermeability of the surface was achieved by animal collagen rather than starch-derived substances. A dated, but still useful article, is Henk Voorn, 'A Brief History of the Sizing of Paper', *The Papermaker*, vol. 30 (February 1961), pp. 47-53. The research laboratory established in 1932 by William James Barrow (1904-67) at the Virginia State Library in Richmond carried out destructive analysis of a sample of 1,470 examples of Renaissance and later paper, see W.J. Barrow Research Laboratory, *Physical and Chemical Properties of Book Papers, 1507-1949*, Richmond, W.J. Barrow Research Laboratory, 1974. More recent techniques, this time involving non-destructive analysis, applied to a sample of 1,495 items, including 363 printed items, of which 200 common to the previous Barrow investigation, has recently been conducted by the splendid 'Paper through Time' project at the University of Iowa, coordinated by Timothy D. Barrett (see website, which has further bibliography of a dauntingly scientific nature). What the survey shows is a high level of collagen sizing up to about the 1490s, after which date it drops, and the believable explanation is that printers preferred lightly-sized papers for their oil-based ink. Although the quantity of manuscript paper from later periods in the

specimen pool is not large, as compared to the printed sample, it does suggest that paper destined for writing purposes received a higher degree of sizing than printing paper. The other inevitable defect of these studies, based on United States collections and the willingness (or unwillingness) of libraries there to make valuable material available for analysis, is the lack of genuinely early paper. The Barrow sample has little previous to the end of the Sixteenth century; the more ample 'Paper through Time' one has only three items, all Italian, previous to 1400 and relatively few before the onset of printing in the second half of the Fifteenth century. There is ample room therefore for a future project looking at paper in Italian archives at the end of the Thirteenth century, in order to clarify the passage from vegetable to animal sizing. One recent Italian publication, which provides information about vegetable or animal sizing in very early, i.e. pre-1300, paper is Giancarlo Castagnari, 'Le origini della carta occidentale nelle valli appenniniche delle Marche centrali da una indagine archivistica', in *Alle origini della carta occidentale*, cit., 2014, pp. 9-34, which cites analyses conducted in 1893 held in the archive of the Miliani firm. It is backed up by a paper in the same volume by Graziella Roselli, Claudio Pettinari, Noemi Proietti, Stefania Pucciarelli, Sara Basileo, 'Tecniche diagnostiche per l'indagine di manufatti cartacei dell'area camerte-fabrianese (secoli XIII-XV)', pp. 239-268. Twenty-one samples are reported on, mostly from local archives: only one item, dated 1286, appears sized with starch; otherwise collagen sizing prevails from an early date.

A census of 316 Thirteenth-century Greek manuscripts written on paper, which charts the passage from "Arab" paper to "Western", published in a somewhat out of the way place, is that by Giovanna Derenzini, 'La carta occidentale nei manoscritti greci datati del XIII e XIV secolo (con una giunta sulla produzione della carta a Fabriano agli inizi del Quattrocento)', in *Contributi italiani alla diffusione della carta in Occidente fra XIV e XV secolo*, a cura di Giancarlo Castagnari, Fabriano, Pia Università dei Cartai, 1990, pp. 99-135.

References to the terms "ream" or "risma" in Medieval Italian documents are usefully brought together by Kirsten Schröter, *Die Terminologie der italienischen Buchdrucker im 15. und 16. Jahrhundert: eine wortgeschichtliche Untersuchung mit besonderer Berücksichtigung von Venedig*, Tübingen, Max Niemeyer, 1998, pp. 193-195. Given that the matter has arisen, a brief *excursus* into the terminology might be helpful. In paper commerce the smallest unit is the *quire*, obviously deriving from the Latin *quaternum* (fourfold) or *quinternum* (fivefold), i.e. what was assembled as a gathering in a parchment manuscript, almost always with four or five sheets (*because of the behaviour of the membrane, larger gatherings can be awkward*). When books started being constructed with paper, the association of *quire* with four or five was lost: on the one hand the term remained as a synonym for gathering, on the other in paper commerce it became a term for a unit of 25 sheets (or alternatively a "short quire" of 24 sheets). Twenty quires, or 500 sheets (*the same quantity as in today's standard pack of A3 or A4*), made up a ream, and this should be taken as the standard definition. For instance, in *L'Art de faire le papier* Lalande cites the *Arrest du Conseil d'État du Roi*, 27 January 1739, which states specifically that "La rame de toutes sortes de Papiers sera composée de vingt mains, chaque main de vingt-cinq feuilles, non compris les feuilles d'enveloppe, qui se mettent dessus & dessous: & sera chaque rame, outré lesdites feuilles d'enveloppe, recouverte de deux feuilles de gros papier, appelé *Maculature* ..." (p. 92 [translation: *The ream for every kind of paper is to be made up of twenty quires, and each quire of twenty-five sheets, not including the so-called wrapping sheets, covered by two sheets of coarse paper, called maculature*]). There was, however, an alternative practice of a "short ream" of 480 sheets. In a ream the two outermost quires were known as "cording quires" or "cassie quires", i.e. from the French *cassé* (broken), and were formed with defective sheets, for which, if they were damaged in transport, it was no matter. For larger quantities, 1,000 sheets = 40 quires = 2 reams = 1 bundle, or, alternatively: 960 sheets = 40 "short" quires = 2 "short" reams = 1 "short" bundle; and likewise: 5,000 sheets = 200 quires = 10 reams = 5 bundles = 1 bale, with the alternative: 4,800 sheets = 200 "short" quires = 10 "short" reams = 5 "short" bundles = 1 "short" bale. Just to complicate matters further, by the beginning of the Nineteenth century, to compensate wastage, printers had introduced their own separate quantities, i.e. 516 sheets, or 21½ "short" quires = 1 printer's ream; 1,032 sheets = 2 printer's reams = 1 printer's bundle; and 5,160 sheets = 5 printer's bundles = 1 printer's bale. Try learning all that off by heart!

Two hefty tomes, with vivid orange covers, expound the lengthily and lovingly harvested knowledge of Ezio Ornato, Paola Busonero, Paola F. Munafò, M. Speranza Storace, *La carta occidentale nel tardo Medioevo*, Roma, Istituto Centrale per la Patologia del Libro, 2001, relating to an extensive survey of the paper in manuscripts and printed books up to the end of the Fifteenth century, known in the various ongoing reports as *Progetto Carta*, while for Francophones some of the material is reworked in Ezio Ornato, 'Princesse ou Cendrillon? Quelques réflexions sur l'histoire du papier filigrané dans l'Occident médiéval', *Scrittura e civiltà*, vol. 25 (2001), pp. 223-301. What it does represent is a corpus of just under a hundred manuscripts and incunabula that have been analysed in laboratory conditions in order to establish the "thickness" and the "whiteness" of the paper. The bad news is that these two volumes were planned as the first instalment of a much larger enterprise, now defunct (*I won't comment on the Italian habit of constructing cathedrals in the*

desert, but I'm sorely tempted). Since a lot of material, especially the images, will now never appear, the usefulness is much impaired; but nevertheless a huge amount of historical and codicological analysis has been poured into this work and, although it means having to wade through pages of graphs and statistics, and coping with some "ornate" Italian prose, it remains well worth the effort. The moment seems appropriate, moreover, to draw attention to the collected essays of Ezio Ornato: again a misnomer, Ornato and friends all on a bicycle together might have been a better title, since this particular codicologist has a deep fondness for collective enterprises, as the volume duly declares: *La face cachée du livre médiéval. L'histoire du livre*, vue par Ezio Ornato, ses amis et ses collègues, Roma, Viella, 1997. To this should be added a small volume, written by the man on his own, *Apologia dell'apogeo. Divagazioni sulla storia del libro nel tardo medioevo*, Roma, Viella, 2000, in which the first of the three essays is 'Un amico poco fidato del manoscritto: la carta' (pp. 19-32).

[5]

Renaissance to Eighteenth-century Descriptions and Images of Papermaking, and Manuals of a Later Era

When I started to compile this listing of all the early references to papermaking, rather ingenuously, I assumed that someone else, somewhere, somehow, had previously done much the same thing. But nothing! or at least I have so far failed to find it. So here are all the published references of a certain importance, both textual and visual, with accompanying bibliography where extant or useful, to the process, as a whole or in part, up to and slightly beyond the end of the Eighteenth century, after which date the sources become unmanageable. The ordering is unashamedly chronological and fuller discussions of all these items appear in Chapter 3.

- 1398. The text of the short treatise *De insignis et armis* by Bartolo da Sassoferrato, in which the great Medieval jurist famously (*but erroneously*) delineated the function of watermarks in paper, was left unfinished at his death and was completed by his son in law Niccolò Alessandri in 1358. As well as circulating in manuscript, it was first published in his *Consilia, disputationes necnon tractatus* in Lyon in 1498, followed in the Sixteenth century by inclusion in his *Consilia, quaestiones, tractatus* in Lyon in 1535 and in volume 11 of the complete edition of his works in Venice in 1570-71. Modern editions are Bartolus de Saxoferrato, *Tractatus de insigniis et armis*, mit Hinzufügung einer Übersetzung und der Citate neu herausgegeben von Felix Hauptmann, Bonn, P. Hauptmann, 1883; *Bartholi De insigniis et armis*, in *Medieval Heraldry: Some 14th Century Heraldic Works*, edited by Evan John Jones, Cardiff, printed by W. Lewis, 1943, pp. 224-252; *A Grammar of Signs: Bartolo da Sassoferrato's Tract on Insignia and Coats of Arms*, edited and translated by Osvaldo Cavallar, Susanne Degenring, and Julius Kirshner, Berkeley, Robbins Collection Publications, University of California, Berkeley, 1995, appendix I, pp. 109-121, with the passage about watermarks at p. 113; it also includes a good English translation at pp. 145-157. The passage about Fabriano in the Eighteenth century was excerpted in Meerman's *De Chartae Vulgaris seu Lineae Origine*, 1767, pp. 7-8 (see below), and in modern times is discussed in particular in Andrea F. Gasparinetti, *Aspetti particolari della filigranologia*, Milano, Rivista "Industria della carta", 1964, p. 30. Lots of people have cited it since, usually taking it at face value.

- 1494. There is no modern critical text, unfortunately, of the *De partibus aedium* by the Parma humanist, Francesco Maria Grapaldo (1460-1515). The first edition attributed to 1494 (ISTC ig 00349000) survives in a little under fifty copies and can be viewed online (*in a badly scratched microfilm*) on the Gallica website, while in the Sixteenth century the work had a further five editions, with minor textual differences, in 1501, 1506, twice in 1516, and in 1517 [see Chapter 3]. The passage describing the papermaking process is found at f. o4v as part of book II, chapter 9, entitled *Bibliotheca*. It has been excerpted various times, for instance in Giacomo Sardini, *Esame sui principj della francese ed italiana tipografia ovvero Storia critica di Nicolao Jenson*, Lucca, per conto della Nuova Società Tipografica, nella Stamperia Bonsignori, 1796-98, III [Appendice], p. 98; Augustin Blanchet, *Essai sur l'histoire du papier et de sa fabrication*, Paris, Ernest Leroux éditeur, 1900, p. 63; Silvia Rizzo, *Il lessico filologico degli umanisti*, Roma, Edizioni di Storia e Letteratura, 1973, p. 18; and in Józef Dabrowski-John S.G. Simmons, 'Permanence of Early European Hand-made Papers', *Fibres and Textiles in Eastern Europe*, vol. 11 (2003), pp. 8-13, also issued in the *Papers of the 24th International Congress of Paper Historians, Porto, Portugal, 11-20 September 1998*, Basel, Peter F. Tschudin, 2001, pp. 253-263. An Italian discussion of the passage, which unhelpfully does not include the Latin text, can be found in Giorgio Montecchi, 'La carta come fondamento dell'*humanitas vitae* e della *memoria* nell'Europa del Quattrocento', in Idem, *Il libro nel Rinascimento. Saggi di bibliologia*, Milano, La storia, 1994, pp. 111-129: 112-114.

- 1546. The earliest known piece of legislation relating to papermaking, which also lays down norms for the numbers of sheets in a ream and so on, is a Polish royal edict of 1546, see Józef Dąbrowski-John S.G. Simmons, “Ad perpetuam rei memoriam ...”. The Royal Regulation of Polish Papermaking in 1546”, in *IPH Congress Book*, vol. 10 (1994), pp. 44-51, also issued in parallel Polish and English versions in *Przegląd Papierniczy*, vol. 52 (1996), pp. 267-272, 329-335.
- 1558-65. The recently discovered manuscript sketch of a beating machine by Alberto Alberti (1526-80), attributed to c. 1558-65, belonging to the Canadian Centre for Architecture in Montreal, can be viewed on the Centre’s website and is discussed by Thea Burns and Myra Nan Rosenfeld, ‘Design for Water-powered Stampers: Early Italian Papermaking Technology illustrated in a Drawing in the Canadian Centre for Architecture, Montreal’, in *Looking at Paper: Evidence & Interpretation*, cit., 2001, pp. 99-104.
- 1568. The image of the papermaker in the *Eygentliche Beschreibung aller Stände auff Erden, hoher und nidriger, geistlicher und weltlicher, aller Künsten, Handwercken und Händeln*, durch d. weitberümpften Hans Sachsen gantz fleissig beschrieben u. in teutsche Reimen gefasset, Franckfurt am Mayn, bey Georg Raben in Verlegung Sigmund Feyerabents, 1568 (VD16 S-244), reprinted in 1574 (VD16 S-245), has been reproduced in just about every discussion of the history of papermaking, and is nowadays easily found in digital form, with the image of the paper factory at f. F2r. Likewise, the parallel Latin text by Hartmann Schopper, *Παροπλία. Omnium illiberalium mechanicarum aut sedentarium artium genera continens*, Francoforti ad Moenum, apud Georgium Coruinum, impensis Sigismundi Feyerabent, 1568 (VD16 S-3897), with the image of the paper factory at f. C4r, is easily found as a digital text online. For a trilingual discussion of these early images, see W. Fr. Tschudin, *Papierer, Buchdrucker und Illuminierer in alten Abbildungen des 16. und 17. Jahrhunderts = Papetiers, imprimeurs et enlumineurs dans des gravures anciennes des 16^e et 17^e siècles = Papermakers, Printers and Illuminators in Engravings of the Sixteenth and Seventeenth Centuries*, Basel, Sandoz, 1964. On Amman’s collaboration with the publisher Sigmund Feyerabend, see Ilse O’Dell, *Jost Ammans Buchschmuck-Holzschnitte für Sigmund Feyerabend. Zur Technik der Verwendung von Bild-Holzstöcken in den Drucken von 1563-1599*, Wiesbaden, Harrassowitz, 1993.
- 1578. The *Theatre des instrumens mathematiques & mechaniques*, or to give its alternative Latin title, the *Theatrum instrumentorum et machinarum* by Jacques Besson is bibliographically complicated, since the preliminary gathering exists in four different states or issues: two in French, one dated 1578 and the other dated 1579, one in Latin dated 1578; and one bilingual in both French and Latin, dated 1578. Although the title-page declares that it was published in Lyon by Barthelemy Vincent, it was actually printed in Geneva, see the splendid GLN15-16 database conceived by Jean-François Gilmont and maintained by the Bibliothèque de Genève for a more detailed analysis. The French 1578 issue was republished in facsimile in Rome, Edizioni dell’elefante, 2001, and is reproduced digitally also in Gallica. The 1579 reissue is available digitally on the website ‘Architectura. Architecture, textes, et images’ of the Centre d’Études Supérieures de la Renaissance (CESR) of the University of Tours. The plate showing the “Noua moletrinae trusaties structura” is number 25. It is reproduced also in Hunter, *Papermaking*, cit., 2nd ed., p. 155.
- c. 1580. The regulations of the paper mill at Regensburg, dated c. 1580, are transcribed in the original German, with an accompanying French translation by Blanchet, *Essai sur l’histoire du papier et de sa fabrication*, cit., 1900, pp. 78-81.
- 1585. The *Piazza universale di tutte le professioni del mondo* by Tomaso Garzoni was first published in Venice by Giovanni Battista Somascho in 1585 (some copies have the variant date 1586), and was reprinted a total of fourteen times up to 1665. The most useful modern edition is that edited by Giovanni Battista Bronzini, Firenze, Olschki, 1996, which introduces the woodcuts from the *Eygentliche Beschreibung* by Jost Amman. The Discorso XXVIII has as its subject: “De’ scrittori, o scrivani, e cartari, e temperatori di penne, e cifranti, e professori di hieroglifici, et ortografi” (pp. 306-316), and bumbles on at length about the cultural importance of the paper industry, but fails to say anything useful.
- 1588. The very bad poem by Thomas Churchyard (c. 1520-1604) has a fairly impossible title, which is rarely cited in its entirety, but which reads: *A Sparke of Frenship and Warne Goodwill, that Shewest the Effect of True Affection and Vnfoldes the Finesse of this World. Whereunto is Joined the Commoditie of Sundrie Sciences, the Benefit that Paper Bringeth, with Many Rare Matters Rehearsed in the Same, with a Description & Commendation of a Paper Mill, Now and of Late Set Vp (neere the Towne of Dardthford) by a High Germayn called M. Spilman, Jeweller to the Queen’s Most Excellent Maiestie*, and was published in London in 1588 in an unsigned edition attributed to Thomas Orwin (ESTC S109866). The first edition is rare, but a facsimile of the Bodleian copy was issued by the Wynkyn de Worde Society in 1978. A German translation of the part about the paper mill was issued in 1941, see Thomas Churchyard, *Johann Spielmann, ein deutscher Papiermacher in England: ein Gedicht aus dem Jahre 1588*, ins Deutsche übertragen von Vera

de Cordova, Zittau, Lehrwerkstatt für Schriftsatz und Druck, 1941. There have also been excerpts of the same by some English private presses. For a brief, but efficacious, discussion of the text, see Hunter, *Papermaking*, 2nd ed., cit., pp. 120-121.

- 1591. The description of the Renaissance papermaking industry by Angelo Rocca appears in his *Bibliotheca Apostolica Vaticana a Sixto V. Pont. Max. in splendidiorem, commodioremq. locum translata*, Romæ, ex Typographia Apostolica Vaticana, 1591, pp. 381-382. Though there have been ample studies on Rocca as the founder of the Biblioteca Angelica in Rome, for which it has been erroneously and unconvincingly claimed that it is Europe's oldest, still extant "public library" (*without any clear definition of what is understood by a public library, but whatever the definitions, the Malatestiana Library in Cesena, opened in 1454, and Francis Trigge Chained Library in the parish church of St. Wulfram's in Grantham, established in 1598, are both older*), this passage has not – to my knowledge – been re-edited in modern times.
- 1607. The fame of Vittorio Zonca's *Nouo teatro di machine et edificii* not only meant that the first edition published in Padua, appresso Pietro Bertelli, 1607, was followed by further editions in 1621, 1627, and 1656, but that it has also enjoyed at least four modern photographic reprints, as follows: Roma, Edindustria, 1960; edited by Karl Weiss, Acuto, Aedes acutenses, 1969; with a presentation by Erminio Caprotti, Milano, L. Maestri tipografo ed editore, 1979; and edited by Carlo Poni, Milano, Il Polifilo, 1985.
- 1637. The first extensive Chinese account of papermaking, including woodcut illustrations of the process, is published by Sung Ying-Hsing, *Thien Kung Kai Wu* [The Exploitation of the Works of Nature]. Since it is a block-book, different impressions have different dates (*Hunter gives it as 1634*) and the illustrations are often included in discussions of the history of papermaking with only vague bibliographical references. A translation into English was provided by Sun Zen I-Tu and Sun Shiou-Chuan, *T'ien-kung k'ai wu. Chinese Technology in the Seventeenth Century*, Philadelphia-London, Pennsylvania University Press, 1966 (*the Chinese names and title were printed as ideograms and thus transcriptions vary*). Chapter 13, describing how the bamboo fibres are prepared for papermaking, is quoted at length in Tsien, *Paper and Printing*, cit., pp. 69-71. Tsien also includes useful notes provided by a subsequent Chinese scholar, Yang Chung-Hsi (1850-1900), which further clarify the process.
- 1649. The gablestone showing the interior of a papermaking factory on the house of Pieter van Haack in Amsterdam is reproduced in W.A. Churchill, *Watermarks in Paper in Holland, England, France, etc., in the XVII and XVIII Centuries and their Interconnection*, Amsterdam, Menno Hertberger & co., 1935; p. 10.
- 1651. The technically detailed and challenging description provided by Giovanni Domenico Peri in *I frutti d'albero* (1651) was edited in Italian by Manlio Calegari, 'La cartiera genovese tra Cinquecento e Seicento', in the series *Quaderni del Centro di studio sulla storia della tecnica del Consiglio Nazionale delle Ricerche*, vol. 12 (1984), defined by Conor Fahy as "a publication difficult to come by even in Italy". Fortunately Fahy himself has solved the problem with his own exemplary edition, including a rendering into English, see 'Paper Making in Seventeenth-century Genoa: The Account of Giovanni Domenico Peri (1651)', *Studies in Bibliography*, vol. 56 (2003-2004), pp. 243-259. Its contents are also discussed in the important books on papermaking in Genoa by Manlio Calegari and Paolo Cevini, see [6e. Liguria] below.
- 1658. In the *Orbis sensualium pictus* by Johann Amos Comenius the papermaking factory is usually n. 92 in the sequence. The earliest version of the rather roughly cut, but accurate, woodcut is reproduced in Tschudin, *Grundzüge der Papiergeschichte*, cit., 2002, p. 93 (p. 96 in the 2012 Italian translation). Several subsequent editions, among the hundreds of reprints in different languages, can be viewed on line: obviously the woodcuts have been done again in different printing shops, occasionally with changes to the iconography.
- 1661. The *Theatrum Machinarum Novum, neu-vermehrter Schauplatz der mechanischen Künsten, handelt von allerhand Wasser-Wind-Ross-Gewicht- und Hand-Mühlen, wie dieselbige zu dem Frucht-Mahlen, Papp- Pulver- Stampff-Segen- Bohren- Walcken-Mangen, und der gleichen anzuordnen*, by Georg Andreas Böckler, appeared in Nuremberg, in Verlegung Paulus Fürsten, gedruckt bey Christoff Gerhard, in 1661 (VD17 3:311413X), and was reissued in 1673 (VD17 39:124700W); a new edition was published in 1703. A Latin version, with the title *Theatrum Machinarum Novum, exhibens Aquarias, Alatas, lumentarias, Manuarias; Pedibus, ac Ponderibus Versatiles, Plures, et Diversas Molas, Variis frumentis commolendis, Chartae, & nitrato pulveri apparando, diversis tundendis, serrandis, terebrandis, panno constipando, decorando, aliisque usibus destinatas, adaptatas*, was published in Köln in 1662 (VD17 23:296774F), with a further edition in Nuremberg in 1686 (VD17 12:654543E). The copper-plate illustrations form a sequence at the end of this large folio volume: that showing the papermill (n. 73) has been reproduced in various histories of the book, such as the recent *Oxford Companion to the Book* (2010), vol. 1, p. 80, and is easily found in

online resources.

- *c. 1689*. The original edition of the *Curioser Spiegel, in welchem der allgemeine Lauff des ganzen menschlichen Lebens ... vorgestellt wird*, by Elias Porzelius, published in Nuremberg, verlegt bei Johann Endter, c. 1689, is rare, but the images are easily found in art history databases, for example in the Objektkatalog der Sammlungen des Germanischen Nationalmuseums. A water-coloured copy of 'Das wohlausgesonnene Pappiermachen' is also reproduced in *Gutenberg: aventur und kunst. Vom Geheimunternehmen zur ersten Medienrevolution*. Katalog zur Ausstellung der Stadt Mainz anlässlich des 600. Geburtstages von Johannes Gutenberg, 14. April-3. Oktober 2000, herausgegeben von der Stadt Mainz, Mainz 2000, p. 171, and the same is discussed by Klaus Roemer, *Geschichte der Papiermühlen in Westpreussen und Danzig, nebst einem Anhang für den Netzedistrikt*, Münster, Nicolaus-Copernicus Verlag, 2000, p. 158.
- *1693*. The whereabouts of the only surviving copy of *Papyrus sive Ars Conficiendae Papyri* by Jesuit priest, Jean Imberdis, published Claromonti, apud Damianum Boujon, 1693, are not known today. A facsimile of the original, accompanied by a translation by Augustin Blanchet, was published in Paris by Charles Béranger in 1899. A German text was published as *Papyrus des Pater Imberdis Sang vom Papier*, translated by Wilhelm Niemeyer, edited and published by Armin Renker, in 1944. An English translation by Eric Laughton was published as *Papyrus, or the Craft of Paper*, in a limited edition by the Paper Publications Society in 1952.
- *1718*. The pamphlet by Leonhard Christoph Sturm, *Vollständige Mühlen-Baukunst*, Augsburg, Wolff, 1718, is a treatise describing the various types of hydraulically-powered mill. The images include a traditional paper stamping mill at Tab. XXII, Tab. XXIII, Tab. XXIV, followed by the newer Hollander beater at Tab. XXV, Tab. XXVI. A digital version can be viewed on the site *Echo. Cultural Heritage Online*. The subsequent work by Leendert van Vuuren, Jacob Polly, and Cornelis van Vuuren, *Groot Volkomen Moolenboock*, 2 vols., Amsterdam, Johannes Covens & Cornelis Mortier, 1734-36, is less easily found.
- *1728*. The text of the *Cyclopædia, or, An Universal Dictionary of Arts and Sciences* by Ephraim Chambers (1728) is most easily consulted (and downloaded) on the *History of Science and Technology* website of the University of Wisconsin. The entry on 'Paper' does not appear in the main sequence, but has to be sought in the *Addenda* at the end of the second volume. Chambers' original entry was cannibalised and elaborated in subsequent English-language encyclopedias, often with interesting additions of detail, such as in the *Pantologia. A New Cabinet Cyclopaedia*, published in 1819, which adds information about recent technological developments, in particular the Fourdrinier machine.
- *1761*. *L'Art de faire le papier* by Joseph Jérôme Lefrançois de Lalande first appeared in the *Descriptions des arts et métiers* of the Académie Royale des Sciences, Paris, chez Desaint & Saillant, 1761 (a photographic reprint was issued by the Scolar Press at Ilkley in 1975) and it was republished in an augmented form in 1820 with an introduction and notes by Elié Bertrand (viewable in Gallica). A modern critical edition of the original French version is however very much a *desideratum*. The manuscript 'Description d'une des plus considerables papeteries d'Auvergne' by Paul Sevin (1693) is held by the Bibliothèque de l'Institut de France, ms. 2393, and its relationship both to Lalande and to the article in the *Encyclopédie* is described by Madelaine Pinault Sorensen, 'L'article Papier de l'Encyclopédie', in *Le papier à l'oeuvre*, cit., 2011, pp. 76-80. On the history of the papermaking factory L'Anglée at Châlette-sur-Loing, near Montargis, see *Châlette-sur-Loing. Deux siècles d'images*, Millau, Maury imprimeur, 1976, which, as well as the inevitable plates from the *Encyclopédie*, includes interesting photographic documentation on the building's history as the Hutchinson rubber factory.

The publication of Lalande's original report generated intense interest at the time and paradoxically the translations into other European languages have fared much better at the hands of scholarship. The Italian version published at Parma in 1762 was made available with an expert commentary under the title *Osservazioni intorno all'arte di fabbricare la carta*, a cura di Andrea F. Gasparinetti, Milano, Il Polifilo, 1962, although some illustrations of the original are omitted and Lalande's name is not mentioned on the titlepage (so finding it in catalogues can be problematic). An English version appeared in the *Universal Magazine*, again in 1762, and this text was re-edited by Colin Cohen and Geoffrey Wakeman for the Plough Press in Loughborough in 1976: *The Art of Making Paper: taken from the Universal Magazine of Knowledge and Pleasure ... here selected from Volumes X, XXX & XXXII*. A modern English translation by Richard MacIntyre Atkinson has been published with the title *The Art of Papermaking*, Kilmurry, The Ashling Press, 1976. A German text was also published in 1762 and has had a modern reprint with additional commentary, see *Die Kunst Papier zu machen, nach dem Text von Joseph Jerom François de la Lande*, übersetzt und kommentiert von Johann Heinrich Gottlob von Justi, 1762, herausgegeben von Alfred Bruns, Münster, Schweizer Papier historiker, 1984. Subsequently it was published in a Spanish translation, see: *Arte de*

hacer el papel segun se practica en Francia, y Holanda, en la Cina, y en el Japon. Descripcion de su origen, de las diferentes materias de que puede fabricarse, de los Molinos Holandeses, y de los de Cylindros; y del arte de hacer los cartones, caxas, y varios adornos de pasta, Madrid, por Pedro Marin, 1778. The apothecary Petrus Johannes Kasteleijn, or Kasteleyn (1746-94), published a Dutch translation of the French text, with the title *De Papiermaker*, Dordrecht, A. Blussé en Zoon, 1792, rather than producing an original treatise, as originally intended, due to Dutch fears about the betrayal of industry secrets, see Arianne Baggerman, *Publishing Policies and Family Strategies. The Fortunes of a Dutch Publishing House in the 18th and Early 19th Centuries*, Leiden-Boston, Brill, 2014, pp. 326-329. Last in the sequence of European translations was the Polish version in 1799. One very useful assessment of papermaking processes, which takes as its basis the text and the illustrations of Lalande, is the monograph number of *The Paper Conservator*, vol. 13 (1989), containing a report by Timothy D. Barrett, in which pp. 7-27 are dedicated to 'Early European Papermaking Methods 1400-1800'. An updated text is now available online at the already praised 'Paper through Time' website at the University of Iowa [35].

- 1765. The *Encyclopédie des arts et métiers* was first published in Paris in folio format and went through several editions in other centres, including Livorno (or, to give it its English exonym, Leghorn) in Italy, before metamorphosing into the *Encyclopédie méthodique*. Anyone using it today is invited to pay due heed to the distinction between the main alphabetical series of entries, issued in seventeen volumes from 1751 to 1765, and the separate series containing the copperplate illustrations, entitled *Recueil de planches sur les sciences, les arts libéraux, et les arts mécaniques*, in eleven volumes, which appeared from 1762 to 1772. The texts of the main entry and the illustrations have to be read in parallel. The entry *Papeterie* in the *Encyclopédie* has been brought together with other entries and the illustrations relating to book-making by Giles Barber, *Bookmaking in Diderot's Encyclopédie*, Farnborough, Gregg International, 1973. On the identities of contributors, see Frank D. Kafker, *The Encyclopedists as Individuals. A Biographical Dictionary of the Authors of the Encyclopédie*, Oxford, The Voltaire Foundation, 1988. Beware on the other hand of a collection of illustrations, comprising 'Papetterie', 'Fonderie en caracteres d'imprimerie', 'Imprimerie en caracteres', 'Relieur', 'Imprimerie en taille douce', and 'Marbreur de papier', brought together by the Bibliothèque de l'Image (Paris 2001), since it includes only the introductions to the images, without the more substantial entries from the main series. Although infinite works have been written about the *Encyclopédie's* psychological, social, and intellectual impact, the one book necessary to read in order to understand the intricacy of its textual and bibliographical history is Robert Darnton, *The Business of Enlightenment. A Publishing History of the Encyclopédie, 1775-1800*, Cambridge (Mass.), Harvard University Press, 1987.

What happens next to the *Encyclopédie* entry on papermaking is quite fun, though again the process cries out for a fuller study. The significant revision and expansion of the original for inclusion in Panckoucke's *Encyclopédie méthodique* (where it appeared in the section *Arts et métiers mécaniques*, vol. V, 2 partie) was entrusted to the geographer Nicolas Desmarest (1725-1815), who in 1768 and 1777 made journeys to Holland to study the workings of the paper mills there and published, after the first of these trips, his 'Premier mémoire sur les principales manipulations qui sont en usage dans les papeteries de Hollande, avec l'explication physique des résultats des ces manipulations', in the *Mémoires de l'Académie Royale des Sciences*, 1771, pp. 335-364, following it with a 'Second mémoire sur la papeterie, dans lequel, en continuant d'exposer la méthode hollandaise, l'on traite de la nature et des qualités des pâtes hollandaises et françaises; de la manière dont elles se comportent dans les procédés de la fabrication; et des apprêts; enfin des différents usages auxquels peuvent être propres les produits de ces pâtes', 1774, pp. 599-687 (also circulated as an extract, which can cause confusion in cataloguing). He not only revised Goussier's unsigned original version, mainly with a series of inserts, but also published it under his own name as *L'Art de la papeterie*, A Paris, de l'Imprimerie de Monsieur, 1789. But biter bit! His version became the basis for a work by Louis Sébastien Lenormand (1757-1839), better remembered as the inventor in 1783 of the parachute (not so strange as it might seem, since the Montgolfier paper factory in Annonay was involved in the construction of the first hot-air balloons), entitled *Manuel du fabricant de papier, ou De l'art de la papeterie*, Paris, à la Librairie Encyclopédique de Roret, 1833.

- 1765-71. Original copies of the *Versuche und Muster ohne alle Lumpen oder doch mit einem geringen Zusatze derselben Papier zu machen* by Jacob Christian Schäffer, containing samples of different sorts of vegetable fibre used to make paper, are fairly rare, but can be viewed in Google books. As with Lalande, this scientist with wide-ranging interests has generated a considerable bibliography, but on his specific contribution to the history of papermaking, see Henk Voorn, *Rondom Jacob Christian Schäffer. Een bijdrage tot de geschiedenis der papierfabricage in de achttiende eeuw*, Amsterdam, De Papierwereld, 1950; Eckart Roloff, 'Jacob Christian Schäffer. Der Regensberger Humboldt wird zum Pionier für Waschmaschinen, Pilze und Papier', in Idem, *Göttliche Geistesblitze. Pfarrer und Priester als Erfinder und Entdecker*, Weinheim, Wiley-VCH Verlag GmbH & Co. KGaA, 2010, pp. 159-182.

- 1767. The letters, which arrived from all over Europe about the origins of rag-based paper, were published as: *Gerardi Meerman et Doctorum Virorum ad eum Epistolae et Observationes De Chartae Vulgaris seu Lineae Origine*, edidit ac praefatione instruxit Jacobus van Vassen, Hagae-Comitum, apud Nicolaum van Daalen, 1767 (*available in Google books*). On the episode, see Peter Bower, 'The White Art: The Importance of Interpretation in the Analysis of Paper', in *Looking at Paper. Evidence & Interpretation*, cit., 2001, pp. 5-16.
- 1769. The Italian *Dizionario delle arti e de' mestieri* was published in Venice by Modesto Fenzo in 18 volumes from 1768 to 1778, and was for the most part an unashamed paraphrase and reduction of the *Encyclopédie*. The first six volumes were authored by Francesco Grisellini, who is therefore responsible for the entry on 'Cartera' in vol. 4 (1769), pp. 131-240; the remainder were written by Marco Fassadoni.

[6]

Histories of Papermaking Districts or of Single Mills

There has been considerable work in this field of late, a lot of it illustrated with attractive period photographs, while older writings come from the ever-glorious Paper Publications Society. For obvious reasons, comprehensiveness is unthinkable, given the vast number of brief articles or notes, often by local historians, on the history of single mills, for which I invite the user to explore the more general bibliographical resources listed at the beginning of this chapter [0]. Here I have tried to stick to monograph publications, with the occasional mention of some more substantial articles. The entries in this section are ordered by countries, regions or equivalents, and single towns.

[a] **Austria.** See Georg Eineder and E.J. Labarre, *The Ancient Paper-Mills of the Former Austro-Hungarian Empire and their Watermarks*, Hilversum, Paper Publications Society, 1960. Austria, of course, has to be taken *sensu lato*, since in the Nineteenth century and even before, the Hapsburg territories included much of Northern Italy, as well as Southern Poland, Czechoslovakia, Hungary, and most of the Balkans. This volume provides excellent tracings of 1,871 watermarks, often distinguished as right or left (*presumably on the sheet viewed from the mould side, though this is not specified*), but with no mention of twins.

[b] **Bulgaria.** In reality as a province of the Ottoman empire, but with paper mainly imported from Italy and, later, France. Italian papermakers soon developed an apposite watermark for paper for the Islamic world, usually three crescent moons, or alternatively worked a single crescent moon into other varieties of watermark, for instance a crown. For these same reasons such papers are rare in Western collections, but obviously abound in those of the former Ottoman empire. These several Bulgarian volumes usefully pay considerable attention to these watermarks, see Vsevolod Nikolaev, *Watermarks in the Ottoman Empire*, Sofia, Bulgarian Academy of Sciences, 1954; Asparoukh Velkov-Stephane Andreev, *Filigranes dans les documents ottomans. Trois croissants*, Sofia, Éditions Texte Trayanov, 1983; Asparouh Velkov, *Les filigranes dans les documents ottomans. Divers types d'images*, Sofia, Éditions Texte Asparouh Trayanov, 2005; Stefan Andreev, *Les filigranes dans les documents ottomans. Couronne*, Sofia, Éditions Texte Asparouh Trayanov, 2007. In these publications the images are mostly acquired with good quality β -radiographs, so worth looking at. In terms of provenance identification, further scholars working on these papers should reference the Toscolano source material cited below: for instance, the one-headed eagle over the letters GFA in paper from the end of the 18th century identifies the Andreoli firm (*GFA = Giovanni di Faustino Andreoli*).

[c] **France.** The best source for information about mills and districts in France up to 1600 remains Briquet, though the organisation of the repertory often makes it difficult to find (*an index was added however in the 1968 reprint edited by Allan Stevenson*). A pioneering pre-Briquet study is Étienne Midoux-Auguste Matton, *Étude sur les filigranes des papiers employés en France aux XIV^e et XV^e siècles*, accompagnée de 600 dessins lithographiés, Paris, Dumoulin; A. Claudin, 1868. Post-Briquet, further work was done by Henri Alibaux (1872-1941), see in particular *Les premières papeteries françaises*, Paris, les Arts et le livre, 1926. A very impressive assemblage of secondary sources is available in Raymond Gaudriault, *Filigranes et autres caractéristiques des papiers fabriqués en France aux XVII^e et XVIII^e siècles*, Paris, CNRS Éditions, 1995, pp. 311-319. The same work includes an extensive listing of known names of papermakers (pp. 166-280) and also of their monograms (pp. 281-310). Useful general information can also be found in Marie-Ange Doizy-Pascal Fulacher, *Papiers et moulins: des origines à nos jours*, Paris, Éditions Technorama, 1989, new edition: Paris, Art & métiers du livre, 1997. In terms of specific geographical areas, references are based on the 2014 Régions, though in some cases the nomenclatures are provisional.

Auvergne-Rhône-Alpes.

Annonay. In France the most fascinating episode is the link between ballooning and papermaking, since the

Montgolfier brothers, Joseph (1740-1810) and Étienne (1745-99), were respectively the twelfth and fifteenth offspring of a family of papermakers of Annonay, see Marie-Hélène Reynaud, *Les moulins à papier d'Annonay à l'ère pré-industrielle: les Montgolfier et Vidalon*, Annonay, Éditions du Vivarais, 1981; Idem, *Une histoire de papier: les papeteries Canson et Montgolfier*, Annonay, Canson, 1989. The picture is updated in Leonard N. Rosenband, *Papermaking in Eighteenth-Century France. Management, Labor and Revolution at the Montgolfier Mill, 1761-1805*, Baltimore, Johns Hopkins University Press, 2000, which draws on the still largely intact Montgolfier archive and focuses in particular on a bitter strike and lockout in 1781. On the history of flight and its early links with the papermaking industry, see Charles Coulston Gillespie, *The Montgolfier Brothers and the Invention of Aviation 1783-1784*, Princeton, Princeton University Press, 1983. The Montgolfier factory was also the first in France to make wove paper in 1777-79, see Marius Audin, 'De l'origine du papier vélin', *Gutenberg Jahrbuch*, 1928, pp. 69-86.

Auvergne. On the general history of papermaking in the area, see Élie Cottier, *Le papier d'Auvergne: histoire d'un vieux métier*, Clermont-Ferrand, Éditions Volcans, 1974; Jean-Louis Boithias and Corinne Mondin, *Les moulins à papier et les anciens papetiers d'Auvergne*, Nonette, Éditions Créer, 1981; and Pierre-Claude Reynard, *Histoires de papier: la papeterie auvergnate et ses historiens*, Clermont-Ferrand, Presses universitaires Blaise-Pascal, 2001. A remarkable labour is Pierre Delaunay, *Catalogue des filigranes relevés sur des papiers d'archives d'Auvergne*, Clermont-Ferrand, Académie des Sciences, Belles-lettres, et Arts de Clermont-Ferrand, 1997. It furnishes the tracings of 2,879 watermarks, organised in Briquet fashion and scrupulously cross-referenced to *Les filigranes*. The mills of the Auvergne in particular supplied Renaissance Lyon, on which see Pierre Chazal, 'Auvergne et Lyonnais au XVI^e siècle. Les achats de papier d'Ambert par S. Gault, marchand lyonnais (1573-1582)', *Revue d'Auvergne*, vol. 95 (1981), pp. 93-102.

Grenoble and the Dauphiné. See Jean-Pierre Borgis, *Moulin-Vieux. Histoire d'une papeterie dauphinoise (1869-1989)*, Grenoble, Presses universitaires de Grenoble, 1991; Carole Darnault, *Rives, la mémoire du papier. Histoire d'une papeterie dauphinoise*, Grenoble, Presses universitaires de Grenoble; Musée Dauphinois, 2000.

Alsace-Champagne-Ardenne-Lorraine.

Troyes. Although papermaking on an Italian model first established itself in France in the Auvergne and in the hills of the South-eastern Massif central, the needs of Paris encouraged the industry to shift further North, so that from the Fourteenth century onwards the city of Troyes became a major producer. See Louis Le Clerc, *Le papier. Recherches et notes pour servir à l'histoire du papier, principalement à Troyes et aux environs depuis le Quatorzième siècle*, Paris, à l'Enseigne du Pégase, 1926, 2 vols. Includes tracings of watermarks from the local mills.

Vosges. See Jean-Marie Janot, *Les moulins à papier de la région vosgienne*, Nancy, Impr. Berger-Levrault, 1952.

Aquitaine-Limousin-Poitou-Charentes.

See Alexandre Nicolăi, *Histoire des moulins à papier du Sud-ouest de la France, 1300-1800: Périgord, Agenais, Angoumois, Soule, Béarn*, Bordeaux, G. Delmas, 1935, 2 vols., reprinted Monein, Éd. Pyrémonde, 2006.

Bretagne.

See Jacques Duval, *Moulins à papier de Bretagne du XVI^e au XIX^e siècle. Les papetiers et leurs filigranes en Pays de Fougères*, Paris, L'Harmattan, 2005.

Normandie.

See René Dubois, *Les moulins à papier de Maromme: l'histoire de la fabrication du papier dans la vallée du Cailly du XV^{ème} siècle au XIX^{ème} siècle*, Luneray, Éditions Bertout, 1996.

[d] **Germany.** A history of the papermill as part of an industrial economy, which regularly innovates in response to competition, is available in the two large tomes by Günter Bayerl, *Die Papiermühle. Vorindustrielle Papiermacherei auf dem Gebiet des alten deutschen Reiches*, Frankfurt am Main, Peter Lang, 1987. An overview of the watermarks, mostly from Central and Eastern Europe, present in one collection is *The Nostitz Papers. Notes on Watermarks found in the German Imperial Archives of the 17th & 18th Centuries, and Essays showing the Evolution of a Number of Watermarks*, cit., 1956.

Bavaria. The first papermill in Germany is held to be that founded by Ulman Stromeir at Nuremberg in 1390, famously depicted a century later in a woodcut in the Schedel Nuremberg chronicle, see Wolfgang Von

Stromer, 'Die erste Papiermühle in Mitteleuropa: Ulman Stromeirs "Hadermühle" Nürnberg 1390-1453, an der Wiege der Massenmedien', in *Produzione e commercio della carta e del libro*, cit., 1992, pp. 297-311.

Brandenburg. Dominated for a long time by Italian and Swiss exports, Germany was slow to establish a real papermaking industry of its own, with the first mechanised mill built only in 1818. See Klaus B. Bartels, *Papierherstellung in Deutschland. Von der Gründung der ersten Papierfabriken in Berlin und Brandenburg bis heute*, Berlin, Be.bra Wissenschaft Verlag, 2011.

Sachsen. An ample survey is the self-published Helmut Cedra, *Aus Tradition geschöpft. 450 Jahre Papierherstellung in Königsten/Sachsen*, Kurort Gohrisch, Helmut Cedra, 2010.

West Prussia. The portrait of activity in one area is provided in Klaus Roemer, *Geschichte der Papiermühlen in Westpreussen und Danzig*, cit., 2000.

[e] **Italy.** There is no proper overview of the whole history of the paper industry in Italy. A survey of some 300 late Eighteenth-century Italian watermarks in documents in Dutch archives is published in Theo Laurentius-Frans Laurentius, *Italian Watermarks 1750-1800*, Leiden-Boston, Brill, 2016. It appears more an excuse to demonstrate reproductions achieved with Soft x-ray radiography [26] than to produce an in-depth analysis of Italian output of the period.

The discussion that follows is arranged on the basis of the modern *Regioni*.

Abruzzo.

Papermaking in this area was largely under the aegis of nearby Fabriano, see Jukic Fredijana, 'Le origini della manifattura della carta in Abruzzo. Le cartiere di Sulmona e de l'Aquila (secoli XIV-XV)', in *Alle origini della carta occidentale*, cit., 2014, pp. 169-198.

Campania.

Amalfi. Land access to Amalfi, except by mule, was only achieved in the Twentieth century, otherwise this beautiful city on the peninsula of the same name was travelled to exclusively by boat. Its commercial and political significance in the Middle ages as one of the four Maritime republics meant that through commerce with North Africa and Spain it acquired a very ancient papermaking industry, probably using Arab methods. The earliest documents mentioning "resimi tres de charta" go back to 1268, see Domenico Ventura, 'Sul ruolo della Sicilia e di Amalfi nella produzione e nel commercio', in *Alle origini della carta occidentale*, cit., 2014, p. 112, who provides further bibliography on the Medieval period. In time, after adopting Fabriano techniques, Amalfi became the main supplier for the Neapolitan printing industry, see Gregorio E. Rubino, *Le cartiere di Amalfi. Profili. Paesaggi protoindustriali del Mediterraneo*, Napoli, Giannini editore, 2006. Further information can be found in Vincenzo Trombetta, *L'editoria napoletana dell'Ottocento. Produzione, circolazione, consumo*, Milano, Franco Angeli, 2008, which dedicates a chapter to Amalfi papermaking in the 19th century. A personal history is that by Angelo Tajani, *Sulle orme della carta: dagli albori del più importante veicolo della cultura all'industrialismo nei ricordi di un'infanzia trascorsa in un'antica cartiera amalfitana*, a cura di Francesco Saverio Alonzo, Salerno, De Luca, 1995.

Emilia Romagna.

Bologna. Two significant and well-documented studies, with ample reference to archive sources, are Pierangelo Bellettini, 'Cartiere e cartari', in *Produzione e circolazione libraria a Bologna nel Settecento. Avvio di un'indagine*. Atti del V colloquio, Bologna, 22-23 febbraio 1985, Bologna, Istituto per la Storia di Bologna, 1987, pp. 17-89; Idem, 'Il gonfalone, l'àncora e la stella. Filigrane bolognesi nella prima metà del XVIII secolo', in *Produzione ed uso delle carte filigranate in Europa*, cit., 1996, pp. 269-308.

Friuli-Venezia Giulia.

In the late Middle ages this area had a certain number of papermaking factories along the base of the mountains, though relatively little research has been done. Briquet knew and cites an article by the Udine librarian, Vincenzo Joppi, 'L'arte della stampa in Friuli', Udine, Tipografia G.B. Doretti e soci, 1880, which mentions the existence of a papermill at Cividale in 1293, but no further information is extant.

Gorizia. Information on the papermills established in the Eighteenth century is available in Eineder-Labarre, *The Ancient Paper-Mills of the Former Austro-Hungarian Empire*, cit., pp. 87-92.

Pordenone. The area to the West of the Tagliamento river became an important paper-producing area in the Eighteenth and early Nineteenth centuries, supplying the Venetian publishing industry and exporting into the Eastern Mediterranean, in particular through the figure of the industrialist Andrea Galvani, see Ivo Mattozzi, 'I

Galvani, fabbricanti di carta (1744-1855). Un modello di formazione dell'imprenditorialità?', in *Andrea Galvani, 1797-1855. Cultura e industria nell'Ottocento a Pordenone*, a cura di Gilberto Ganzer, Pordenone, Edizioni Studio tesi, 1994, pp. 17-41. Also, for the outlying district of San Valentino, see: *Acque e cartiera nel parco di San Valentino*, Pordenone, Comune-Biblioteca dell'immagine, 1997.

Liguria.

Genoa. The inevitable starting point is Briquet's first great sally into the field of watermark scholarship: 'Papiers et filigranes des Archives de Gênes 1154 à 1700', *Atti della Società ligure di storia patria*, vol. 19/2 (1887), pp. 269-394, better known from the substantial repaged offprint, Genève, H. Georg, Libraire-éditeur, 1888 (*the title-page says "avec 593 dessins autographiés", but there are in fact 594 in the listing*), republished in the already mentioned, but never too highly praised: *Briquet's Opuscula. The Complete Works of Dr. C.M. Briquet without "Les filigranes"*, Hilversum, the Paper Publications Society, 1955, pp. 171-218, planches I-LXXV. As Conor Fahy has since observed, "this article contains one of the great understatements of scholarship, when Briquet refers to his contribution, with its 594 tracings of watermarks, as 'de simples notes d'un touriste en passage'", see Fahy, 'Paper Making in Seventeenth-century Genoa', cit. (2003-04), p. 245. Rather too many subsequent scholars, especially those of the lazy or superficial variety, have blithely assumed that the information herein was absorbed into *Les filigranes*; it wasn't, or only very partially. A very quick comparison, for instance, is provided by my favourite 'Basilic' (*Dragon*) watermark, of which the Genoa article includes eight examples and *Les filigranes* 110. In three instances the same image, albeit turned around in every case, appears in both repertoires: nn. 27 (= 2617), 28 (= 2618), 32 (= 2643); in a fourth, n. 29, the reference is a secondary one (n. 2624), which does not mention that the image appears in the earlier article; the remaining four tracings, i.e. nn. 30 (*dated 1445*), 31 (*dated 1441*), 33 (*dated 1448*), and 34 (*dated 1475*), however, do not make their way into the successive *magnum opus*. Mine might well be a *vox clamantis in deserto*, but I do get annoyed with the plethora of state-of-the-art, cutting-edge, hypertechnological, nerd-inspired, projects, that put this and that on line in fantastic, head-spinning, exciting new solutions, but cannot find the time to sit down and do some simple straightforward bibliographical research, or even just read. So, I draw attention to the fact that a more than worthwhile project would be an extended comparison between the two publications, in order to produce a concordance and eventually recover in a digital format the missing images. A pioneering website (*at least for its time*), which translates Briquet's article into a digital format, is *Le filigrane degli archivi genovesi*, but which has run into engineering and software problems and so is stuck in 2009: nevertheless worth a glance.

The all-important document, which, on the 24th June 1235, records an agreement to establish a papermaking shop in Genoa, is to be found at the Archivio di Stato, Archivio Notarile di Genova, Notaro Gianuino de Predono ed altri, anno 1230, f. 304r. The text was published and discussed by Briquet, 'Papiers et filigranes des Archives de Gênes 1154 à 1700', cit., 1888, p. 36, of the offprint (*again, except for a fleeting reference, this information does not transit into Les filigranes*). A more recent discussion is Peter F. Tschudin, 'Paper Comes to Italy', in *Papers of the 24th International Congress of Paper Historians*, cit., 2001, pp. 60-66. Since the whole matter of the early chronology of paper-making in Italy is extremely controversial, this is a very important item and repays careful scrutiny.

Voltri, or the hilly area to the West of Genoa. For a general introduction, see Manlio Calegari, *La manifattura genovese della carta (sec. XVI-XVIII)*, Genova, Ecig, 1986. An extraordinary book, written by a historian of architecture, meaning that it was missed by most paper history scholarship when first published, but definitely a must-have, is Paolo Cevini, *Edifici da carta genovesi: secoli XVI-XIX*, Genova, Sagep, 1995. A somewhat home-made volume, with wide-ranging ambitions, but with useful information about its home turf, is Ernesto Renato Arri, *Carta e cartiere. L'antica arte dei "paperai", con particolare riferimento al comparto del genovesato e del savonese*, Varazze, Associazione Culturale San Donato, 2012.

Lombardy.

Como. A useful assemblage of historical essays is *Cinque secoli di carta. Produzione, commercio e consumi della carta nella "Regio Insubrica" e in Lombardia dal Medioevo all'età contemporanea*. Atti del convegno: Varese, 21 aprile 2005, a cura di Renzo P. Corritore e Luisa Piccinno, Varese, Insubria University Press, 2005.

Milan. Important in terms of its historical documentation is Kevin M. Stevens-Paul F. Gehl, 'Giovanni Battista Bossi and the Paper Trade in Late Sixteenth-Century Milan', *La Bibliofilia*, vol. 96 (1994), pp. 43-90, which publishes two inventories from 1595, in which the paper is arranged in reams of 500 sheets. More ambitious and informative than its title suggests is Arnaldo Ganda, 'Cenni su carta, cartai, cartolai nel Quattrocento milanese', *La Bibliofilia*, vol. 116 (2014), pp. 149-163, which recovers precious information about the existence of paper mills, many of them property of the various religious orders, from archive sources. An

attractive volume, with ample reference to archive material, is the catalogue of the exhibition *Sì, carta!* Catalogo della mostra, novembre 2013-febbraio 2014, Milano, Archivio di Stato, 2013.

Pavia. Outside the main papermaking districts, there were numerous examples of single mills, serving a particular town. One example for which ample archive evidence has been published is Arnaldo Ganda, 'La cartiera della Certosa di Pavia a Boffalora sopra Ticino (secoli XVI-XVIII)', *Bollettino della Società Pavese di Storia Patria*, vol. 103 (2003), pp. 115-166.

Toscolano and Lake Garda. Although Toscolano, where papermaking is documented as early as 1381, geographically is closer to Milan, its importance in the Renaissance was that from early in the Fifteenth century it was in Venetian territory and thus able to supply the printing shops of the Serenissima with vast quantities of high-quality paper. A recent overview can be found in Ivo Mattozzi, 'Le radici, il tronco e le diramazioni della produzione cartaria nella Valle delle cartiere di Toscolano', *La Bibliofilia*, vol. 118 (2016), pp. 389-408. See the collection of essays, with an extensive photographic coverage, albeit somewhat coffee-tableish, in *Cartai e stampatori a Toscolano. Vicende, uomini, paesaggi di una tradizione produttiva*, a cura di Carlo Simoni, Brescia, Grafo, 1995. Some the material, especially that by geographers and historians, is extremely interesting; the contributions by book-historians and bibliographers are on the other hand disappointing. A subsequent, sumptuously produced, collection of essays can be found in *Mulini da carta: le cartiere dell'alto Garda: tini e torchi fra Trento e Venezia*, a cura di Mauro Grazioli, Ivo Mattozzi, Ennio Sandal, Verona, Cartiere Fedrigoni, 2001. Papermaking in the Valle delle cartiere above Toscolano was abandoned in 1962, in favour of a large industrial establishment down on the lake itself, and most of the buildings were allowed to fall into ruin. More recently, a Fondazione Valle delle Cartiere has been established to promote the recovery of the same and in 2007 a museum was opened in the former mill of Maina Inferiore [33]. Although the local industry was centred on Toscolano, papermakers established mills in just about every suitable locality, surveyed in Giuseppe Nova-Giuseppe Cinquepalmi, *Le cartiere bresciane "minori" (Mompiano, Concesio, Carcina, Prevalle, Calvagese, Gavardo, Vobarno, Sabbio Chiese, Anfo, Padenghe, Gardone Riviera, Campione, Limone)*, Roccafranca, Compagnia della stampa Massetti Rodella editori, 2010; and in their subsequent: *Carta e cartai a Brescia (XV-XIX secolo)*, Roccafranca, Compagnia della stampa Massetti Rodella editori, 2012.

On the local watermarks, Leonardo Mazzoldi, *Filigrane di cartiere bresciane*, Brescia, Ateneo di Scienze, Lettere ed Arti, 1990-91, 2 vols., reproduces in his first volume 1,036 watermarks from 1400 to 1778 traced from documents in the Brescia State archive. The presupposition, but not certainty, is that most of this paper was produced on the nearby Lake Garda and the work provides a large number of examples of counter- or cornermarks [13], which are characteristic of Toscolano and the other mills of the area (*on the other hand the tracings do not show the placing of wire and chain-lines, nor are we told which side of the sheet is involved, and there is no mention whatsoever of twin watermarks, so the usefulness of the work is impaired*). The second volume, much more helpfully, publishes 152 documents, mainly contracts, from 1460 to 1560 relating to the paper industry. Further documentation relating to the first thirty years of the Seventeenth century is available in the research on a Verona printing firm, which again, for obvious reasons, obtained its paper supply mostly from nearby Toscolano, see Federica Formiga, *Le filigrane nelle edizioni di Bartolomeo Merlo e Angelo Tamo (1600-1630) presso la Biblioteca civica di Verona*, Vago di Lavagno, La grafica editrice, 1998.

The nearby Valle del Garza is the subject of a book by Sandro Rossetti, *Le cartiere della Valle del Garza*, Brescia, Grafo, 1995, which includes an attractive selection of early photographs.

Marches.

Fabriano and Fiorano. As is unequivocally stated above [Chapter 2], when a history of paper gives "1275" or "1276" as the date of the introduction of paper manufacture into Italy or, worse, Europe, it is probably a good idea to close the book there on the spot.

Some historical howlers are difficult to trace to their origin, but this venerable item has a precise beginning in the immense *Storia della letteratura italiana* by Girolamo Tiraboschi, Seconda edizione modenese riveduta corretta ed accresciuta dall'autore, tomo V, parte prima, In Modena, presso la Società tipografica, 1789, note at pp. 98-101, where Tiraboschi expresses his gratitude to the Fabriano scholar who sent him the information: "Tutto ciò, che intorno le Cartiere di Fabriano fin qui ho detto, deesi alla erudizione e alla diligenza del Sig. Luigi Mostarda Nobile Fabrianese, che ne ha raccolti, e me ne ha cortesemente trasmessi i documenti". Since finding the right page in Tiraboschi in a library is a tedious task, here is what the note sent by Mostarda, in Italian, mixed with Latin, actually says about the deeds relating to the monastery of Saint Benedict in Fabriano: "In essa adunque *sub trasanna carteris sororis benentesse morici gentilis* la stessa Suor Benentessa alla presenza di alcuni ivi nominati *existens in cartere suo posito in contrada gualdi prope Fabrianum iuxta stratam publicam &c.* dona alla Chiesa di S. Benedetto di Montefano de' medesimi Monaci

Silvestrini posta circa tre miglia lungi da Fabriano *dictum carterem pro dimidia cum solo & edifitio* con tutti gli altri suoi beni. La seconda appartiene a' 22. di Novembre del 1278. nella sesta Indizione; e in essa una certa Temperanza di Albertuzio vende al Sindaco del medesimo Monastero pel prezzo di otto Lire Ravennati o Anconitane un'altra cartiera: *quemdam Carterem cum solo & edifitio positum a ponte gualdi iuxta viam a primo latere*" (2nd ed., tomo V, parte I, pp. 99-100, note [Translation: *In the said document "inside the papermill of sister Benentessa of Morico Gentile", the said sister Benentessa in the presence of the here listed witnesses "in her papermill placed in the fraction of Gualdo near Fabriano by the public road etc." gives to the church of Saint Benedict of Montefano of the Silvestrine congregation "half of the said papermill with the grounds and the building" and all her goods. The second belongs to 22 November 1278, in the sixth indiction, and in it a certain Temperanza, daughter of Albertuzio, sells to the administrator of the same monastery for the price of eight Ravenna or Ancona pounds another papermill: "the said papermill with its grounds and building placed at Ponte Gualdo along the road on the first side"*]).

For a century and half the progress of the mistake was (*and continues*) inexorable, up to 1930, when its genesis, i.e. that *carcere* had been read as *cartere*, was pointed out and explained in Romualdo Sassi, 'Due documenti che non esistono nella storia antichissima delle cartiere fabrianesi', in *Atti e Memorie della Deputazione di Storia per le province delle Marche*, s. IV, vol. 7 (1930), pp. 204-209, with a separately paged offprint: Fabriano, Tip. Gentile, 1931. A year or so later he published the correspondence between Tiraboschi and Mostarda, see: 'Un carteggio inedito del Tiraboschi', in *Atti e Memorie della Deputazione di Storia per le province delle Marche*, s. IV, vols. 8-9 (1931-32), pp. 47-70, with a separately paged offprint: Fabriano, Tip. Gentile, 1932. The untruth of the 1275 or 1276 date has also been emphatically stated by Andrea Gasparinetti, *Conclusione su due documenti di Montefasano*, Torino 1942, repeated in English: 'Two Legendary Paper Mills', *The Paper Maker*, vol. 24 (1955), pp. 37-41, and in German: 'Zwei alte Papiermühlen, die nie existiert haben', *Papiergeschichte*, vol. 7 (1957), pp. 23-26. The date has also been debunked, albeit without knowing Sassi's contributions, by Burns, 'Paper Comes to the West: 800-1400', in *Europäische Technik im Mittelalter 800 bis 1400*, cit., 1996, who writes that "Fabriano's claim rests on two charters – a gift of August 1276, and a sale of November 1278, to the new Benedictine congregation of Silvestrine monks at Montefano. In each, a woman recluse-hermit gives to the monastery her enclosure or 'prison' – Latin *carcer*; misread by Fabriano partisans as a form of Italian *cartiera* or paper mill! There is no papermaking in these documents, much less hydraulic mills" (p. 416). Rather strangely, the exorcism of the false date leads Burns to argue that paper was introduced to Fabriano later than 1276, instead of realising that nothing is demonstrated, one way or another.

The 1276 question is in any case antedated by the discovery of a document in the Medieval archive of the small city of Matelica, some fifteen km to the South of Fabriano. A ledger, in an entry for 13 January 1264, records five separate purchases of sheets of paper, together with other items of stationary and candles. The provenance of the paper is not specified, but the reasonable assumption is that it is coming from Fabriano. Attention was first drawn to this document some thirty years ago by Giancarlo Castagnari, who has recently transcribed the document in 'Le origini della carta occidentale nelle valli appenniniche delle Marche centrali da una indagine archivistica', in *Alle origini della carta occidentale*, cit., 2014, pp. 9-34: 29 (*mention of the early paper documents in the Matelica archive appears, however, also in Zonghi's 1884 pamphlet, note 3*).

On the names of Fabriano papermakers in Thirteenth-century watermarks, see [12] below.

The study of the history of papermaking in Fabriano is dominated by the work of the Zonghi brothers, the elder, Aurelio (1830-1902), bishop of Fano, and the younger, Augusto (1840-1916), professor at the local school. Bibliographically speaking, the history of their several publications on watermarks is complicated and not entirely edifying. The story begins with the publication by Aurelio of *Le marche principali delle carte fabrianesi dal 1293 al 1599*, Fabriano, Tipografia Gentile, 1881, reprinted Sala Bolognese, Forni, 1979, in order to accompany a sample of 300 watermarks in Medieval and Renaissance paper put on display at the third 'Esposizione nazionale' in Milan. Crucially, the text contains only a bare listing of the watermarks, without the reproduction of any tracings, something that for reasons either of skill or cost Zonghi was unable to include (*interestingly, in several letters to Aurelio Zonghi in subsequent years, Briquet explains to his correspondent in detail how to transfer tracings onto a lithographic stone, apparently to no avail, see [18]*). The success met by this first venture led to a second catalogue of a larger collection, put on display at the "Esposizione Generale Italiana" in Turin in 1884, see *Le antiche carte fabrianesi alla Esposizione Generale Italiana di Torino. Memoria del can. Aurelio Zonghi*, Fano, Tipografia Sonciniana, 1884, reprinted Bologna, Saletta, 1981. On the occasion 1,887 marks were traced in 134 tables, albeit, again, without their being reproduced in order to accompany the catalogue. The display was awarded a silver medal and encouraged the Zonghi brothers to send the same material to the Exposition Universelle in Paris in 1900. The accompanying catalogue *Musée rétrospectif de la classe 88 Fabrication du papier (Matières premières,*

matériel, procédés et produits) à l'Exposition Universelle Internationale de 1900, à Paris. *Rapport de la Commission d'Installation*, s.n.t. (Saint Cloud, impr. Belin frères), p. 15, cites "Dix cartons remplis d'échantillons de papiers fabriqués à Fabriano (Italie), de 1267 à 1599", with a chronological break-down of the contents of the ten boxes and a description of some of the contents (pp. 16-17). Together with the originals, the display included a manuscript volume entitled "Segni delle antiche cartiere Fabrianesi", containing the tracings of some 20,000 watermarks (*an item that seems to have disappeared in the interim*), and the catalogues of 1881 and 1884 (*interestingly, the next entries but one are for two of Briquet's earliest pamphlets*). The Zonghi's writings on paper are rounded off with a third pamphlet, this time signed by Augusto, entitled *I segni della carta. La loro origine e la loro importanza*, Fabriano, Premiata Tipografia Economica, 1911 (*but, as Labarre points out, the voice is Aurelio's and it is plausible that he was the real author*).

For all its importance, the material assembled by the Zonghi brothers would have remained hardly visible, except for the fact that Émile Labarre set out to recover it by putting the three pamphlets together and publishing them as: *Zonghi's Watermarks: The Watermarks Collected by A. & A. Zonghi as Traced from the Original Papers by C. Canavari*, Hilversum, The Paper Publications Society, 1953, with the addition, for good measure of an essay by A.F. Gasparinetti (*be careful of the fact that there is a double issue, a larger one comprising both English and Italian, and a smaller one with only English*). Most importantly, Labarre had a copy made of the 134 tables by local artist and engraver, Carlo Canavari (1895-1981), which were also included, thus giving the repertory its fundamental value (*though how accurate the tracings are is quite another matter*). Labarre further recognised that the first listing of 300 items in 1881 had been absorbed into the bigger list of 1884, so that he indicated the fact with a double numbering of the 1,887 tracings reproduced in the tables (*for more information on these collections, see [31]*). Quite recently, the three pamphlets have been republished in a sumptuous volume with the title: *L'opera dei fratelli Zonghi. L'era del segno nella storia della carta*, a cura di Giancarlo Castagnari, Fabriano, Cartiere Miliani, 2003. Very oddly indeed, the Italian original is accompanied by a new rendering into English by Paola Farenzi, which is not up to the same standard as that published by Labarre, and also the 134 tables of watermarks are omitted, making the whole operation almost entirely worthless (*might it not have been simpler, better, and infinitely more sensible to reprint the 1953 volume?*).

Proper study of the Zonghi collection has been largely impeded, up to now, by the fact that the main collection has remained in the hands of Augusto's descendents and up to quite recently has not been available to scholars (*for the recent purchase of the same by the Fedrigoni foundation, see [31]*). It should be understood that rather than a balanced overview, as in Briquet, the lay-out of the Zonghi collection is dictated mostly by the nature of the leaves they were permitted to "remove" from various archives. In quite a few instances, the pairings of dates suggest that they inadvertently purloined twin watermarks, see, for instance, the dragon watermarks dated 1372 at nn. 1027-1028, 1390 at nn. 1033-1034, 1410 at nn. 1035-1036, and 1412 at nn. 1038-1039. Sadly, without discovering the source of the marks in the collection, it will be impossible to obtain a confirmation, one way or the other.

The Zonghis were followed in more recent times by papermill engineer, Andrea Federico Gasparinetti (1893-1964), who produced a large number of articles, which in their original form are not always easy to find, since he published in trade journals such as *The Paper Maker*, *Papiergeschichte*, and *L'industria della carta*. A biography and badly executed bibliography of Gasparinetti are to be found in Giancarlo Castagnari, *Carta cartiere cartai. La tematica storica di Andrea Gasparinetti*, Fabriano, Pia Università dei Cartai, 2006, which republishes the text of Gasparinetti's first article of 1938 in the *Risorgimento grafico*. A proper, comprehensive collection of Gasparinetti's articles would be a wonderful project. I only hope somebody will make it happen.

Otherwise, especially in the last twenty odd years, the problem with Fabriano has been too much rather than too little, since a great deal has appeared under or near the aegis of the splendid, and well worth visiting, Museo della Carta e della Filigrana, opened a little over twenty years ago in the city's former Dominican convent, in collaboration with the Pia Università dei Cartai (*or the papermakers guild*) and by the Miliani paper factory (*now owned by Fedrigoni*), which is the town's biggest employer. Two useful publications produced early on by the museum are the miscellany: *L'arte della carta a Fabriano*, Fabriano, Museo della carta e della filigrana, 1991, and Ulisse Mannucci, *La qualchiera medioevale fabrianese*, Fabriano, Museo della carta e della filigrana, 1992, which provides excellent photos of the reconstruction of a Medieval stamping mill in the museum.

Further publications about the history of papermaking and the papertrade in Fabriano almost invariably involve the figure of Giancarlo Castagnari; but the abundance has included much repetition and some carelessness, especially in the correction of the proofs. The first block of volumes he edited includes:

Contributi italiani alla diffusione della carta in Occidente fra XIV e XV secolo, cit., 1990; *Miscellanea di storia della carta: origini, tecniche, imprenditori, fede religiosa*, a cura di Giancarlo Castagnari, Fabriano, Pia Università dei Cartai, 1991; *Carta e cartiere nelle Marche e nell'Umbria dalle manifatture medioevali all'industrializzazione*, a cura di Giancarlo Castagnari, Ancona, Proposte e ricerche, 1993; *Produzione e uso delle carte filigranate in Europa (secoli XIII-XX)*, a cura di Giancarlo Castagnari, Fabriano, Pia Università dei Cartai, 1996. These volumes do contain a lot of information, much of it deriving from first-hand research, but they also suffer from a certain "sameness". Castagnari has also brought together a selection of eighteen of his various articles, published between 1982 and 2000, including several from the just-mentioned volumes, in *L'uomo, il foglio, il segno. Studi di storia della carta*, Fabriano, Pia Università dei Cartai, 2001. As ever, this is convenient, although, with an author tendentially repetitious, reading through is a rather tiresome process; more annoyingly, the volume includes a list of 29 of his 'Studi di storia della carta', without indicating which ones are present in the same. These are small issues, but they do help the reader! It's not over yet. After something of a pause, Castagnari reappears as the editor of a beautifully-printed substantial tome, containing parallel Italian and English versions, albeit spoiled by some maccheronic renderings of the Italian originals, entitled: *L'impiego delle tecniche e dell'opera dei cartai fabrianesi in Italia e in Europa. Atti delle giornate europee di studio = The Use of Techniques and Work by Papermakers from Fabriano in Italy and in Europe*. Congress Book of European Paper Days. Fabriano 16-17 giugno 2006, a cura di = editor Giancarlo Castagnari, Fabriano, Cartiere Miliani, 2007. It is followed by an interesting volume about women in the local paper industry: *Le "cartare" di Fabriano. Società, donne, lavoro nei tempi della città della carta*, a cura di Giancarlo Castagnari, Fabriano, Fondazione Gianfranco Fedrigoni-Istituto Europeo di Storia della Carta e delle Scienze Cartarie, 2013, including some splendid photographs, and a return to more normal business with: *Alle origini della carta occidentale: tecniche, produzioni, mercati (secoli XIII-XV)*. Atti del convegno, Camerino, 4 ottobre 2013, a cura di Giancarlo Castagnari, Emanuela Di Stefano, Livia Faggioni, cit., 2014. Finally, and fresh off the press, comes another imposing, sumptuously-printed tome: *La forma. Formisti e cartai nella storia della carta occidentale = The Mould. Paper- and Mould-makers in the History of Western Paper*, a cura di = editor Giancarlo Castagnari, Fabriano, Fondazione Gianfranco Fedrigoni- ISTOCARTA: Istituto Europeo di Storia della Carta e delle Scienze Cartarie, 2015. It contains valuable essays by Ezio Ornato, Peter Bower, Peter Tschudin, and other distinguished paper scholars, as well as photographic documentation of some of the Miliani's factory's collection of 2,300 moulds. All the texts are available both in Italian and English, albeit with some erratic translation. On the other hand, rather than this plethora of conference acts, the same energy and the same monies might have been more usefully dedicated to the publication of the records of the Medieval merchant, Lodovico d'Ambrogio and other early sources [21].

Further research on the spread of papermaking techniques from Medieval Fabriano elsewhere in Italy and in Europe can be found in Gabriele Metelli, *I cartai di Fabriano, Pioraco e Esanatoglia attivi a Foligno agli inizi dell'età moderna*, Fabriano, Cartiere Miliani, 2007, and in Emanuela Di Stefano, *Le carte di Fabriano e di Pioraco sui mercati europei. Leadership e dispersione fra XIV e XV secolo*, Fabriano, Cartiere Miliani, 2007.

Papermaking in Fabriano went through a period of decline in the Seventeenth century, due to competition from other centres and the economic crisis faced by the booktrade, which saw a sharp fall in printed output in the first half of the century, with a consequent drop in the request for paper. In the Eighteenth century the industrial set-up was transformed by Pietro Miliani (1744-1817), who reconquered lost markets and re-established the importance of Fabriano as a production centre, see the volume *Pietro Miliani fabbricante di carta*, a cura di Andrea F. Gasparinetti, Fabriano, Cartiere Miliani, 1963. His family successfully carried on the business, in particular his grandson Giuseppe Miliani (1816-90), see Emo Sparisci, *Giuseppe Miliani. Un cartaro antico e moderno*, Fabriano, Pia Università dei Cartai, 1998. The several entries, all by Castagnari, relating to the Miliani family in the *Dizionario biografico degli Italiani*, vol. 74 (2010), emphasise their political and economic activity, but are not without utility, see pp. 489-491 (Giambattista, 1856-1937), pp. 491-493 (Giuseppe, 1816-1890), and pp. 493-495 (Pietro, 1744-1817). On the Miliani family and on the broader context, see the collective volume *L'industria della carta nelle Marche e nell'Umbria. Imprenditori, lavoro, produzione, mercati: secoli XVIII-XX*, a cura di Giancarlo Castagnari, Fabriano, Pia Università dei Cartai, 2010, which provides information about the modern period, including collateral activities such as rag-collecting and the construction of industrial paper-making machinery.

An almost final word. Obtaining some these Fabriano titles can be a nuisance, since most of them are not distributed through normal bookselling networks. Inquiries relating to the publications of the Pia Università dei Cartai, should be sent c/o Chiesa di Santa Maria Maddalena, Viale Pietro Miliani 31/33, 60044 Fabriano; likewise the publications of the Cartiere Miliani can be obtained by addressing a request to the firm's Archivio Storico (email: archiviostorico@cartieremilianifabriano.com; tel. 0732 702502, fax 0732 702333). The city does however boast a truly excellent specialist bookshop, which traces its origin back to 1735, with an extensive collection of works about paper, so if all else fails try there: contact the Cartolibreria Lotti, Corso

Repubblica 52/58, 60044 Fabriano (Ancona).

Finally, and very new, a major English-language account of the history of the paper industry in Fabriano is Sylvia Rodgers Albro, *Fabriano. City of Medieval and Renaissance Papermaking*, Washington, Library of Congress; New Castle, Oak Knoll Books, 2016. Extensively illustrated, with an ample section on watermarks.

Fermignano. Papermaking was introduced here in 1407 or 1408, see Franco Mariani, 'La cartiera di Fermignano: carta e cartai', in *Castrum Firmignani, castello del ducato di Urbino*, a cura di Mario Luni, Urbino, Quattroventi, 1993, pp. 213-229.

Piedmont.

Vercelli. The activity of some mills around Vercelli from the Fifteenth century onwards are described in Timoty Leonardi, 'Carte filigranate in edizioni vercellesi del XVI secolo', *Bibliofilia subalpina*, 2005, pp. 57-96; Idem, 'Vicende della carta in Piemonte: imprenditorialità e rapporti sociali nella cartiera di Parella', *Bollettino storico vercellese*, vol. 67 (2006), pp. 39-57.

Sicily.

For the piece of paper dated 1109 at the Palermo State Archive, see [4]. Briquet included Sicily in his 1889-90 journey, giving rise to the article: 'Lettre à M. le chevalier I. Giorgi, préfet de la Bibliothèque Nationale de Palerme, sur les papiers usités en Sicile à l'occasion de deux manuscrits en papier dit de coton.', *Archivio storico siciliano*, n.s., vol. 17 (1892), pp. 52-65, republished with a manipulation of the title, i.e. 'Sur les papiers usités en Sicile à l'occasion de deux manuscrits en papier dit de coton. Lettre à M. le chevalier I. Giorgi, préfet de la Bibliothèque Nationale de Palerme', in *Briquet's Opuscula*, cit., 1955, pp. 228-234.

Tuscany.

The best documented and easily finest historical study available for any Italian district is Renzo Sabbatini, *Di bianco lin in candida prole. La manifattura della carta in età moderna e il caso toscano*, Milano, Franco Angeli, 1990. Based on an extensive trawl through the archives, it documents the economic and social history of the papermaking industry in Tuscany, concentrated at Colle Val d'Elsa, Pescia, and Villa Basilica (*in the hills above Lucca*) in the Eighteenth and Nineteenth centuries. Sabbatini's numerous other articles relating to the history of the paper industry in Tuscany, including the role of women in the same, are listed on his personal webpage at the University of Siena.

Colle Val d'Elsa. Briquet puts together a succinct, but handy summary, in the introduction for the entries 'Tête humaine'; otherwise, considering Colle's importance as a historical papermaking centre, studies are thin on the ground. The best starting point remains Francesco Dini, *Carta e cartiere a Colle*, Firenze 1982, which brings together and reprints a series of articles issued in local journals at the beginning of the Twentieth century. Watermarks in Colle paper employed in printing Florentine incunabula are reproduced by Roberto Ridolfi, *Le filigrane dei paleotipi: saggio metodologico*, Firenze, Tipografia Giuntina, 1957. Likewise a description of the paper in some incunabula printed at Colle appears in Curzio Bastianoni, 'Le filigrane dei paleotipi di Colle Val D'Elsa 1478-1480', in *Produzione e uso delle carte filigranate in Europa*, cit., 1996, pp. 133-148. A more recent study of a single mill is Renzo Ninci, *Il mulino "detto il Moro", già cartiera (secc. XIII-XX)*. *Appunti per una storia economica di Colle Val d'Elsa*, Colle di Val d'Elsa, C.G.I. Modernografica, 2001.

Lucca. Briquet's pioneering essay on the watermarks of Genoa (1888) inspired other initiatives, one of which is an album by Luigi Volpicella, at the time director of the State Archive in Lucca. His *Primo contributo alla conoscenza delle filigrane nelle carte antiche di Lucca*, Lucca, Tipo-Litografia Dessena, 1911, reproduces 333 watermarks from 1284 to 1500. Rather curiously, he does not seem to be aware of the publication of Briquet's *magnum opus* in 1907. Its significance, perhaps, is that it reproduces a pair of very early marks, dated 1284 and 1286 [19].

Pescia. Dominated by the Magnani dynasty, one exceptional text was produced by one of the last members of the family, see Carlo Magnani, *Ricordanze di un cartai*, Alpignano, edizioni Tallone, 1961, reprinted in 1979. This is a beautifully written, hauntingly evocative, cider-with-Rosie account of the papermaking universe seen through the eyes of a child at the beginning of the Twentieth century. Absolutely worth having, if you can manage the strongly vernacular Tuscan (*which has native Italians reaching for their dictionaries*). But there is a drawback. It is only available in an edition hand-printed by the Tallone family, on hand-made, watermarked paper from the Magnani mill, so it is delight to hold and to read, but somewhat, albeit not excessively, expensive. On the other hand, if you have a birthday coming up and a generous, wealthy, indulgent lover, seeking only to please you, here is something to ask for (*after the Ferrari, of course*).

Prato. In the mountain valley running northwards from Prato towards Bologna, the Granduchy of Tuscany

built a large mill, for which some documentation has survived, see the excellent and highly recommended study by Marco Piccardi, *La Cartiera de la Briglia e la manifattura della carta nel Granducato di Toscana (secoli XVII-XIX)*, Prato, Biblioteca Comunale Alessandro Lazzerini, 1994.

San Marcello Pistoiese. Established by the Cini family in 1807, it was the first Italian mill to install a Fourdrinier Machine, which started working in 1838, see Neri Farina Cini, *La famiglia Cini e la cartiera della Lima (1807-1943)*, Firenze, Le Monnier, 1947; Angelo Nesti, *La cartiera Cini de La Lima (PT). Uno studio archeoindustriale*, Firenze, Edizioni Polistampa, 2005. On the Cini dynasty, particularly useful summaries, which include political and other activities, are available in the entries by Nidia Danelon Vasoli in the *Dizionario biografico degli Italiani*, vol. 25 (1981), pp. 603-607 (Bartolomeo, 1809-77), 616-620 (Giovanni, 1778-1844), pp. 620-621 (Giovanni Cosimo, 1840-1930), pp. 623-626 (Tommaso, 1812-52).

Trentino. See Aldo Chemelli-Clemente Lunelli, *Filigrane trentine. La vicenda delle cartiere nel Trentino*, Trento, Assessorato alle Attività Culturali della Provincia Autonoma di Trento, [1979].

Umbria. The history of the industry was heavily influenced by the proximity to Fabriano in the nearby Marche. A useful survey of Nineteenth-century watermarks, related to archive sources, is Fabio Bettoni-Bruno Marinelli, 'Filigrane di cartiere umbre nell'Ottocento', in *Produzione e uso delle carte filigranate*, cit., 1996, pp. 221-254.

Foligno. Still useful is Michele Faloci Pulignani, 'Le antiche cartiere di Foligno', *La Bibliofilia*, vol. 11 (1909-10), pp. 102-127. For more recent work, see Gabriele Metelli, 'Carta e cartiere folignati tra Cinquecento e Settecento', in *Carta e cartiere nelle Marche e nell'Umbria*, cit., 1993, pp. 209-242; Idem, 'La filigrana a Foligno in età moderna', in *Produzione e uso delle carte filigranate*, cit., 1996, pp. 189-220.

Veneto. Though Venice as – during the Renaissance – Europe's foremost printing centre obtained the bulk of its paper supply from Lake Garda, the base of the mountains running along the Northern edge of the Po valley furnished ideal conditions for paper-making and numerous small establishments flourished, without however reaching the concentration or the importance of Fabriano or Toscolano. Most of them disappeared with the demise of papermaking at the vat and their existence has been largely forgotten. See in general terms: Antonio Fedrigoni, *L'industria veneta della carta dalla II dominazione austriaca all'Unità d'Italia (1814-1866)*, Torino, ILTE, 1966; Ivo Mattozzi, *Produzione della carta nello stato veneziano settecentesco. Lineamenti e problemi*, Bologna, s.n., 1975; Idem, 'Le filigrane e la questione della qualità della carta nella Repubblica Veneta della fine del '700. Con un catalogo di marchi di filigrane dal 1767 al 1797', in *Produzione e uso delle carte filigranate*, cit., 1996, pp. 309-339; Idem, *Prodotti, tecniche, uomini di Fabriano negli stati dell'area veneta nel '300 e '400*, Fabriano, Cartiere Miliani, 2007.

Bassano. The important publishing firm of the Remondini family assured its paper supply by purchasing or renting two papermills at Oliero, some ten kilometres away, see the chapter 'Le cartiere e le carte', in the excellent book by Mario Infelise, *I Remondini di Bassano. Stampa e industria nel Veneto del Settecento*, Seconda edizione, Bassano, Ghedina & Tassotti, 1990, pp. 65-76.

Vittorio Veneto. See Ivo Mattozzi, 'Un processo di accumulazione di capitale manifatturiero: le cartiere di Ceneda nel primo '600', *Studi trevisani*, vol. 7 (1988), pp. 105-129; Eugenio Tranchini, *Le cartiere vittoriesi tra il XVII e il XIX secolo. Appunti di storia economico-sociale*, Vittorio Veneto, La Vittoriese, 1991.

[f] Netherlands. Albeit in Dutch, the starting point is Henk Voorn, *De Gescheidenis der Nederlandse Papierindustrie. I: De Papiermolens in de Provincie Noord-Holland*, Haarlem, De Papierwereld, 1960, II: *De Papiermolens in de provincie Zuid-Holland, alsmede in Zeeland, Utrecht, Noord-Brabant, Groningen, Friesland, Drenthe*, Wormerveer, Nederlandse Papierindustrie, 1973; and III. *De Papiermolens in de Provincie Gelderland, alsmede in Overijssel en Limburg*, Harlem, Vereniging van Nederlandse Papier, 1985. An update, covering Belgium as well, with bibliography, is Inge Van Wegens, 'Paper Consumption and the Foundation of the First Paper Mills in the Low Countries, 13th-15th Century. A Status Quaestionis', in *Papier im mittelalterlichen Europa*, cit., 2015, pp. 71-91. Seventeenth-century watermarks are surveyed by Theo Laurentius-Frans Laurentius, *Watermarks (1600-1650) found in the Zeeland Archives*, 't Goy-Houtent, Des & De Graaf Publishers, 2007, and by the same authors: *Watermarks (1650-1700) found in the Zeeland Archives*, 't Goy-Houtent, Des & De Graaf Publishers, 2008.

[g] Russia. The inevitable departure point, at least for Western scholars, is the material assembled by Nicolay Petrovich Likhachyov (1862-1936), alternatively transliterated as Likhachev, aristocrat, collector, and scholar under the Tsars, who went unscathed through the first phases of the USSR, before being disgraced and exiled in 1930. As a palaeographer he put together an impressive manuscript collection of four thousand watermark tracings, published in Russian in 1899, and reissued in the West in 1994, see *Likhachev's*

Watermarks: an English-language version, edited by J.S.G. Simmons and Bé van Ginneken-van de Kastele, Amsterdam, The Paper Publications Society, 1994, 2 vols., including an introductory biography by Simmons, 'Nikolai Petrovich Likhachev (1862-1936), Scholar and Pioneer Russian Codicologist and Student of Watermarks', pp. xli-li. Labarre and Simmons also recovered and republished in facsimile, with an accompanying English translation, the older repertory, containing 1,824 tracings, by Kornilii Yakovlevich Tromonin, see *Tromonin's Watermark Album. A Facsimile of the 1844 Moscow Edition*, Hilversum, The Paper Publications Society, 1965. In most cases the watermarks are of European origin since, up to the Twentieth century, little paper was made in Russia itself.

[h] **Scandinavia**. A little goes a long way, see Henk Voorn, *The Paper Mills of Denmark & Norway and their Watermarks*, Hilversum, The Paper Publications Society, 1959, and the subsequent H.M. (Haakon Mathias) Fiskaa-O.K. Nordstrand, *Paper and Watermarks in Norway and Denmark*, Amsterdam, Paper Publications Society, 1978. Focused instead on the matter of paper imported from outside Scandinavia, with lots of tracings of watermarks, is Nils J. Lindberg, *Paper comes to the North. Sources and Trade Routes of Paper in the Baltic Sea Region 1350-1700. A Study based on Watermark Research*, Marburg/Lahn, IPH, 1994.

[i] **Spain**. The history of Spanish scholarship on papermaking is dominated by the figure of Oriol Valls i Subirà (1915-91), whose best known title is the bilingual two-volume work: *El papel y sus filigranas en Catalunya = Paper and Watermarks in Catalonia*, Amsterdam, The Paper Publications Society, 1970. He followed this with a more general three-volume history of paper in Spain, see *La historia del papel en España*, Madrid, Empresa Nacional de Celulosas, 1978-82, also issued in English with the title *The History of Paper in Spain*. His sweeping claims about the priority of the Medieval Spanish industry have been effectively countered by Robert I. Burns, S.J., see [4] above. On the further development of the industry, see J.C. (José Carlos) Balmaceda, *La contribución genovesa al desarrollo de la manufactura papelera española*, Málaga, J.C. Balmaceda, 2004.

The study of watermarks in Spanish documents is complicated by the presence of Italian and French imports. One survey along Briquet parameters, in eight imposing volumes, is José Luis Basanta Campos, *Marcas de agua en documentos de los Archivos de Galicia hasta 1600*, La Coruna, Fundación Pedro Barrié de la Maza, 1996-2002. See also the meaningfully titled: Maria Carmen Hidalgo Brinquis, 'Spanish Watermarks of the 14th and 15th Centuries: The Great Unknown', in *Le papier au Moyen Âge*, cit., 1999, pp. 203-213.

The Spanish version of the Bernstein exhibition *Cabeza de buey y sirena* (2011), see [35], provides a useful overview of the state of play in the Iberian peninsula.

[k] **Switzerland**. Switzerland of course means Briquet, like chocolate and watches, beginning with: 'Notices historiques sur les plus anciennes papeteries suisses', published in 18 instalments in *L'Union de la papeterie*, republished in *Briquet's Opuscula*, cit., 1955, pp., 70-111, as well as the information dispersed through the *magnum opus* of 1907.

Basel. Work on the history of paper has led to a remarkable success story in the creation of the Basel Papiermuseum. On the ancient history of the city's papermills, see Walter Friedrich Tschudin, *The Ancient Paper-mills of Basle and their Marks*, Hilversum, The Paper Publications Society, 1958, and more recently Peter F. Tschudin, *Schweizer Papiergeschichte*, herausgegeben zum Jubiläum der Schweizerischen Eidgenossenschaft 1291-1991 von den Schweizer Papierhistorikern, Basel, Basler Papiermühle, 1991. Further information on Basel paper production in the Fifteenth century is available in Stevenson's book on the *Missale Speciale* and in Hans Kälin, *Papier in Basel bis 1500*, Basel, Selbstverlag, 1974.

Berne. A fundamental work, also in terms of method, since it is the first repertory to trace systematically twin watermarks, is Johann Lindt, *The Paper-Mills of Berne and their Watermarks, 1465-1859*, with the German Original, Hilversum, The Paper Publications Society, 1964. The text is bilingual, English and German.

Fribourg or Freiburg im Üechtland. A remarkable study is Theo Gerardy, *Das Papier der Seckelmeisterrechnungen von Freiburg i. Ue. 1402-1465*, Schinznach-Bad, Schweizer Papierhistoriker, 1980, which carefully delineates the paper supplies in the city's account books from 1402 to 1456 (*not the 1465 of the title*). In particular, it identifies 102 pairs of twin watermarks and eight singletons, carefully related to Briquet, Piccard, and other repertories.

[l] **Syria**. Albeit kept in Germany. A well written piece, undated and available only on the net, is the description of the watermarks – mostly exported Italian and French paper – in the manuscripts of the Refaiya library, originally in Damascus, purchased for the University Library in Leipzig in the Nineteenth century. See Beate Wiesmüller, 'The Watermarks from the Refaiya Library', pdf. on the uni-leipzig site (*just google*).

[m] **United Kingdom.** Paper arrived late in England and for a long time quality paper was imported from elsewhere, from Italy, and subsequently from France and Holland.

A pioneering and still interesting attempt to document the papers used in England was conducted by historian and erudite, Sir John Fenn, in his edition of the famous Paston letters, documenting the life of an English family in the late Middle ages. As well as imitations of signatures, texts, and seals, the copperplate illustrations include examples of the watermarks, see *Original letters, Written during the Reigns of Henry VI, Edward IV, Edward V, Richard III, and Henry VII, by Various Persons of Rank and Consequence, Containing Many Curious Anecdotes ... Digested in Chronological Order, with Notes, Historical and Explanatory, and Authenticated by Engravings of Autographs, Fac-similes, Paper Marks, and Seals*, London, printed for G.G.J. and J. Robinson, 1787-89, in four volumes, with a fifth published by John Murray added in 1823. On the history of the Paston Letters, see David Stoker, "Innumerable Letters of Good Consequence in History". The Discovery and First Publication of the Paston Letters', *The Library*, s. VI, vol. 17 (1995), pp. 107-155. After many vicissitudes, the bulk of the collection is now at the British Library and a modern revisitation of the watermarks in the paper would be a fascinating project.

An outstanding analysis of the paper supplies imported from abroad and used in Fifteenth-century English printing is provided by Paul Needham, 'The Paper of English Incunabula', in the *Catalogue of Books printed in the XVth-century now in the British Library. XI. England*, 't Goy-Houten, Hes & De Graaf, 2007, pp. 311-334. In a more general fashion, still useful, if somewhat antiquated, are the three articles by geographer, Edward Heawood, who also authored one of the better-known watermark repertories, see: 'Sources of Early English Paper Supply', *The Library*, s. IV, vol. 10 (1929-30), pp. 282-307, 427-454; 'Papers used in England after 1600', *The Library*, s. IV, vol. 11 (1930-31), pp. 263-299, 466-498; and 'Further Notes on Paper used in England after 1600', *The Library*, s. V, vol. 2 (1947-48), pp. 119-149.

The home-grown industry established itself gradually, and over time produced some of the most significant innovations in papermaking history, such as the introduction of the wove mould [15] and the development of the Fourdrinier machine, invented in France, but made a genuine reality in Britain [16]. This supremacy, especially of the Whatman firm, meant that by the end of the Eighteenth-century English paper was not only exported, but also widely counterfeited on the Continent. For an overall survey, see Richard L. Hills, *Papermaking in Britain. A Short History*, London, Athlone Press, 1988, as well as the more dated D.C. Coleman, *The British Paper Industry, 1495-1860. A Study in Industrial Growth*, Oxford, at the Clarendon Press, 1958. The history of the same is expertly discussed also in the two collections of conference acts published by the British Association of Paper Historians, see *Oxford Papers. Studies in British Paper History*. I. Proceedings of the British Association of Paper Historians Fourth Annual Conference, held at St. Edmund Hall, Oxford, 17-19 September 1993, edited by Peter Bower, London, 1996, and *The Exeter Papers. Studies in British Paper History*. II. Proceedings of the British Association of Paper Historians Fifth Annual Conference, held at Hope Hall, University of Exeter, Exeter, 23-26 September 1994, Oxford, 2000. An earlier study, focusing on England, is Alfred H. Shorter, *Paper Mills and Paper Makers in England 1495-1800*, Hilversum, The Paper Publications Society, 1957, while the myriad of short articles by the same author are brought together in his *Studies on the History of Papermaking in Britain*, edited by Richard L. Hills, Aldershot, Variorum, 1993. Scotland, as ever, receives separate treatment in Alistair G. Thomson, *The Paper Industry in Scotland, 1590-1861*, Edinburgh, Scottish Academic Press, 1974, while Wales is treated in A.E. Davies, 'Paper-Mills and Paper-Makers in Wales 1700-1900', *National Library of Wales Journal*, vol. 15 (1967), 30 p. (available on line).

Information about the subsequent British paper industry can be gleaned from the pages of Harry Dagnall, *The Taxation of Paper in Great Britain 1643-1861. A History and Documentation*, published by the Author (30, Turner Road, Queensbury, Edgware, Middlesex HA8 6AY, UK), in collaboration with The British Association of Paper Historians, 1998, distributed by The British Association of Paper Historians (see website). By the same author, in synthesis, see: 'The Taxes on Knowledge: Excise Duty on Paper', *The Library*, s. VI, vol. 20 (1998), pp. 347-366.

In-depth studies of specific mills are less common. One example, interesting due to the link with Oxford University Press, is Harry Carter, *Wolvercote Mill. A Study in Paper Making at Oxford*, Oxford, for the Society at the University Press, 1957.

Cambridgeshire.

Interesting documentation about the figure of the German papermaker, Remigius Guidon, is provided by Benjamin Pohl-Leah Tether, 'Remigius Guidon, Cambridge's Old Paper Mill and the Beginnings of Cambridge University Press, c. 1550-1559', *Transactions of the Cambridge Bibliographical Society*, vol. 15 (2013), pp. 177-227.

Kent.

Maidstone. For the history of the Whatman Turkey mill, see [15] below.

Lincolnshire.

A deserving portrait of an industry that disappeared is Hugh Nott, *Papermaking in Lincolnshire 1600-1900*, Lincoln, Society for Lincolnshire History and Archaeology, 2008, with an update by Daven Chamberlain, 'Updated Notes on 'Papermaking in Lincolnshire 1600-1900'', *The Quarterly*, n. 81, January 2012.

[n] **United States, Mexico, and South America.** For the history of watermarks in the United States, see the titles by Thomas Gravell cited below [23]. A comprehensive study of early American papermaking is now available in John Bidwell, *American Paper Mills, 1690-1832. A Directory of the Paper Trade, with Notes on Products, Watermarks, Distribution Methods, and Manufacturing Techniques*, Worcester, Massachusetts, 2013, which also provides an ample bibliography.

Bark paper made by the indigenous peoples of South America is described in Victor Wolfgang von Hagen, *The Aztec and Maya Papermakers*, New York, J.J. Augustin, 1944, reprinted Mineola, Dover Publications, 1999. Extremely interesting, since it also includes samples of handmade paper, is Hans Lenz, *El papel indigena mexicano. Historia y supervivencia*, Mexico, Editorial cultura, 1950, trans. English as *Mexican Indian Paper. Its History and Survival*, Mexico, Editorial libros de Mexico, 1961.

[7]

Sheet-sizes and the Text of the Bologna Stone

The original manuscript of the statute of Bologna of 1389 is held at the State Archive of Bologna, Comune governo, Statuti del Comune, vol. 14, with the passage concerned at f. 368v. The text is excerpted in Andrea F. Gasparinetti, 'Documenti inediti sulla fabbricazione della carta in Emilia', *Rivista Industria della carta* (1963), pp. 5-39 (*misleadingly he speaks of a "lastra di marmo dell'anno 1389", whereas, as we point out above, the material is limestone and is not dated*). The obscurity both of the original document and of his article has led to some misciting, in which the date of the statutes is given as "1308", see Tschudin's *Grundzüge der Papiergeschichte*, cit., 2002, pp. 95, 100, or "1398", see, for instance, the pamphlet by Arthur D. Dunn, *Notes on the Standardization of Paper Sizes*, Ottawa 1972. In the subsequent statutes of 1454 the two smaller sizes are designated "meçana" and "minuta", see Carmen C. Bambach, 'The Purchases of Cartoon Paper for Leonardo's "Battle of Anghiari" and Michelangelo's "Battle of Cascina"', *I Tatti Studies in the Italian Renaissance*, vol. 8 (1999), pp. 105-133: 112.

The differing measurements for the stone, based on indications provided by Luigi Balsamo and Jan Tschihold, are summarized with intelligence and a welcome touch of irony by J. Peter Gumbert, 'Sizes and Formats', in *Ancient and Medieval Book Materials and Techniques*, cit., 1993, I, pp. 227-263: 240. Detailed measurements are also provided in Bambach, 'The Purchases of Cartoon Paper for Leonardo's "Battle of Anghiari" and Michelangelo's "Battle of Cascina"', cit., 1999, who also reproduces the original (Fig. 6). A good photograph, which clearly shows the texture of the limestone, appears in Conor Fahy, 'La carta nelle edizioni aldine del 1527 e del 1528', *La Bibliofilia*, vol. 103 (2001), pp. 263-289: 270. The Medieval Italian practice of placing stones with official measures on public buildings is briefly described in Evelyn Welch, *Shopping in the Renaissance. Consumer Cultures in Italy, 1400-1600*, New Haven and London, Yale University Press, pp. 79-81, with a reproduction of the tiles from Assisi.

The fact that Medieval paper did not contain cotton fibres was established with exemplary clarity by Charles-Moïse Briquet, 'La légende paléographique du papier de coton', first published in the *Journal de Genève*, 29 October 1884, but also circulated widely at the time as an offprint: Genève, Imprimerie Charles Schuchardt, 1884. The text was reprinted in *Briquet's Opuscula*, cit., 1955, pp. 112-115. He returned to the subject in 'Recherches sur les premiers papiers employés en Occident et en Orient du X^e au XIV^e siècle', *Mémoires de la Société Nationale des Antiquaires de France*, vol. 46 (1886), issued also as a offprint: Paris 1886, reprinted in *Briquet's Opuscula*, cit., 1955, pp. 129-158. Parallel German research, scientifically more solidly-founded, by botanist Julius von Wiesner (1838-1916), is described in his 'Die mikroskopische Untersuchung des Papiers mit besonderer Berücksichtigung der ältesten orientalischen und europäischen Papiere', *Mitteilungen aus der Sammlung der Papyrus Erzherzog Rainer*, vols. 2-3 (Vienna 1887), issued also as a separate offprint: Wien, Verlag d. K. K. Hof- u. Staatsdruckerei, 1887. For a more recent analysis, see Thomas Collings-Derek Milner, 'The Nature and Identification of Cotton Paper-making Fibres in Paper', *The Paper Conservator*, vol. 8 (1984), pp. 59-71.

One early, but still useful, discussion of “bombicina” and analogous terms in early papermaking is Edward Maunde Thompson, *An Introduction to Greek and Latin Palaeography*, Cambridge, Cambridge University Press, 1912, pp. 35-36. More recent information, especially relating to Medieval Italian documents, is found in Kirsten Schröter, *Die Terminologie der italienischen Buchdrucker im 15. und 16. Jahrhundert*, cit., 1998, pp. 29-33, as well as in the online *Lessico etimologico italiano*, see entry *Bambyce/Bambycius*, while the inventories of the Estense Library in Ferrara (*not considered by Schröter*), which contain numerous references to “carta bombicina” or “charta di bambaso”, are published in Giulio Bertoni, *La biblioteca estense e la coltura ferrarese ai tempi di duca Ercole I (1471-1505)*, Torino, Ermanno Loescher, 1903, appendice I [Borso d’Este, 1467, pp. 211-225], appendice II [Eleonora d’Aragona, 1493, pp. 227-233]. The association of the word with the Syrian city of Manbij, known to the Byzantines as Bambyce, and consequent linguistic confusion, was suggested by Karabacek, ‘Das arabische Papier’, cit., 1887, p. 129, and is repeated by other scholars, including Bloom, *Paper before Print*, cit., 2001, p. 57; but the hypothesis is challenged by Tschudin, *Grundzüge der Papiergeschichte*, cit., 2002, p. 89. By the by, though no fibres have been found in the relatively small number of samples of Medieval paper so far analysed, Italy did have a cotton-growing industry at an early stage, see Maureen Fennell Mazzaoui, *The Italian Cotton Industry in the Later Middle Ages*, Cambridge, Cambridge University Press, 1981.

The probable meaning of the term *reçute* on the Bologna stone is suggested by Andrea F. Gasparinetti, ‘Ein altes Statut von Bologna über die Herstellung und Handel von Papier’, *Papiergeschichte*, vol. 6 (1956), pp. 45-47. See also his subsequent article: ‘Eine Bestellung von Wasserzeichenpapier in alter Zeit’, *Papiergeschichte*, vol. 8 (1958), pp. 40-43. References to “Riciute reali di Fabriano”, “Charte riciute di Pioracho”, “Charte riciute tonde di Fabriano”, etc. appear in a list of products on sale in Avignon communicated in a letter of 6 April 1384 in the archive of the Medieval merchant, Francesco Datini, at Prato, see Emanuela di Stefano, ‘Proiezione europea e mediterranea della carta di Camerino-Pioraco e di Fabriano all’apogeo dello sviluppo medievale (secoli XIV-XV)’, in *Alle origini della carta occidentale*, cit., 2014, pp. 35-62: 45. A letter sent by two Florentine merchants to Fabriano on 13 May 1389 (*it took 14 days to get there!*), in order to request bales of “charte riciute”, “charte grandi”, and “charte tonde”, is discussed by A.F. Gasparinetti, ‘Eine Bestellung von Wasserzeichenpapier in alter Zeit’, *Papiergeschichte*, vol. 6 (1956), pp. 40-43. Four sheet-sizes, specifically “fogli reali”, “meçani”, “comuni”, and “picholi” are listed in the inventory of the stationer and bookseller, Gherardo di Giovanni, in Florence in 1478, see Giuseppe Sergio Martini, ‘La bottega di un cartolaio fiorentino della seconda metà del Quattrocento: nuovi contributi biografici intorno a Gherardo e Monte di Giovanni’, special number of *La Bibliofilia*, Firenze, Olschki, 1956 (*also issued as a separate book, but if your library has the journal, it should have this number*).

A still pertinent article applied to sheet sizes in English Renaissance and invaluable starting point for further reading is Graham Pollard, ‘Notes on the Size of the Sheet’, *The Library*, s. IV, vol. 22 (1941), pp. 105-137. The great Allan Stevenson was also aware that new sizes with different proportions were introduced into the paper system by the beginning of the Sixteenth century, though he does not appear to have expressed this intuition in writing, see however Gaskell, *A New Introduction to Bibliography*, cit., 1972, p. 67.

Paul Needham’s several articles on sheet sizes and formats in the Fifteenth-century and early Sixteenth-century printed book are obligatory reading for anyone trying to get their head round the subject. At the same time, they represent an evolution of his thought over more than a decade and so manifest a growing awareness of the complexity of the problem. The best thing is to read them all together. The importance of correctly identifying sheet-size in the cataloguing of incunabula is expounded with exemplary clarity in: ‘ISTC as a Tool for Analytical Bibliography’, in *Bibliography and the Study of 15th-century Civilization*. Papers presented at a Colloquium at the British Library, 26-28 September 1984, edited by Lotte Hellinga and John Goldfinch, London, The British Library, 1987, pp. 39-54. In this, as yet, early contribution Needham makes reference in his examples only to the four sizes present on the Bologna stone. Following on from this first ground-breaking article, Needham published: ‘Res Papirea: Sizes and Formats of the Late Medieval Book’, in *Rationalisierung der Buchherstellung im Mittelalter und in der frühen Neuzeit*. Eines buchgeschichtlichen Seminars der Herzog August Bibliothek (Wolfenbüttel 12.-14. November 1990), herausgegeben von Peter Rück, Marburg an der Lahn, Institut für historische Hilfswissenschaften, 1994, pp. 123-145, and followed it with ‘Concepts of Paper Study’, in *Puzzles in Paper*, cit., 2000, pp. 1-36. Needham has the sometimes frustrating habit (*at least for his admirers*) of publishing important articles in out-of-the-way places, some of them so out of the way that they are difficult to find even in today’s obsessively global village. This is especially true for the important and fascinating essay, in which he shows Aldus ordering and obtaining sheets of paper – defined as a sort of “narrow Median” – which depart from the norm of the invariant rectangle and instead employ a ratio of 1 : 1.25, so that, on folding, folio and octavo formats become a ratio of 1 : 1.6, see ‘Aldus Manutius’ Paper Stocks: The Evidence of Two Uncut Books’, *Princeton Library Chronicle*, vol. 55 (1994), pp. 287-307, issued also with the title: *The Same Purposeful Instinct: Essays in*

Honour of William H. Scheide, edited by William P. Stoneman, Princeton, Princeton University Library, 1994, pp. 135-155.

In his most recent article, 'Format and Paper Size in Fifteenth-century Printing', in *Materielle Aspekte in der Inkunabelforschung*, herausgegeben von Christoph Reske und Wolfgang Schmitz, Wiesbaden, Harrassowitz, 2017, pp. 59-107, Needham has coagulated his various thoughts about incunabula sheet-sizes and formats in a single item that is absolutely indispensable reading for anyone interested in paper studies. In it he defines in particular the five additional sizes that entered the paper market by the end of the Fifteenth century and are recognisable in the incunabula editions of the age. The one weakness that should be noted about the article is that the measures Needham discusses for the rectangles on the Bologna stone are those available in Briquet, not the more accurate measurements, especially of the inner frame, supplied in more recent scholarship.

As a result of Needham's 1987 article, the *Incunabula Short Title Catalogue* (ISTC) did commit itself to including sheet-sizes in its descriptions, but quite naturally such things are easier said than done and at the time of writing the map is very incomplete. As matters stand, the only incunabula for which the sheet-sizes are regularly identified are those in Hebrew, for which the information derives from excellent descriptions in BMC XIII *Hebraica* by Adrian K. Offenberg, see therein the summary at pp. XIX-XXI. A discussion about establishing Fifteenth-century sheet-sizes, in order to introduce them into the ISTC, is in course as part of the ERC-financed 15cBooktrade project hosted by the Faculty of Medieval and Modern Languages of the University of Oxford. The project also includes an edition of the *Zornale* of the bookseller, Francesco de Madiis, wherein, in order to understand the bookpricing system in Renaissance Venice, sheet-sizes will be determined for the editions identified as sold through this shop in the Rialto district, see Cristina Dondi-Neil Harris, 'Exporting Books from Milan to Venice in the 15th century: Evidence from the *Zornale* of Francesco de Madiis', *La Bibliofilia*, vol. 116 (2014) [containing the acts of the conference: *Incunabula. Printing, Trading, Collecting, Cataloguing*. Milano, 10-12 settembre 2013, a cura di Alessandro Ledda], pp. 121-148.

A good introduction, written in a friendly and easily comprehensible fashion, to the process that led to the introduction of the DIN and ISO standards is Robin Kinross, *A4 and Before. Towards a Long History of Paper Sizes*, Wassenaar, Netherlands Institute for Advanced Study, 2009 (*available online, also in a Dutch translation*), while an engaging history of the square-root of two in the history of civilisation, including a mention of its role in paper, has been written by French mathematician Benoît Rittaud, *Le fabuleux destin de $\sqrt{2}$* , Paris, Éditions Le Pommier, 2006. See also the website curated by Markus Kuhn, *International Standard Paper Sizes*, hosted on a Cambridge University website.

[8]

Tables of Sheet-sizes

While at the end of the Fourteenth century the Bologna stone displays only four sheet-sizes, as time goes by, especially after the advent of printing, the varieties and the nomenclatures multiply exponentially.

An important and much cited document, taken from Bodleian manuscript Rawlinson D. 398, f. 156, is published by R.W. Chapman, 'An Inventory of Paper, 1674', *The Library*, s. IV, vol. 7 (1926-27), pp. 402-408. He describes it as "a report, rendered to Bishop Fell in 1674, of a number of lots of paper, offered, it should seem, by the two merchants whose names are given" (p. 402). In fact, the document is not dated and more likely belongs to c. 1671-73; the handwriting is that of Fell's principal collaborator, Thomas Yate, who presumably viewed the stocks of paper in London; and John Fell was consecrated Bishop of Oxford only in 1676. The 67 paper stocks in the original undated document, which more likely belongs to c. 1671-73, have been tabulated in a graph by John Lane, see Chapter 4. The paper supply to Oxford University Press, including the document published by Chapman, is analysed in detail by Martyn Ould, *Printing at the University Press, 1660-1780. Volume 1. Resources: Premises, People, & Paper*, Seaton, the Old School Press, 2015, pp. 76-142 (*this impressive work is issued in both an ordinary and a de-luxe version: the latter comes with a further pamphlet entitled Correspondence on Paper, publishing the text of several letters from London paper dealers to Thomas Yate*).

For Great Britain, in terms of original sources, rather curiously, the best lists of sheet-sizes with attached names are furnished by official legislation. In England the Customs and Excise Act of 1711 (10 Anne c. 19), sections 32 and 38, established different rates of duty payable on imported paper and home-made paper, necessarily calibrated to the different sheet-sizes. The said legislation was summarized by a number of pamphlets printed for the use of the officers in Excise service, in particular the *Instructions to be Observed by the Officers Employ'd in the Duties on Paper*, London, s.n., 1713 (ESTC T505495), reprinted in 1720

(ESTC N505412), 1729 (ESTC N47492) and in 1744 (ESTC T179774). Tables of paper sizes also appear in more general helpmeets for Excise officials, such as *The Royal Gauger, or, Gauging made Easy, as it is actually practiced by the Officers of His Majesty's Revenue of Excise*, by Charles Leadbetter, first published in 1739, with numerous successive editions, see Rupert C. Jarvis, 'The Paper-makers and the Excise in the Eighteenth Century', *The Library*, s. V, vol. 14 (1959), pp. 100–116; Dagnall *The Taxation of Paper in Great Britain 1643-1861*, cit., 1998, p. 17. Later British legislation also crops up in the volume *Anno Regni Georgii III. Regis Magnae Britanniae, Franciae, & Hiberniae, vicesimo primo. At the Parliament begun and holden at Westminster, the thirty-first day of October, anno Domini 1780, being the First Session of the Fifteenth Parliament of Great Britain*, London, printed by Charles Eyre and William Strahan, 1781, in folio, containing a total of 1907, [21] p. (ESTC N58103). The act on paper (21 Geo. III. c. 24), with the title *An Act for Repealing the Present Duties upon Paper, Pasteboards, Millboards, and Scale-boards, made in Great Britain, and for Granting Other Duties in Lieu Thereof*, taking up pp. 975-1010, was issued as a separate offprint (ESTC N58103). Further useful contemporary texts, produced as helpmeets for excise purposes, are the short pamphlets by John Paine junior, *The Paper-Maker's and Stationer's Assistant, being a Correct List of All the Different Papers, Their Tables, Rates, and Sizes, with the New and Additional Duties*, London, sold by H.D. Symonds, 1784 (ESTC T93515), and by Richard Johnson, *New Duty on Paper. The Paper-maker and Stationers Assistant, Containing I. The Average Weight of Paper. II. The Quantity of Reams in a Day's Work. III. The Dimensions. IV. The Old Duty. V. The Advance Duty. VI. The Whole Duty as Altered by the Late Act of Parliament*, London, sold by Debrett, Piccadilly; Johnson, St. Paul's Churchyard; and Bladon and Symonds, Pater-noster Row, 1794 (ESTC N120896). The consequent lists of sheet-sizes in all these sources are usefully summarized and discussed in Dagnall, *The Taxation of Paper in Great Britain 1643-1861*, cit., 1998.

As regards France, Briquet, *Les filigranes*, cit., 1907, vol. I, pp. 5-6, includes a listing of the *Tarifs des Formats et Poids des Papiers, fin, moyen, bulle, variant ou gros bon, fixés par arrest du Conseil d'Etat du 18 Septembre 1741*, which go from Grand-aigle (670×988 mm) down to Petit-Jésus (257×358 mm). The full original text of the same, which includes the previous *Arrest du Conseil d'Etat ... du 27 Janvier 1739*, is published in Lalande, *L'Art de faire le papier*, cit., 1761, pp. 89-102, obviously with the original non-metric measurements.

Another potential source for information about paper types and sizes, albeit not necessarily including the measurements, are the stock-books and inventories of printers. Those of the Eighteenth-century London printers, William Bowyer and William Strahan, now respectively in the Bodleian and in the British Library, are described in Herbert Davis, 'Bowyer's Paper Stock Ledger', *The Library*, s. V, vol. 6 (1951), pp. 73-87, and in Patricia Hernlund, 'William Strahan's Ledgers, II: Charges for Papers, 1738–1785', *Studies in Bibliography*, vol. 22 (1969), pp. 179-195. In the same fashion, the archive of the Société Typographique de Neuchâtel, covering the period 1769-89, now in the city library, includes a stock-book for paper and correspondence with paper suppliers, see Jacques Rychner, 'Running a Printing House in Eighteenth-century Switzerland. The Workshop of the Société Typographique de Neuchâtel', *The Library*, s. VI, vol. 1 (1979), pp. 1-24. Likewise, the 1811 inventory of the printing shop of Nicolò Bettoni in Padua provides a long list of the different sorts of paper size in stock, given in reams, and the value per ream calculated in Italian *lire*. The prices go from a maximum of 70 *lire* for "Imperial fioretto uso Olanda" and 60 *lire* for "Imperial fina Galvani" down to a minimum of 4.25 *lire* for "Corsiva quadra" and 4.60 *lire* for "Scriver senza cola", see Marco Callegari, *Stampatori e librai a Padova nella prima metà dell'Ottocento*, Saonara (Padua), Il Prato, 2013, pp. 40-41. The sheet-sizes recorded in the business activity of an American papermaking firm from about 1790 to 1830 are analysed and described by John Bidwell, 'The Size of the Sheet in America: Paper-moulds Manufactured by N. & D. Sellers of Philadelphia', *Proceedings of the American Antiquarian Society*, vol. 87 (1978), pp. 299-342.

Another potential source for sheet-sizes are printers' manuals, for instance Émile Leclerc, *Nouveau manuel complet de typographie*, Paris, L. Mulo, libraire-éditeur, 1897, p. 286, lists 18 sizes from "Pot (papier écolier) 31×40" to "Grand-monde 90×120".

As for the critical discussion, a round up is provided by E.J. Labarre, 'The Sizes of Paper: their Names, Origin and History', in *Buch und Papier. Buchkundliche und papiergeschichtliche Arbeiten: Hans H. Bockwitz zum 65. Geburtstag dargebracht*, Herausgeber Horst Kunze, Leipzig, Harrassowitz, 1949, pp. 35–54. A summary is also available in Gaskell, *A New Introduction to Bibliography*, cit., 1972, pp. 72-75, where the table of paper sizes and watermarks at pp. 72-75 brings together Chapman, the English legislation of 1711 and 1781, and the French legislation of 1741. The same scholar also has illuminating remarks in an earlier article, 'Notes on Eighteenth-century British Paper', *The Library*, s. V, vol. 12 (1957), pp. 34-42. In his short treatise on the history of the printer, John Baskerville, Gaskell further provides a landmark example of how to

integrate paper evidence and information about sheet sizes in the bibliographical description of individual editions, see *John Baskerville. A Bibliography*, Cambridge, at the University Press, 1959. Gaskell also published the history of the Eighteenth-century Foulis Press in Glasgow, an academically inclined publisher and printer, that made great play on the varieties of paper within the same edition, to all intents and purposes creating distinct issues, sometimes in differing formats, all of which required attention on the part of the bibliographer, see *A Bibliography of the Foulis Press*, London, Rupert Hart-Davis, 1964, reprinted Winchester, St. Paul's Bibliographies, 1986. The other great example of paper analysis in the description of individual books is the extraordinary *Catalogue of Botanical Books in the Library of Rachel McMasters Miller Hunt*, Pittsburgh, Hunt Botanical Library, 1958-61, 2 vols., where the entries are by Allan Stevenson.

[9]

Knowing Formats

It should be noted that the problem of determining format antedates paper, since books in parchment also require a format to be established on the basis of the way the skin of the animal – in which the dorsal stripe has the same role as the wirelines in a sheet of paper – has been folded and cut; see the very clear synthesis by J. Peter Gumbert, 'Sizes and Formats', in *Ancient and Medieval Book Materials and Techniques*, cit., 1993, I, pp. 227-263.

The bibliographical discussion, fittingly, has its beginning in the first volume of a journal that appeared monthly and only later became the mouthpiece of the Bibliographical Society, see William Blades, 'On Paper and Papermakers', *The Library*, vol. 1, n. 7, July 1889, pp. 217-223, where he insists, in opposition to the measurement system, that "Truly the natural system is the only way". Otherwise, another potential starting point is Charles Mortet, *Le format des livres. Notions pratiques suivies de recherches historiques*, Paris, Champion, 1925, which brings together two articles published in the *Revue des bibliothèques* in 1894 and in 1924. Although the idea of a progressive discussion of how formats developed in the history of printing is a good one, Mortet is often inaccurate and is by now very dated. Theoretical aspects of the problem are expounded by G. Thomas Tanselle, 'The Concept of Format', *Studies in Bibliography*, vol. 53 (2000), pp. 67-115, and in a more practical fashion, applied in particular to the period in which mechanical paper first came onto the market, by Brian J. McMullin, 'Watermarks and the Determination of Format in British Paper, 1794-circa 1830', *Studies in Bibliography*, vol. 56 (2003-2004), pp. 295-315.

The earliest diagrams of format layouts are in the *Orthotypographia, hoc est Instructio operas typographicas correcturiis* by Hieronymus Hornschuch, printed in Leipzig in 1608, and generally considered the first printing manual (see the 1983 reprint edited by Martin Boghardt). The woodcut diagrams are for Quarto, Octavo, Duodecimo and, curiously, Decimooctavo. The practice expands hugely in subsequent printing manuals, including the entry 'Imprimerie' in the *Encyclopédie des arts et métiers*, and culminating in the extravagance of the oft-pillaged, and rarely acknowledged, entry 'Imposing' by William Savage, *A Dictionary of the Art of Printing*, London, Longman, Brown, Green and Longmans, 1841 (available online in Google books). A summary of the most common lay-outs are provided also in various manuals of bibliography, most helpfully and thoroughly in that by Philip Gaskell, *A New Introduction to Bibliography*, cit., 1972, pp. 84-107, which also includes a helpful note about 'The Identification of Format'.

The language with which formats and impositions are described sometimes requires elucidation. Gaskell's manual defines as "common octavo" a lay-out in which, after folding, the four corner leaves of the sheet become the first half of the gathering (p. 92); its opposite, "inverted octavo", places the same leaves in the second half of the gathering (p. 93). Gaskell's lexis here is in debt to D.F. Cook, 'Inverted Imposition', *The Library*, s. V, vol. 12 (1957), pp. 193-196. An alternative terminology, first suggested in German by Martin Boghardt in the just-mentioned introduction to the reprint of Hornschuch, subsequently promoted in English and Italian by Conor Fahy [11], describes the first imposition as "centripetal" (i.e. the leaves in the second half of the gathering form the centre of the sheet) and the second as "centrifugal".

As Needham warns in 'Res Papirea', cit., 1994, unless you are certain that the person describing a manuscript or an early printed book knows what they are about, indications relating to any format lesser than 16° in a bibliography or catalogue should be treated with extreme caution. One salutatory episode in the misdescription of an early Sixteenth-century edition, in which carelessness led to a stern correction, is dealt with in Conor Fahy, 'Il formato in 24° di Alessandro Paganino', *La Bibliofilia*, vol. 98 (1996), pp. 59-63. The complexities of imposition in very small formats are briefly handled in Oliver Lee Steele, 'Half-sheet Imposition of Eight-leaf Quires in Formes of Thirty-two and Sixty-four Pages', *Studies in Bibliography*, vol. 11 (1962), pp. 274-278. The smallest format known to have been used in a Renaissance book, and indeed for a long time afterwards, is 128°, employed by Christopher Plantin to print a *Kalendarium* in Antwerp in 1570.

Quite remarkably and very fortunately, one copy has survived in unbound form in the archive of the Plantin-Moretus Museum, see Frans A. Janssen, 'The Smallest Format Reinstated', *Quaerendo*, vol. 12 (1982), pp. 80-81, reprinted with the title: 'The Smallest Format Reinstated (Plantin 1570)', in Idem, *Technique and Design in the History of Printing*, 't Goy Houten, Hes & De Graaf, 2004, pp. 141-144.

A short article that illustrates the problem of establishing the format in incunabula printed on sheets of different sizes is Curt F. Bühler, 'Chainlines versus Imposition in Incunabula', *Studies in Bibliography*, vol. 23 (1970), pp. 141-145. Mixed formats are usually indicated in repertories of incunabula, among which the BMC is punctilious in giving the make up of the copies it describes. An analysis of the mixed format editions in the collection of the Franciscan library in Florence, including a copy of the extremely complicated 1480 Renner Bible, in which Needham identifies "Half-median" sheets, appears in Neil Harris, 'Né pesce né carne. Ritratto dell'incunabolo come un libro bifronte', in *Gli incunaboli della Biblioteca Provinciale dei Frati Minori di Firenze*, a cura di Chiara Razzolini, Elisa di Renzo, Irene Zanella, Firenze, Regione Toscana-Pisa, Pacini editore, 2012, pp. 11-46. The specific problem posed by Fifteenth-century broadsides is discussed by Paul Needham, 'The Formats of Incunable Broadsides', in *Buch-Bibliothek-Region. Wolfgang Schmitz zum 65. Geburtstag*, herausgegeben Christine Haug und Rolf Thiele, Wiesbaden, Harrassowitz, 2014, pp. 127-144.

From the late Seventeenth century, beginning in Holland, mills constructed and employed side-by-side twin-sheet moulds, generally intended as good-quality writing paper. The particularity of the construction required a reversal of the normal lay-out, so that in sheets of paper made on such moulds the wire-lines are parallel to the short edge and the chain-lines to the long edge, see Allen T. Hazen, 'Eighteenth-Century Quartos with Vertical Chain-lines', *The Library*, s. IV, vol. 16 (1935-36), pp. 337-342; K. Povey-I.J.C. Foster, 'Turned chain lines', *The Library*, s. V, vol. 5 (1950), pp. 184-200. In dealing with such cases, which remain rareish, a certain bibliographical circumlocution is required in explaining the format. Alternatively the two sheets could be made in end-to-end moulds, leaving the determination of the format unchanged, see the diagram in Gaskell, *A New Introduction to Bibliography*, cit., 1972, p. 65. For the difficulties posed by the identification of such "quadruplet" watermarks in the correspondence of Ludwig van Beethoven, see Alan Tyson, 'Prolegomena to a Future Edition of Beethoven's Letters', in *Beethoven Studies 2*, edited by Alan Tyson, London, Oxford University Press, 1977, pp. 1-32: 9-12.

The very bad, indeed abominable, library practice of assigning formats purely on the basis of the height of the copy, which seems to derive from a failure earlier in the century to think through the consequences of the introduction of mechanical papermaking, was denounced by Henry Bradshaw in 1882 in his 'Address at the Opening of the Fifth Annual Meeting of the Library Association', Cambridge 1882, appendix III, pp. 36 sqq., reprinted with the title 'A Word on Size-notation as distinguished from Form-notation' in his *Collected Papers*, Cambridge, Cambridge University Press, 1889, republished 2011, pp. 406-409. It is enjoyable to dwell *en passant* on his somewhat scathing observations about the competence of contemporary librarianship: "It may perhaps have been thought superfluous for me to define the meaning of the term 'quarto,' a definition which *mutatis mutandis* applies to all such terms. But the truth is that, although Frenchmen seem to be generally taught these things as elementary facts, I am bound to say that I have not found, during the last twenty years, five Englishmen, either librarians or booksellers, who knew how to distinguish a folio from a quarto, or an octavo from a 12° or a 16°. It is surely high time then, that we should make a serious effort to arrive at some common understanding as to a matter of such purely practical concern; seeing that we are all agreed that it is desirable to convey some idea of the size of a book by the notation we use to describe it" (p. 409). See also the remarks by Needham, 'ISTC as a Tool for Analytical Bibliography', cit., 1987, p. 46. It has still taken over a hundred years for the practice to disappear and one still finds cases in which lazy, incompetent, and useless cataloguers copy the format indication off an old catalogue card rather than actually look at the book.

[10]

Papermaking Moulds, Watermark Patterns, and Twin Watermarks

The passage cited from Briquet in Chapter 5, which includes the indication of not more than two years as the lifetime for a mould in regular use, is excerpted from: 'De la valeur des filigranes de papier comme moyen de déterminer l'âge et la provenance de documents non datés', *Bulletin de la Société d'Histoire et Archéologie de Genève*, tome I, livre 2 (1892), pp. 192-202, reprinted in *Briquet's Opuscula*, cit., 1955, pp. 235-240.

A detailed analysis of how moulds were made and structured, with lengthy comparisons of Oriental and Occidental practice, can be found in E.G. Loeber, *Paper Mould and Mouldmaker*, Amsterdam, The Paper Publications Society, 1982. Watermark patterns, i.e. the blocks of wood with nails, on which watermarks were first drawn and then shaped by bending the copper wire, have rarely impinged on the consciousness of

watermark scholars, but a single pattern obviously not only served to shape the twin watermarks on a pair of moulds, but it could be employed again and again to make a series of more or less identical watermarks. Some observations based on an early Twentieth-century Dutch account appear in Allan Stevenson, *The Problem of the Missale Speciale*, London, The Bibliographical Society, 1967, Excursus III, 'The Watermark Maker', pp. 245-247. In 1964 in his in-depth study of watermarks in Berne [6k], Johann Lindt argued that the durability of some watermarks appeared superior to that of the moulds: "The watermarks were used until they were completely worn out and useless. After being used on old moulds they were transferred to new moulds and this often happened more than once. In the process of renewed sewing-on it happened that the watermark assumed a somewhat divergent shape, for – when necessary – it also underwent some repair during this operation and so was further altered" (p. 146). I suspect that what might really be described here are different marks from the same pattern being attached to successive moulds over the course of time, a possibility to which Lindt makes no reference, but the truth can only be established by a fresh examination of the original evidence.

The one article that must be read if one is going to attempt serious scholarship through paper is Allan H. Stevenson, 'Watermarks are Twins', *Studies in Bibliography*, vol. 4 (1951-52), pp. 57-92, with further information available in Idem, 'Paper as Bibliographical Evidence', *The Library*, s. V, vol. 17 (1962), pp. 197-212. On the figure of Stevenson and his enormous contribution to the history of paper scholarship, see Paul Needham, 'Allan H. Stevenson and the Bibliographical Uses of Paper', *Studies in Bibliography*, vol. 47 (1994), pp. 23-64, which also provides an abbreviated listing of Stevenson's writings.

Not centred on the question of twins, but still very much about physical paper evidence and ways of establishing a comparative chronology is the pamphlet by Roberto Ridolfi, *Le filigrane dei paleotipi*, cit., 1957. The originality of this Italian's scholar's contribution is underlined by Conor Fahy, 'Roberto Ridolfi, Italian Bibliographical Scholar', *Studies in Bibliography*, vol. 51 (1998), pp. 26-47, of which an Italian version appeared with the title 'Roberto Ridolfi e lo studio bibliologico della carta', *La Bibliofilia*, vol. 97 (1995), pp. 35-57.

One promising sounding, but disappointing, title, since all it does is lead the reader into a strange maze of diagrams, mostly about how watermarks arrange themselves in the fascicules of manuscripts (*but does the blindingly obvious have to be so needlessly complicated?*), is Monique Zerdoun Bat-Yehouda, *Les papiers filigranés médiévaux. Essai di méthodologie descriptive*, Turnhout, Brepols, 1989, 2 vols. But it does have nice β -radiographs, so one can always look at the pictures.

Rather surprisingly, or perhaps not surprisingly at all, relatively few photographic images of twin watermarks are reproduced in the critical literature relating to paper studies, with the exception of Stevenson's fundamental 1951 article and the *tour de force* of *The Problem of the Missale Speciale* (1967). The same scholar includes a couple of graceful unicorns among the β -radiographs he adds to the 1968 edition of Briquet, see the Tables following p. *36. Otherwise, in chronological order of the original document, here are some examples you can look at. Two full sheets from Basle in 1446, each with a horn watermark, respectively in the right and left halves are shown as backlit images in Tschudin, *Grundzüge der Papiergeschichte*, cit., 2002, fig. 71 (p. 198 in the Italian version, though in both instances the quality of the image leaves something to be desired). A selection of β -radiographs of the twin watermarks in the Gutenberg Bible, taken from the Pierpont Morgan Library copy, are reproduced by Paul Needham, 'The Paper Supply of the Gutenberg Bible', *The Papers of the Bibliographical Society of America*, vol. 79 (1985), pp. 303-374; the same Needham illustrates, again with β -radiographs, the twin watermarks, in different states, in the three impressions of the Mainz *Catholicon*, see 'Johann Gutenberg and the Catholicon press', *Papers of the Bibliographical Society of America*, vol. 76 (1982), pp. 395-456: 445-451. Two graceful mermaids from Venetian Sixteenth-century maps printed around 1570, baptised Mary and Martha, are reproduced in β -radiograph by David Woodward in his 1996 catalogue [26], though they are not explicitly identified as twins (nn. 91-92, pp. 68-69). Quite a few other watermarks in this repertory are plausibly twins, but the nature of the material makes it difficult to be certain. Six pairs of watermarks from Sixteenth and Seventeenth-century literary manuscripts are reproduced by Mark Bland, *A Guide to Early Books and Manuscripts*, cit., pp. 28, 33, 42-44, 47: in four cases these are taken from the Bodleian's archive of β -radiograph images going back to 1987. Conor Fahy, *Printing a Book at Verona in 1622. The Account Book of Francesco Calzolari Junior*, Paris, Fondation Custodia, 1993, figg. x-xii, reproduces with backlit photographs, not entirely distinctly, the twin Eagle, Anchor, and Lion watermarks, with their respective countermarks, found in the *Musaeum Francisci Calceolarii*. Otherwise, find your own twin watermarks. It is not difficult!

The issue of how to label the watermarks produced by a pair of twin moulds has been treated primarily by scholars in the German-speaking world. As part of the lengthy debate on the "1460" Mainz *Catholicon* [30], Theo Gerardy, 'Wann wurde das Catholicon mit der Schuss-Schrift von 1460 (GW 3182) wirklich gedruckt?',

Gutenberg Jahrbuch (1973), pp. 105-125, applies a system in which the watermark in the sheet, viewed from the mould side, if on the left, is denominated *zugewandt*, i.e. “turned towards”, or “Z”, and the opposite twin mark, on the other side of its respective sheet, is *abgewandt*, i.e. “turned away”, or “A”. Gerardy has expounded the same nomenclature in other writings, in particular in ‘Die Beschreibung des in Manuskripten und Drucken vorkommenden Papiers’, *Codicologia*, vol. 5 (1980), pp. 37-51, and in the important monograph: *Das Papier der Seckelmeisterrechnungen von Freiburg i. Ue, 1402-1465*, cit., 1980, pp. 72-88. In this latter study, in which many pairs of watermarks are placed in the same half of the mould, he employs the further distinction of A I and A II, or Z I and Z II. What this method signifies in practical terms is that Z marks are traced and reproduced from the mould side of the sheet and A marks are taken from the felt side, an inconsistency that other scholars tendentiously dislike (*and, at least as far as I am concerned, the method is not always easy to remember*). Gerardy’s method has enjoyed the public approval of R.J. Lyall, ‘Materials. The Paper Revolution’, in *Book Production and Publishing in Britain, 1375-1475*, edited by Jeremy Griffiths and Derek Pearsall, Cambridge, Cambridge University Press, 1989, pp. 11-29, with the addition of an asterisk to signify when the watermark is upside-down. Still in the context of the *Catholicon*, Eva Ziesche and Dierk Schnitger, ‘Elektronen radiographische Untersuchungen der Wasserzeichen des Mainzer Catholicon von 1460’, *Archiv für Geschichte des Buchwesens*, vol. 21 (1980), cols. 1303-1360, employ “a” when the original watermark in the mould was in the left-hand side and “b” when in the right-hand side. Last but not least, and still with reference to the *Catholicon*, Paul Needham has employed a simple and self-explanatory system: the sheet is viewed from the mould side and the watermark, the right-way up, is designated “mould-side left”, abbreviated as mL, or “mould-side right”, abbreviated as mR, see ‘Johann Gutenberg and the Catholicon press’, cit. (1982), p. 453, where he surveys also the methods of Gerardy and Ziesche-Schnitger. In more recent publications Needham has adopted the alternative abbreviations MsL and MsR. Although this nomenclature works well for straight-forward designation purposes, not all scholars are comfortable with a terminology that reverses the positions of the watermarks on the original moulds. In my own work, therefore, I cite watermarks as they were placed in the original mould as L (*i.e. left*) and R (*i.e. right*), adding however a specification about how appear they appear on the mould-side of the sheet, as in Needham’s diction, so “L (MsR)” and “R (MsL)”. If both watermarks are in the same half of their respective moulds, as is common up to the second half of the Fifteenth century, the letters double up, i.e. L and LL, and R and RR.

[11]

Countermarks

A word of warning. Traditional watermark repertories cannot always be relied on to reproduce countermarks (*astonishingly, since in many ways they are more distinctive than the principal watermarks*). At one extreme Briquet generally includes them and acknowledges their importance, at the other Piccard’s sequence of *Findbuch* systematically ignores them and thus renders his tracings almost useless. So be careful!

On the whole, the discussion of countermarks has been somewhat muted, possibly due to the fact that they are considered primarily an Northern Italian phenomenon (*which is true, but that does not make them any less important*), possibly also due to the fact that they represent a code that generally proved impervious to scholarship. Leonardo Mazzoldi, *Filigrane di cartiere bresciane*, cit., 1990-91, who is scrupulous about recording their presence, offers the most likely interpretation, i.e. that they designate the “titolari delle cartiere”. See further Paola F. Munafò-Maria Speranza Storage, ‘Countermarks in 15th Century Italian Paper’, in *Paper as a Medium of Cultural Heritage. Archaeology and Conservation. 26th Congress IPH. Rome-Verona, August 30-September 6th, 2002*, edited by Rossella Graziaplana, with the assistance of Mark Livesey, Roma, Istituto Centrale per la Patologia del Libro, 2004, pp. 311-321. Examples of countermarks placed in the centre of the half of the sheet opposite to the mark from the late 1640s can be found in the watermark repertories of Churchill, Heawood, and Mošin [18].

Observations pointing out the helpfulness of countermarks in order to determine imposition appear in Conor Fahy, ‘Notes on Centrifugal Octavo Imposition in Sixteenth-century Italian Printing’, *Transactions of the Cambridge Bibliographical Society*, vol. 10 (1994), pp. 489-504; ‘Centripetal and Centrifugal Imposition in Aldine Octavos’, vol. 10 (1995), pp. 591-602. Their utility in separating twin moulds is mentioned also by the same author, see ‘La carta nelle edizioni aldine del 1527 e del 1528’, *La Bibliofilia*, vol. 103 (2001), pp. 263-289.

[12]

Names and Dates in Watermarks

The fact that paper-makers at Fabriano at the beginning of the Fourteenth century for a brief period placed their names in the moulds was known to early gatherers of watermark information, such as the Zonghi brothers and Briquet. The latter discusses the practice in his pioneering article on the watermarks of Genoa (1888) and subsequently, in *Les filigranes*, under the heading 'Noms' provides a series of examples, such as "ANDRUZO A" (nn. 12005, 12028), "BARTOLI P" (n. 12006), "BENE" (n. 12007), "CICCO V" (n. 12008), "CRESSCE M" (n. 12009), "FILIPO Z" (n. 12010), "FILIPVZO Z" (n. 12011), and so on and so forth. These indications were followed up by Andrea F. Gasparinetti, 'Über die Namen alter italienischer Papiermacher', *Papiergeschichte*, vol. 2 (1952), pp. 13-16, also in his *Aspetti particolari della filigranologia*, cit., 1964, p. 27, where he drew attention to an amusing misreading by Briquet, who transcribed a back-to-front "PINTAVOZ" (n. 12020), instead of a correct "ZOVAGNI G" (*which he had registered correctly at n. 12027, but evidently the penny didn't drop*). In more recent times the subject has been expertly discussed by the French paleographer, Jean Irigoien; see his 'Les filigranes de Fabriano (noms de papetiers) dans les manuscrits grecs du début du XIV^e siècle', *Scriptorium*, vol. 12 (1958), pp. 44-50, 281-282; Idem, 'Une série de filigranes remarquable: les noms de papetiers de Fabriano (début du XIV^e siècle)', in *Le papier au Moyen Âge*, cit., 1999, pp. 139-147. Irigoien establishes an arc of time for the practice running from 1305 to 1312 for archive documents and from 1309 to 1314 for manuscripts, in which the way paper was acquired and consumed was evidently slower. The whole phenomenon is remarkable in that the names are in the vernacular and surnames or patronymics, given the period, are abbreviated. Why the fashion suddenly appeared and why it equally suddenly disappeared remains mysterious, but it provides a delightful example of the pioneering use of watermarks in the Middle Ages.

The inclusion of the name of the paper-maker – usually in a cartouche underneath the watermark – resurfaces in France during the second half of the Sixteenth century as a consequence of legislation in 1567 and 1582, see Briquet, *Les filigranes*, cit., 1907, vol. I, p. 9. The shape of the phenomenon is clear from a leisurely stroll through the pages of the same repertory, where Briquet's discussion of "Raisin" (vol. IV, p. 646) includes examples for names of the Seventeenth and Eighteenth centuries. Otherwise the phenomenon is relatively little charted, but see the examples in the repertories by Churchill, Heawood, and Gaudriault [18].

Dated watermarks in the same period are extremely rare and linked to heraldry. The earliest examples in Briquet, who surveys the 95 examples in his repertory in the entry for 'Millésimes' (p. 587), are for the arms of a Troyes papermaker: see nn. 1181-1183, dated respectively 1545, 1546 and 1549 (*the identification of the owner is provided by Stevenson in his notes to the 1968 edition*). At a later stage dates in watermark become commonplace as a consequence of excise legislation, see the excellent study by Harry Dagnall, *The Taxation of Paper in Great Britain 1643-1861*, cit., 1998.

[13]

Tranchefiles

In the critical literature there is some confusion about what exactly constitutes a tranchefile. It is *not* just a chainline that happens to seem to be closer to the edge of the mould, since this is often an illusion (*the said effect can obviously be caused by trimming, but deckles were often made so that they slightly overlapped the mould and thus cut off a few millimetres in the moment in which the sheet is formed*). A tranchefile is instead a thickish brass wire attached to the underside of the sieve, normally at about 18 mm from the penultimate chain-line on the extremities of the mould and at about 10 mm from the edge of the same (*obviously the distance is difficult to establish since the sheet has usually been trimmed*). It is sewn into position by having a chain-line formed above it, to which it is attached (*see the illustrations of mould making both in Lalande, who also provides a useful account of its placing and purpose, and in the entry 'Papeterie' in the Encyclopédie, which both show tranchefiles as an intrinsic part of the mould*), and is recognisable by the fact that the same chain-line (*which is obviously the outermost*) is visibly closer to the penultimate chain-line. Its peculiarity is that it does not have a supporting rib underneath, since its closeness to the border of the mould would have impeded the flow of the liquid. Its purpose evidently was to strengthen the short edges, which were the most vulnerable part of the mould, given that there was no way of fixing the ends of the wires. It has been pointed out (Gilbert and Ransom) that *tranchefile* perhaps is a misnomer, since this is really a bookbinder's term signifying the 'headband' in the binding and that the correct term should be *transfil* (*good point, but, apart from the fact that the term goes back at least to the Eighteenth century, it is probably too late in the day to do anything about it*).

Tranchefiles are very explicitly and very specifically a feature of paper made North of the Alps, especially in France, beginning in the Auvergne, and gradually expanding Northwards to Holland, although an exception can be made for Piedmont in North Eastern Italy in the Fifteenth century. Evidence points to the three varieties of royal paper employed in the printing of the Gutenberg Bible, watermarked with a grape, a bull's head or a bull, as imported from paper factories working in the neighbourhood of Turin, with moulds distinguished by the presence of tranchefiles, see A.W. Kazmeier, 'Wasserzeichen und Papier der zweiundvierzigzeiligen Bibel', *Gutenberg Jahrbuch*, 1952, pp. 21-29; Paul Needham, 'The Paper Supply of the Gutenberg Bible', *Papers of the Bibliographical Society of America*, vol. 79 (1985), pp. 303-374. Stevenson, *The Problem of the Missale Speciale*, cit., 1967, also provides a useful discussion of the tranchefiles in the papermoulds used in Basle.

The only exception to the rule that Italian moulds do not have tranchefiles, that I have personally encountered, involves the printing of the Gospels in Arabic in Rome in 1590-91 by the Medici Oriental Press. This edition, which appeared in two seemingly different issues, one with only the Arabic text and one with a Latin interlinear gloss [30], employs for the most part Median sheets watermarked with a crown and clearly visible tranchefiles, see Neil Harris, 'Printing the Gospels in Arabic in Rome in 1590', in *A Concise Companion to the Study of Manuscripts, Printed Books, and the Production of Early Modern Texts*, edited by Edward Jones, Chichester, Wiley-Blackwell, 2015, pp. 131-149. I add that I have found the same crown watermark and tranchefiles in a manuscript of Daniele Barbaro in the Marciana Library, so it almost certainly came from an Italian mill.

The placing of tranchefiles can be extremely useful, not just in recognising the parts of a sheet that are not watermarked, but also in deciphering complex imposition problems; see David F. Foxon, 'Some Notes on Agenda Format', *The Library*, s. V, vol. 8 (1953), pp. 163-173; Annemie Gilbert and Silvia Ransom, 'The Imposition of Eighteenmos in Sixes, with Special Reference to Tranchefiles', *Bulletin of the Bibliographical Society of Australia and New Zealand*, no. 17 (1980), pp. 269-275.

[14]

Telling Mould Side/Felt Side Apart

In the discussion following the paper by Richard Hills at the Paris conference *Le papier au Moyen Âge* in 1998, a scholar of the stature of Conor Fahy admits that "I am incidentally glad that somebody else has difficulty in deciding which is the felt side and the mould side" (p. 162); and in my own conversations with him Conor was always rather sceptical about whether this could be done in a reliable fashion. It is also a skill that relatively few scholars, even those who work a lot on paper evidence seem to have in their repertoire. The only article I know on the subject is Allan Stevenson, 'Chain-indentations in Paper as Evidence', *Studies in Bibliography*, vol. 6 (1954), pp. 181-197, with useful remarks about how this technique can be employed to detect cancels.

It has to be admitted that it is not always easy, especially in dealing with volumes that have been much handled, as well as rebound and heavily pressed. Nevertheless telling felt side/mould side apart is a fundamental skill in the analysis of paper, since it is also the preliminary step to identifying the twin watermarks that should emerge in every paper supply.

The basic difference is that the wirelines, chainlines and the watermark(s) on the mould side leave a deeper indentation in the finished sheet. The easiest way to distinguish them is with a raking light in a darkened room, but of course ideal conditions are often not possible in libraries and so the solution is incessant practice. If you are a novice, start with paper in manuscripts or in archive documents that have not been heavily used and get into the habit of doing it all the time. Outside the library, an excellent device is an overhead projector: turn it on in a darkened room, find the chain-lines, hold the sheet flat along the line of the beam with the chain-lines at right angles, and it works beautifully (*so don't let technonerd discard these very useful machines as obsolete*). Otherwise God's good sun pouring through a window, if you can obtain a narrow ray of light, will serve the same purpose, and the new variety of rechargeable LED cycling lights can be very handy (*unless you leave them on the bicycle, that is*).

[15]

Wove Paper

Technically, Oriental papers made on a floating mould covered with cloth are "wove", as can be seen by the imprint left by the fabric on the surface of the sheet. Otherwise, in terms of Western papermaking, "wove",

applied to a metal mesh, first appeared in England in 1757. In the first half century or so of wove, traces of chain and wirelines are often still apparent and so can be helpful in determining format (*the problem was obviated by putting a layer of rougher, more widely-spaced mesh, between the supports and the wove surface itself*). On the biography of its inventor, or at least of the person who commissioned the moulds, see John N. Balston, *The Elder James Whatman, England's Greatest Paper Maker*, West Farleigh, [published by the author], 1992. The third, follow-up volume, with the title *The Whatmans and Wove (Velin) Paper: Its Invention and Development in the West*, West Farleigh, John Balston, 1998, looks at the material evidence. (*These books are not easy to obtain, though copies do appear in Abebooks and in other used book selling sites. Alternatively order them directly from the Whatman firm, which still exists, albeit no longer as a papermaking business: contact Whatman House, St. Leonard's Road 20, Maidstone, Kent ME16 0LS, England*). Worthwhile biographical summaries of the lives of James Whatman senior (1702-59) and junior (1741-98) by Anne Pimlott Baker are available in the *Oxford Dictionary of National Biography*, Oxford, vol. 58 (2004), pp. 402-403.

Bibliographical information about the first edition printed employing wove paper, or *Publii Virgilio Maronis Bucolica, Georgica, et Aeneis*, Birminghamiae, typis Johannis Baskerville, 1757, is available in Philip Gaskell, *John Baskerville. A Bibliography*, cit., pp. 19-23. A word of warning: it is necessary to distinguish the 1757 *editio princeps* from its later, deceptively and sneakily identical, reprint, which was probably done in about 1773.

[16]

Mechanical Paper

The early history of the Fourdrinier machine is described in a chapter in Hunter, *Papermaking*, cit., 2nd ed., 1947, pp. 341-373, but a much more detailed account is Robert H. Clapperton, *The Paper-making Machine. Its Invention, Evolution and Development*, Oxford, Pergamon Press, 1967. A useful summary is also provided by Gaskell, *A New Introduction to Bibliography*, cit., 1972, pp. 214-230, including a β -radiograph of the trace left by a sewing seam. A short, but expensive, biography of the first inventor is Henry Morris, *Nicolas Louis Robert and his Endless Wire Papermaking Machine*, Newtown, Bird & Bull Press, 2000. A facsimile of Robert's original "brevet d'invention" for a "Machine à fabriquer le papier d'une très grande étendue", presented on 18 January 1799, was published in 2000 by the Institut National de la Propriété Industrielle in Paris, including a reproduction of the original drawings. Useful biographical and bibliographical indications are available in the entry on Bryan Donkin (1768-1855) by Roger Lloyd Jones in the *Oxford Dictionary of National Biography* (2004), vol. 16, pp. 402-403, and in that on Henry Fourdrinier (1766-1854) by Anita McConnell, vol. 20, pp. 559-560.

An important study on the history of the paper-industry in France as a consequence of the mechanisation of the process is Louis André, *Machines à papier. Innovation et transformations de l'industrie papetière en France, 1798-1860*, Paris, Éditions de l'École des Hautes Études en Sciences Sociales, 1996. See also, by the same author, 'Une révolution de papier. Le papier et la seconde révolution du livre', *Revue française d'histoire du livre*, n. 106-109 (2000), pp. 219-230. Three books that describe its impact on the paper making industry in Britain and in the United States are Joan Evans, *The Endless Web. John Dickinson & Co. Ltd, 1804-1954*, London, Jonathan Cape, 1955; Judith A. McGaw, *A Most Wonderful Machine. Mechanization and Social Change in Berkshire Paper Making, 1801-1885*, Princeton, Princeton University Press, 1987; and by the biographer of Dard Hunter, Cathleen A. Baker, *From the Hand to the Machine. Nineteenth-century American Paper and Mediums: Technologies, Materials, and Conservation*, Ann Arbor, The Legacy Press, 2010.

Gaskell, *A New Introduction to Bibliography*, cit., 1972, pp. 226-228, lists a series of tests, some of them destructive, that identify mechanical paper, while an excellent description of how damage and repairs to the web of a Fourdrinier machine provide evidence is provided in Brian J. McMullin, 'Machine-made Paper, Seam Marks and Bibliographical Analysis', *The Library*, s. VII, vol. 9 (2008), pp. 62-88.

[17]

Papermaking Terminology

Lexis can be a problem, given the multilingual nature of paper studies. A helpfully polyglot volume therefore is E.J. Labarre, *Dictionary and Encyclopaedia of Paper and Paper-making with Equivalents of the Technical Terms in French, German, Dutch, Italian, Spanish & Swedish*, 2nd ed., rev. and enlarged, Amsterdam, Swets

& Zeitlinger, 1952, integrated by E.J. Labarre-E.G. Loeber, *Dictionary and Encyclopaedia of Paper and Paper-making: Supplement*, Amsterdam, Swets and Zeitlinger, 1967. I have not had more than a chance to glance at Jean-Claude Perrin, *Glossaire du papetier: dictionnaire des mots et des expressions usités par le papetier, depuis l'invention du papier à ce jour, ...* 124 illustrations de l'auteur, ainsi qu'une bibliographie sélective complètent l'ouvrage, Marcq-en-Baroeul, Vergeures & Pontuseaux associés, 2003, but it appears helpful.

For older, or historically established, vocabulary, for English and French, the obvious sources are Chamber's *Cyclopaedia* and the *Encyclopédie* [5]. For Italian, the problem is more complex, due to the circumstance that a source such as the *Dizionario delle arti e de' mestieri* by Francesco Grisellini, published from 1768 to 1778, models its vocabulary on the *Encyclopédie*, rather than trying to discover the correct Italian equivalents. Better and more reliable is the *Prontuario di vocaboli attenenti a parecchie arti, ad alcuni mestieri, a cose domestiche e altre di uso comune*, by Giacinto Carena, published in three volumes at Turin from 1846 to 1860, with successive reprints, which includes a useful section on the 'Cartajo'.

[18]

Watermarks, Briquet and Other Repertories

There is no way of avoiding, nor should one even desire to, the four weighty tomes of Charles-Moïse Briquet, *Les filigranes. Dictionnaire historique des marques de papier dès leur apparition vers 1282 jusqu'en 1600*, published in his home city of Geneva in 1907. The title-page of the first edition is more elaborate than most subsequent catalogue entries reveal, since the list and addresses of some seven publishers, aka distributors, shows the interest with which the work, announced by a prospectus in 1902, was expected by the specialist market, i.e. in the first column: Paris, Alphonse Picard & fils, 82 Rue Bonaparte; Londres, B. Quaritch, 15, Piccadilly; Leipzig, Karl W. Hiersemann, 3, Königsstrasse; and in the second column: Amsterdam, Feikema, Caarelsen & C^{ie}, N.Z., Voorburgwal; Rome, Fratelli Bocca, Corso; Madrid, José Ruiz, Plaza de S^{ta} Ana, 13; rounded off at the bottom by what has traditionally been taken as the main publisher: Genève, A. Jullien, 32, Bourg-de-Four. Although the title gives 1600 as the cut-off point, the limit is not rigidly adhered to: some seventy odd images belong to the Seventeenth century, mostly the first decade, but even afterwards, for instance 1611 for nn. 4442 and 13216, 1612 for n. 13212, 1628 for n. 934, and 1630 for n. 13206 (*the presumption of course is that this is older paper used at a subsequent date*). The second edition published in Leipzig in 1923 adds a 'Notice sur la vie et les travaux' of the author, written by his nephew, John Isaac Briquet (1870-1931), who at the time was director of Geneva's Botanical Garden and a well-known scholar in his own right. Since the donation of Briquet's papers to the same city's library did not include personal material, this biography is the main source for Briquet's life and career (*it is a pity therefore that it is not included in the 1968 reprint*). It also provides a listing of Briquet's writings, including his articles on Alpinism and mountaineering, and the obituaries. Though there are other modern reprints, the one which it is very necessary to have to hand is the so-called 'Jubilee edition', published for the fiftieth anniversary of Briquet's death, see *Les Filigranes ... a Facsimile of the 1907 Edition with Supplementary Material contributed by a Number of Scholars*, edited by Allan Stevenson, Amsterdam, The Paper Publications Society, 1968, including, among other additions, an index of the libraries and archives visited by Briquet, pp. *87-*92. Take note that the 1968 edition reorganizes the structure of the original, by concentrating the text in the first two volumes and the illustrations in the latter two, an improvement that makes consultation much more practical. Briquet's other writings are brought together in *Briquet's Opuscula. The Complete Works of Dr. C.M. Briquet without "Les filigranes"*, cit., 1955, which repays thoughtful study. The largely eulogative 1952 *Briquet Album* provides a short biography of Briquet by Armin Renker, with versions both in German and English, but otherwise is not as useful as it could have been.

One small problem, that can prove annoying, is what precisely is the man's name? The surname is straightforward enough, but should we call him Charles-Moïse, Charles Moïse, Charles-Moise, Charles Moise, or just Charles M., since various scholars cite him in a whole variety of ways? The simple answer is that there is no answer, unless somebody produces a birth certificate, since Briquet himself unhelpfully signs his original publications with his initials, either "C.-M.", mostly in the articles, but "C.M." on the 1907 titlepage of *Les filigranes*. In the present work, the name gets the full Monty, both the hyphen and the diaeresis, but if you want to do it differently, feel free.

For the Briquet archive at Geneva, see Daniel W. Mosser, 'The Charles-Moïse Briquet Watermark Archive in Geneva', in *Looking at Paper: Evidence & Interpretation*, cit., 2001, pp. 122-127, and also the material coming on line in the Gravell Watermark Archive. The website also includes a transcription of the inventory of the contents of the Briquet Archive, which lists Briquet's working papers, the tracings of the watermarks, and

the diaries relating to his journeys. For all his fame, and with the centenary of his death looming, not enough is done or known about Briquet and his method. For instance, hardly any of his correspondence has been collected and published. The only exception I know is a collection of 23 interesting letters, since they include explanations of how he transferred his tracings into lithography, sent from Briquet to Aurelio Zonghi between 1881 and 1888, see Nora Lipparoni, 'Il rapporto di collaborazione Zonghi-Briquet da un epistolario inedito', in *Produzione e uso delle carte filigranate*, cit., 1996, pp. 79-121 (rather surprisingly, this article does not include the letter from Briquet, dated 1 December 1884, reproduced photographically in the introduction to Zonghi's Watermarks, cit., 1953, p. x).

Very much a continuation of Briquet, both in method and in content, since about 40% of the contents are from the archive of unpublished tracings in Geneva, are the two volumes by Vladimir A. Mošin-Seid M. Traljic, *Vodeni znakovi XIII. i XIV. vijeka = Filigranes des XIII^e et XIV^e ss.*, Zagreb, Jugoslavenska Akad. Znanosti i Umjetnosti, Historijski Inst. = Académie Yougoslave des Sciences et des Beaux Arts, Institut d'histoire, 1957. Mošin subsequently published, co-signed with Mira Grozdanović-Pajić: *Agneau pascal*, Belgrade, Editions Prosveta, 1967, and on his own: *Anchor Watermarks*, edited and translated by J.S.G. Simmons and B.J. Van Ginneken-Van de Kastelee, Amsterdam, The Paper Publications Society, 1973.

Still along the same lines as the great Swiss scholar are the seventeen *Findbuch*, in 25 tomes, by Gerhard Piccard (1909-89), published by Kohlhammer in Stuttgart between 1964 and 1997. They are organized thematically, as follows: vol. 1: *Die Kronenwasserzeichen* [crown watermarks from 1385 to 1695] (1961); vol. 2: *Die Ochsenkopfwasserzeichen* [bull's head watermarks from 1327-1660], 3 parts (1966); vol. 3: *Die Turmwasserzeichen* [tower watermarks from 1313 to 1758] (1970); vol. 4: *Wasserzeichen Buchstabe P* [gothic P watermarks from 1300 to 1695], 3 parts (1977); vol. 5: *Wasserzeichen Waage* [scales watermarks from 1336 to 1604] (1978); vol. 6: *Wasserzeichen Anker* [anchor watermarks from 1315 to 1623, with a supplement for some designs up to 1816] (1978); vol. 7: *Wasserzeichen Horn* [horn watermarks from 1322 to 1680, with a supplement for some designs up to 1821] (1979); vol. 8: *Wasserzeichen Schlüssel* [key watermarks from 1297 to 1680] (1979); vol. 9: *Wasserzeichen Werkzeug und Waffen* [working tools, i.e. arm, spade, hammer, clippers, knife, axe, sickle, scissors, compass, anvil; and weapons, i.e. shield, sword, arrow, dart, crossbow, from 1312 to 1743], 2 parts (1980); vol. 10: *Wasserzeichen Fabeltiere: Greif, Drache, Einhorn* [watermarks of mythical creatures: griffons, dragons, unicorns, from 1332 to 1728] (1980); vol. 11: *Wasserzeichen Kreuz* [cross watermarks from 1294 to 1733] (1981); vol. 12: *Wasserzeichen Blatt, Blume, Baum* [watermarks of leaves, flowers, trees, from 1300 to 1818] (1982); vol. 13: *Wasserzeichen Lilie* [flower or lily watermarks from 1299 to 1837] (1983); vol. 14: *Wasserzeichen Frucht* [watermarks of grapes from 1420 to 1730; watermarks of other fruit from 1316 to 1592] (1983); vol. 15: *Wasserzeichen Vierfüßler* [animal watermarks], 3 parts, subdivided into: *Wasserzeichen Hirsch* [deer or stag watermarks from 1337 to 1782], *Wasserzeichen Raubtiere* [watermarks of bear, leopard, lion, from 1347 to 1723], and *Wasserzeichen Verschiedene Vierfüßler* [watermarks of other animals from 1328 to 1709, with a supplement for some designs up to 1862] (1987); vol. 16: *Wasserzeichen Dreieck* [three hill watermarks from 1312 to 1666], 2 parts (1996); vol. 17: *Wasserzeichen Hand und Handschuh* [hand and glove watermarks from 1375 to 1688].

In its paper version the project got no further. It is excellent news, therefore, that Piccard's archive has taken on new being in one of the most important and innovative projects in the field of watermark studies on the website of the State Archives in Stuttgart, with the title *Wasserzeichen-Informationssystem*, which can also be viewed through the portal of the Bernstein 'Memory of Paper' project [35]. The baptism of the online version was accompanied by the publication of a volume, containing the papers delivered on occasion of the launch in November 2004, see: *Piccard-Online. Digitale Präsentationen von Wasserzeichen und ihre Nutzung*, herausgegeben von Peter Rückert, Jeannette Godau, und Gerald Maier, Stuttgart, Kohlhammer, 2007, while a volume of conference acts for the centenary of Piccard's birth is: *Wasserzeichen und Filigranologie. Beiträge einer Tagung zum 100. Geburtstag von Gerhard Piccard (1909-1989)*, herausgegeben von Peter Rückert und Erwin Frauenknecht, Stuttgart, Kohlhammer, 2011. A critical study that makes extensive use of the data in Piccard to establish the movement of paper in European commerce is Maria Zaar-Görgens, *Champagne-Bar-Lothringen. Papierproduktion und Papierabsatz vom 14. bis zum Ende des 16. Jahrhunderts*, Trier, Porta-Alba-Verlag, 2004.

A different sort of repertory describes the watermarks found in a particular corpus of manuscripts. One cleverly conceived example is Dieter und Johanna Harlfinger, *Wasserzeichen aus griechischen Handschriften*, Berlin, Verlag Nikolaus Mielke, 1974-80, 2 vols., which – in some copies – has the unusual characteristic of being distributed in ring binders, thus facilitating comparison, but also making it easy to lose leaves. The project is continued in Mark L. Sosower, *Signa officinarum chartariorum in codicibus graecis saeculo sexto decimo fabricatis in bibliothecis Hispaniae*, Amsterdam, Adolf M. Hakkert, 2004. Importantly, these two repertories describe, trace, and present to the reader the watermarks in the corpus as twins. It is

perhaps unfortunate therefore that they are not more widely known, outside specialist reading rooms.

Another example of a genre-based repertory is Monique Zerdoun Bat-Yehouda, *Les papiers filigranés des manuscrits hébreux datés jusqu'à 1450 conservés en France et en Israël*, Turnhout, Brepols, 1997, in two volumes, one dedicated to the description of the paper and the other to the watermarks.

Further down the chronological scale, but also conscious epigones of Briquet, are two volumes that take his method and repertory into subsequent centuries: W.A. Churchill, *Watermarks in Paper in Holland, England, France, etc., in the XVII and XVIII Centuries and their Interconnection*, cit., 1935, and Edward Heawood, *Watermarks, mainly of the 17th and 18th Centuries*, Hilversum, The Paper Publications Society, 1950. A further extension of Briquet, this time limited to France in the Seventeenth and Eighteenth centuries, is Raymond Gaudriault, *Filigranes et autres caractéristiques des papiers fabriqués en France aux XVII^e et XVIII^e siècles*, cit., 1995. At one level this is an invaluable piece of historical research, especially in its assembly of the secondary bibliography, including numerous archive and manuscript sources; at another the tracings are mostly recopied from previous repertories, without any indication of wire or chainlines (*even when they are present in the source*), and thus are only helpful in a very general sort of way.

Numerous repertories, including all the more important ones, have been converted into digital format and are consultable on the Bernstein 'Memory of Paper' project [35].

[19]

Claims and Controversies about the Earliest Known Watermark

As well as in *Les filigranes*, n. 5410, Briquet included the tracing of the watermark attributed, with a question mark, to 1282 among the items on display at the Paris Exhibition of 1900, see *Musée rétrospectif de la classe 88 Fabrication du papier*, cit., 1900, pp. 48-49, where attention is drawn to a similar mark, on a piece of paper dated 1293, in the Zonghi collection (p. 16), subsequently cited also as a secondary reference in *Les filigranes*, n. 5412 (*with the date, however, "1294"*). It might have slipped Briquet's mind that in his early article 'Recherches sur les premiers papiers', cit., 1886, he had cited and reproduced a similar Greek cross (n. 39), with the date 1294, found in the archive at Fabriano, for which he had provided a reference to the source.

A further curiosity about the earliest recorded watermark is that, though it was certainly discovered in his Italian journey of 1889-90, in none of his writings previous to 1900 does Briquet himself make reference to it, nor is it cited in his diary for that particular journey. It is plausible, therefore, that he himself remained doubtful about the reliability of the date. In his 'Addenda and corrigenda' to the 1968 edition, p. *68, Stevenson remarks that the 1282 date was contested by Piccard, who had discovered the same design in a document dated 1294, see Gerhard Piccard, 'Carta bombycina, carta papyri, pergamena graeca: ein Beitrag zur Geschichte der Beschreibstoffe im Mittelalter', *Archivalische Zeitschrift*, vol. 61 (1965), pp. 46-75. On the so far unsuccessful search for the original document seen by Briquet in the State Archive at Bologna, see Nicoloangelo Scianna, 'Le filigrane bolognesi di Charles Moïse Briquet', in *Belle le contrade della memoria. Studi su documenti e libri in onore di Maria Gioia Tavoni*, a cura di Federica Rossi, Paolo Tinti, Bologna, Pàtron editore, 2009, pp. 365-378.

The unconvincing and unwise claim relating to a watermark dated "1271" can be found in 'La più antica filigrana conosciuta (non posteriore al 1271) e una Rima volgare inedita del XIV sec. ("Rima lombarda de vallore")', pubblicate a cura di Ubaldo Meroni, commento alla Rima e glossario di Concetta Meroni-Zanghi, Cremona, Biblioteca Governativa e Libreria Civica di Cremona, 1953 (*Annali della Biblioteca Governativa e Libreria Civica di Cremona*, 5, fasc. 1, 1952; *Monumenta cremonensia*, 1). The manuscript in question (ms. A.1), which in 1952-53 was in the archive of the Ospedale Maggiore at Cremona, has since been deposited, together with the rest of the hospital's Medieval archive, at the State Archive in Cremona.

[20]

Seeing Watermarks

To see a watermark, you need a source of light. Traditionally this has been a window on a sunny day; more recently, with artificial lighting, it has been possible to position a light behind a sheet (*anglepoise lights are particularly helpful from this point of view*). Bibliographers have, however, got into the habit of travelling with their own light sources: Conor Fahy often carried a rechargeable camping light, which actually worked very well. Highly recommended, from any decent sports or bicycle shop, are the new generation of cycling lamps

with Led technology. Not only are they very cheap (*approximately € 8*), they are also light and easy to handle, so that I use them out of preference when conducting rapid searches through the watermarks of a book, rather than a more cumbersome lightsheet. They have the additional advantage that they can be used as well to generate an on-the-spot raking light, which is invaluable in distinguishing mould/felt side of the sheet. Led technology means that they are also rechargeable from a computer or from a cell-phone charger, which saves one the grief of a battery dying halfway through the scrutiny of a document, as once happened to me in Berlin (*but that is another story*). Otherwise remember that the latest generation of cellphones incorporate a torch device.

With bound volumes, on the other hand, matters are more complex and technologies have been developed to make the task of viewing easier. From the mid-1990s various companies have marketed light-boxes or, more recently, thin optic-fibre light-sheets, which have applications in much wider fields than just looking at paper. Some are however conceived and presented specifically for applications to books and documents. While early versions of these products, which require a converter, were fairly bulky and heavy, and also hideously expensive, the latest products are much lighter, can easily be carried around, and, being ultra-thin, get right into the margin of even tightly-bound books, so that serious paper scholars need to add them to their working luggage (*if they have not already done so*). On the matter of prices, a word of caution. The market place includes a number of small firms, specialising in conservation and restoration, also with reference to the field of art history, who offer this equipment at prices that are sometimes rather high (*or, more simply, exorbitant*). So shop around!

In what follows, I have tried to keep my information as up-to-date as possible, including pricewise, but, as ever, in the commercial market products come and go. One firm is Preservation Equipment, which has a base at Diss, Norfolk (GB). In 2016 it is offering a basic A4-sized light-sheet for £ 107, and a top of the market fibre-optic light-sheet of the same size for £ 762, where the price seems a trifle steep; it also offers portable light-boxes at a variety of prices, and their catalogue is certainly worth perusal. The Italian firm CTS (*no idea what the acronym stands for*) specialises in supplies and know-how in the field of art history, which is now very big business, but they do a side-line in archive and book conservation. The headquarters is near Vicenza, with subsidiaries in Italy at Milan, Florence, Rome, Naples, and elsewhere in France, India, Romania, Spain, Switzerland, and Turkey. In their 2016 catalogue, section 11.8, they offer an A4-sized light-sheet, together with a robust carrying case (*total weight 2 kil.*). The price does not appear, but I am reliably informed that it is € 200; a query about availability made directly to the firm in 2016, however, established that at present no light-sheets are in stock. In England the firm Earlypaper, owned by Ian Christie-Miller, offers an A4 lightsheet for £ 400 and an A3 for £ 600, excluding VAT (www.earlybook.info). As matters stand, therefore, decidedly the best option is the truly excellent selection of light-sheets available from the American firm CPD Lighting in Colmar, Pennsylvania, a spin-off from the larger firm Ceelite, which was marketing them several years ago. On enquiry, I received a courteous reply from Don Sowers (don@cpdlighting.com) with a list of several sizes: just to give an idea of the prices, in 2016 an A4 panel with converter was \$ 82, A3 \$ 146, and A2 \$ 339. Obviously, shipping costs have to be added, but a discount is offered for a bulk purchase. If any library conservator is perusing this paragraph (*by mistake*), these devices are invaluable also for the wear and tear they save on the books, unless you sadistically enjoy the spectacle of scholars waltzing around and holding priceless manuscripts or printed artefacts up to the sunbeam coming through the window. So please, please buy at least a couple and, as well as the basic A4 size, think about getting a larger A3 which makes it possible to photograph a leaf of Royal paper or a whole sheet of Chancery.

Light-sheets also make it much easier to photograph watermarks, even with a hand-held cellphone, a procedure nowadays accepted in most libraries and archives. (*Who says technology is entirely bad?*)

[21]

Naming and Describing Watermarks

The earliest extensive list of watermark names, as well as references to different sheet sizes, appears in the ledgers of the firm established by the Fabriano paper merchant, Ambrogio di Bonaventura, and carried on by his son, Lodovico d'Ambrogio. It is a chance survival, since the Medieval archive of Fabriano was destroyed in the Sixteenth century, in one of Italy's innumerable local wars, and in any case these are commercial papers. Fourteen registers relating to this particular firm have survived and reached the Fabriano city archive from the local Foundling hospital (*something not uncommon in the history of Italian documents*): the earliest covers the years 1363-66; the next the years 1395-1416, and about half of them relate to the activity of the *cialandratore*, or paper-polisher. Although their contents are summarized by Zonghi, they are still unpublished (*and this is a pity and a nuisance*). For a fuller description, see Giancarlo Castagnari-Nora

Lipparoni, 'Arte e commercio della carta bambagina nei libri dei mercanti fabrianesi tra XIV e XV secolo', in *Atti e Memorie della Deputazione di Storia Patria per le Marche*, vol. 87 (1982), pp. 185-222. A transcription of the contents of one of the registers, pressmark n. 1354, covering the years 1398-1414, is available, however, in the M.A. thesis of Elisabetta Graziosi, 'Il registro contabile di Lodovico di Ambrogio, mercante di carta: un'edizione', Venezia, Università Ca' Foscari, Corso di laurea magistrale in Storia dal Medioevo all'età contemporanea, relatore prof. Marco Pozza, 2013-14 (*available through the website of the University of Venice*), which also provides an extensive introduction to the figure of Lodovico d'Ambrogio. This one example whets the appetite to know the contents of the rest.

Another important Renaissance source, containing references to watermark names and sheet sizes, is the so-called Ripoli Diary, recording the activity of a press in the Dominican female convent in Florence, see Melissa Conway, *The Diario of the Printing Press of San Jacopo di Ripoli (1476-1484). Commentary and Transcription*, Firenze, Olschki, 1999, which includes an index 'Listing the types and sources of paper used' (pp. 327-331). This index, however, contains numerous omissions and imprecisions, while the present writer has expressed doubts about the quality and accuracy of the edition in general, see Neil Harris, 'A Review of the *Diario*', *The Book Collector*, vol. 50 (2001), pp. 10-32, which is followed by a reply by the author of the book (pp. 33-41).

A detailed descriptive procedure for the description of watermarks is expounded by G. Thomas Tanselle, 'The Bibliographical Description of Paper', *Studies in Bibliography*, vol. 24 (1971), pp. 27-67, republished in *Readings in Descriptive Bibliography*, edited by John Bush Jones, Kent (Ohio), Kent State University, 1974, pp. 71-115, and in Tanselle, *Selected Studies in Bibliography*, Charlottesville, Bibliographical Society of the University of Virginia, 1979, pp. 203-243. Though this article is much cited, I have rarely seen its prescriptions applied.

Indications about how palaeographers approach the problem of describing paper can be found in Denis Muzerelle, *Vocabulaire codicologique. Répertoire méthodique des termes français relatifs aux manuscrits*, Paris, CEMI, 1985. The expanded Italian and somewhat cuckoo-like version of the same is Marilena Maniaci, *Terminologia del libro manoscritto*, Milano, Editrice bibliografica, 1996 (*but, at least on the subject of paper, this last work is sadly misleading and inaccurate, as is pointed out by self in a review in The Library*, s. VI, vol. 20, 1998, pp. 145-147). A similar operation has also been conducted in Spain, see Pilar Ostos, Maria Luisa Pardo, Elena E. Rodriguez, *Vocabulario de codicología*, version española revisada y aumentada del *Vocabulaire codicologique* de Denis Muzerelle, Madrid, Arco, 1997. A hypertextual version, which brings together French, Italian, Spanish, and provisionally English versions, is available on the site www.palaeographia.org, but seems stuck in 2002. A useful survey of the problems posed by a polyglot lexis for palaeographers approaching paper is Nigel F. Palmer, 'Verbalizing Watermarks. The Question of a Multilingual Database', in *Piccard-Online. Digitale Präsentationen von Wasserzeichen und ihre Nutzung*, cit., 2007, pp. 73-90.

Otherwise, the issue of standardising the vocabulary and constructing a thesaurus of descriptive terms is complicated by the instinctive polyglottism of paper and watermark scholarship (*though it is nice working with such an erudite bunch of people*). Just to cast an eye at how the problem posed itself in the pre-computer era, see in Italian: Andrea F. Gasparinetti, 'Per l'adozione di una terminologia generale delle filigrane', in *The Briquet Album*, cit., 1953, pp. 119-121, and in German: Wisso Weiss, 'Zur Terminologie der Wasserzeichenkunde', *Papiergeschichte*, vol. 12 (1962), pp. 9-17; while a new era is heralded by Denis Muzerelle-Ezio Ornato-Monique Zerdoun, 'Un protocole de description des papiers filigranés', *Gazette du livre médiéval*, vol. 14 (1989), pp. 16-24. The Rare Books and Manuscripts Section of the Association of College and Research Libraries, itself a division of the American Library Association, has published, as part of its series of controlled vocabularies, *Paper Terms. A Thesaurus for Use in Rare Book and Special Collections Cataloguing*, prepared by the Bibliographic Standards Committee of the Rare Books and Manuscripts Section (ACRL/ALA), Chicago, Association of College and Research Libraries, 1990. In its original draft it is mostly the work of Sidney E. Berger, who brought his enormous experience as a book and papermaker to the task, and it is now available as an online source on the RBMS website. It can be consulted both as an Alphabetical list and as a Hierarchical list, although its usefulness is restricted primarily to the field of rare book cataloguing. Most importantly, it steers well away from the Scylla and Charybdis of nomenclatures for watermarks.

For more general purposes, therefore, the best place to go is to the *International Standard for the Registration of Papers with or without Watermarks = Internationale Norm für die Erfassung von Papieren mit oder ohne Wasserzeichen = Norme internationale d'enregistrement des papiers avec ou sans filigrane*, issued by the International Association of Paper Historians and mostly the work of the fertile genius of Peter F. Tschudin, with the purpose of establishing a Thesaurus and standard procedure for electronic cataloguing

and retrieval. Their proposals were first issued in 1992 (IPH Standard 1.0), reissued in 1997 (IPH Standard 2.0), further revised in 2013 (IPH Standard 2.1.1), and are available for download on the IPH website. Four languages are available: English, German, French and Italian (*the 1997 standard has Spanish instead of Italian*), while Appendix 1A 'Index of Watermark Classes and Subclasses, Illustrated', also includes the terminology in Russian and Spanish. They are well worth looking at, although scholars puzzling over the watermarks in a single manuscript or printed book might decide that they are a bit too much of a headache. In terms of a practical application, the multiple lexis – English, French, German, Italian, Russian, and Spanish – of the Bernstein 'Memory of Paper' project provides an excellent example of how intricate harnessing the vocabulary of paper can be.

[22]

Describing Unwatermarked Paper

A bit like the seamy, but ever-delightful, joke about the Oxford don sunbathing in the nude at Parson's Pleasure (*look it up!*), seasoned paper scholars do sometimes assert that sheets of paper should be studied in their entirety rather than relying on the sometimes unreliable watermarks. This recommendation is something of a necessity when the sheets are devoid of watermarks, but, unless distinctive features such as tranchefiles or chain-lines are broken or have slipped out of position, like most homely prescriptions, it is easier said than done. The two essential features that should be noted, however, are the sheet-size (*even if trimming renders the measurement approximate*) and the distances between chain-lines. The spacing of wirelines can also be useful. Some useful tips about procedures that can be followed, albeit with reference to Eighteenth-century examples, are to be found in David Vander Meulen, 'The Identification of Paper without Watermarks. The Example of Pope's *Dunciad*', *Studies in Bibliography*, vol. 37 (1984), pp. 58-81.

One related problem is when a manuscript or printed document, in a medium or small format, contains unwatermarked parts of sheets, which have to be related to the larger original entity. Here, the finest example of how to go about the problem is Alan Tyson's work on the paper of Mozart [25].

[23]

Reproducing Watermarks

Watermarks can be reproduced by freehand drawing, tracing, rubbing, photography with an ordinary light behind the sheet, β -radiography, soft x-ray radiography, electron-radiography, infra-red imaging, DYLUX, digital imaging, and various other cutting-edge methods that I struggle to comprehend. As far as the more advanced technologies go, in their application to a field which falls essentially in the poverty-stricken parish of the humanities, the sensation as ever is of one step forwards and two or three backwards. The main problem, rather perplexingly, has proved to be obsolescence, which translates itself into difficult to find and expensive when you do find it. Procedures such as β -radiography and DYLUX paper were spin-offs from other procedures and therefore have mostly disappeared, together with their original applications. Where they have been kept available, the costs are onerous, especially considering the shoestring budgets paper scholars commonly work on. In this paragraph therefore I have sought not only to determine what has been and can be achieved by each and every method, but also the present-day availability and cost-effectiveness.

Comparisons are invidious, so it is very difficult for an outsider to decide which is the "best" method. One excellent and very useful article therefore is Manfred Werner-Helmgard Wallner-Holle, 'Determination of Watermarks by Non-destructive Techniques. Comparative Studies', in *Paper as a Medium of Cultural Heritage*, cit., 2004, pp. 142-152, see also the slides displaying the same material from a 2009 lecture by Manfred Schreiner, 'Technical Studies of Watermarks at the Academy of Fine Arts, Vienna', on the Bernstein 'Memory of Paper' site. The said study takes four essential technologies, i.e. simple backlighting with a light-panel and a digital photo, DYLUX paper, β -radiography, and Soft x-ray radiography, and applies them to the same three test cases (*all of them rather awkward*). As a spoiler, Soft x-ray radiography gets home by a nose compared to β -radiography, while DYLUX paper does badly, and backlighting cannot even see the watermark. It would be very useful to see a fuller study along these lines, with perhaps some more average samples, and including the full range of procedures described here below, including an assessment of availability and cost-effectiveness. An analogous comparative study in the field of art-history is Peter Meinlschmidt-Volker Märgner, 'Advantages and Disadvantages of Various Techniques for the Visualization of Watermarks', *Restaurator*, vol. 30 (2009), pp. 222-243, which extends the evaluation to consider infra-red and phosphorescence techniques.

To get back to practicalities, it is inevitably important to distinguish between the mere reproduction of watermarks, usually in manuscript, and publication of the same, which requires a specific, and sometimes complex, printing technology (*it is worth remembering that among Briquet's interests was a small publishing house that specialised in photolithographic images of the Swiss scenery, so when you look at the skillful layout of the images in Les filigranes, remember that it is the outcome of long-standing expertise*).

One thing the field requires as a starting point for future work is a thorough, up-to-date survey of early publications containing reproductions of watermarks, in which the method is specified, together with details such as accurate sheet measurements, the identification of twin watermarks, and recognition of the felt/mould side of the sheet. Briquet himself starts the ball rolling with a preliminary picture in 'Papiers et filigranes des Archives de Gênes 1154 à 1700', cit., 1888, pp. 57-61, and adds a fuller listing in his 'Bibliographie. Liste des principaux publications relatives aux filigranes' in the *magnum opus* (I, pp. viii-x), including notes on the number of watermarks reproduced in each item. More recently, Phillip Pulsiano, 'A Checklist of Books and Articles containing Reproductions of Watermarks', in *Essays in Paper Analysis*, cit., 1987, pp. 115-153, has given an intelligent listing of 534 titles, ordered alphabetically by author, including an indication of the number of watermarks in each item. Unfortunately, he does not specify the technique of reproduction concerned, which might have been helpful. Indications are provided as well by David Schoonover, 'Techniques of Reproducing Watermarks. A Practical Introduction', also in *Essays in Paper Analysis*, cit., 1987, pp. 154-167. But, certainly, more could be done.

The earliest published reproduction of a watermark is in the collective work of Gerard Meerman and others, *De Chartae Vulgaris seu Lineae Origine*, cit., 1767, wherein the observations of Johann Samuel Heringen are accompanied by highly-stylised woodcut reproductions of a crown watermark (p. 110) and a bull's head watermark (p. 125) [5]. Subsequent early publications employ copperplates or, as in Briquet, lithographs to reproduce freehand drawings or tracings. In his introduction to *Les filigranes* Briquet provides a brief description of his method of tracing watermarks, while other basic systems, such as rubbing, require relatively little explanation [see Chapter 6].

In a more scientific mode, the best known technique is radiography, in some form or other. In terms of the general principles and procedures, see *Radiography of Cultural Material*, edited by Janet Lang and Andrew Middleton, 2nd edition, Oxford, Butterworth-Heinemann, 2005 (1st edition: 1997), which includes an essay by Vincent Daniels-Janet Lang, 'X-rays and Paper', pp. 96-111.

Historically the earliest of the various techniques to be applied to paper, the use of β -radiographs, was announced in the West by J.S.G. Simmons, 'The Leningrad Method of Watermark Reproduction', *The Book Collector*, vol. 10 (1961), pp. 329-332, which provides bibliographical information about early Russian experiments and related publications; see also Allan Stevenson, 'Beta-radiography and Paper Research', in *International Congress of Paper Historians*, vol. 7, edited by J.S.G. Simmons, Oxford 1967, pp. 159-168. Also pioneering is Charles F. Bridgman, 'Radiography of Paper', *Studies in Conservation*, vol. 10 (1965), pp. 8-17. The earliest published example, at least in a Western book, may be the example of a passport watermark in J.L. (John Laban) Putman, *Isotopes*, Harmondsworth, Penguin Books, 1960, plate 15. In the materials added to the 1968 reprint of Briquet, Allan Stevenson includes twelve examples, some of them twins, of 'Watermark Beta-radiographs' (plates *A-*C), together with a commentary, and β -radiographs feature also in *The Problem of the Missale Speciale*, cit., 1967. A good pair of illustrations, showing the same watermark, photographed once with ordinary light and once with a β -radiograph, from a 1477 incunable appear in Gaskell, *A New Introduction to Bibliography*, cit., 1972, p. 64 (*unfortunately we are not told whether the image is from the mould or the felt side, or anything about the twin*). Two pages of 'Bibliography of Works dealing with Beta-radiography of Watermarks, 1960-1972' are provided by Frederick Hudson at the end of his article in *Essays in Paper Analysis*, cit., 1987, pp. 59-60.

Further applications of β -radiography in the field of the Fifteenth-century book are described in Dierk Schnitger, Eva Ziesche and Eberhard Mundry, 'Elektronenradiographie als Hilfsmittel für die Identifizierung schwer oder nicht erkennbarer Wasserzeichen', *Gutenberg Jahrbuch*, 1983, pp. 49-67, while its utility in the field of music manuscripts and printing is expounded in Frederick Hudson, 'The Study of Watermarks as a Research Factor in Undated Manuscripts and Prints: Beta-radiography with Carbon 14 Sources', in International Musicological Society, *Report of the Eleventh Congress, Copenhagen 1972*, Copenhagen 1974, I, pp. 447-453. In the field of art history, β -radiography has been applied to the reproduction and description of the paper used by Rembrandt's prints, see Nancy Ash and Shelley Fletcher, *Watermarks in Rembrandt's Prints*, Washington, The National Gallery of Art, 1998, with a *resumé* by the same authors, 'Watermarks in Rembrandt's Prints: The Use of Watermarks to Study the Prints of an Artist', in *Puzzles in Paper*, cit., 2000, pp. 57-65. As far as collections of drawings are concerned, the Louvre has been pioneering in this field, making extensive use of β -radiography, see the trilingual pamphlet by Ariane de la Chapelle-André Le Prat,

Les relevés de filigranes = Watermark Records = I rilievi di filigrane, Paris, La Documentation Française, 1996, defining the ground-rules for their activity, including some very nice illustrations, and, more specifically, Ariane de la Chapelle, 'La bêtaradiographie et l'étude des papiers: beaucoup plus qu'une belle image', *Gazette du livre médiéval*, n. 34 (1999), pp. 13-24. The Louvre has also been active in the Bernstein project. For the application of β -radiography to Renaissance copper-plate maps, see David Woodward, *Catalogue of Watermarks in Italian Printed Maps ca 1540-1600*, Firenze, Olschki, 1996 (and the titles listed in [26] below). An ample selection of β -radiographs can be viewed and downloaded on the project, masterminded by David L. Gants, 'A Digital Catalogue of Watermarks and Type Ornaments used by William Stansby in the Printing of *The Works of Benjamin Jonson* (London 1616)', on the website of the Institute for Advanced Technology in the Humanities at the University of Virginia, though the images were actually obtained by James Riddell from the Huntington in the 1990s (I thank David Gants for this information). The various imaging services in major institutions contacted by myself informed that there has been very little request for β -radiographs in the last decade or so, to which have to be added the increasing restrictions about the use of radioactive sources and difficulties in obtaining the right sort of paper for the negative image. In 2016 I established by correspondence that the imaging services of some major research libraries, such as the Huntington Library (possibly) and the Bodleian Library (very hypothetically), might still be willing to produce β -radiographs, but the cost would be (in their own words) "onerous". Otherwise, and it is a big otherwise, the only structure where the technique is still being used is the Institut für Mittelalterforschung in Vienna, as part of the ongoing research project on the watermarks in Medieval manuscripts in Austrian libraries (contact dr. Emanuel Wenger).

For a description and examples of the images obtained by electron radiography, see the website of the Watermarks in the Low Countries project hosted by the Koninklijke Bibliotheek in The Hague. The same website, however, fails to explain that the technology is no longer being applied to the project and has to be considered no longer available. Which is a pity!

In the mid-1980s Soft x-ray radiography was applied by former professor of dental radiology at the University of Utrecht, Jan van Aken, to the technical problem of imaging watermarks (no dentist jokes, please!). Albeit essentially the same principle as β -radiographs, the x-rays are imparted from a tube through a layer of helium. The procedure is described by its inventor in Jan van Aken, 'An Improvement in Grenz Radiography of Paper to Record Watermarks, Chain and Laid Lines', *Studies in Conservation*, vol. 48 (2003), pp. 103-110, as well as more recently in Laurentius & Laurentius, *Italian Watermarks 1750-1800*, cit., 2016, pp. 7-9. At an early stage the procedure was applied with success to the study of the paper used by Rembrandt, who was something of a fanatic about paper and the first European artist to use Japanese paper, for his prints, see Theo Laurentius, Harry M.M. van Hugten, Erik Hinterding and Jan Piet Filedt Kok, 'Het Amsterdamse Onderzoek naar Rembrandts Papier: Radiografie van de Watermerken in de Etsen van Rembrandt', *Bulletin van het Rijksmuseum*, vol. 40 (1992), pp. 353-384. One small problem: it's in Dutch, but one can always look at the etchings. Subsequent applications have been by Theo and Frans Laurentius to their studies of Dutch watermarks in the Seventeenth century [6f] and to the same authors' study of Italian watermarks of the modern period [6e]. Personal consultation with Frans Laurentius in 2016 has established that the method is available to outsiders at the Laurentius' laboratory in Middleburg, and likewise, after consultation with Manfred Scheiner, could be made available at the Akademie der Bildenden Künste in Vienna, though in the latter case the procedure has been in abeyance for several years. Digital radiography is being developed in medicine and dentistry, with a knock-on effect for cultural artefacts in several different fields. One insightful introductory page is 'Digital Radiography for Cultural Heritage Professionals', with indications about the technical bibliography, on the website of the Smithsonian.

Turning to alternative procedures, DYLUX Instant Access Imaging Paper was developed in the early 1960s and put on the market as a product for the graphic arts industry in 1969, where it was employed as a proofing medium for lithographic negatives, allowing a user to generate an immediately accessible image. The philatelist and paper historian, Thomas Gravell (1913-2004), applied DYLUX paper to obtain prints, as from negatives, of the watermarks in stamps, before enlarging the application to watermarks in a more traditional fashion. Essentially the method consists of shining fluorescent light through the sheet of paper containing a watermark to an underlying piece of DYLUX 503 for a period, depending on the thickness of the paper, of between one to five minutes. Where the paper is thinner, in correspondence with the watermark and chain-lines, more light passes through and thus "nullifies" the yellow dye coating on the surface of the DYLUX paper. Afterwards the DYLUX paper is exposed to a long-wave ultra-violet light, which causes the less-exposed dye to turn sky-blue, while the watermark and the chainlines appear as white. As a technology, it was at the time both cheap and easy to use, once the basic procedures had been mastered. Gravell described the method in 'A New Method of Reproducing Watermarks for Study', *Restaurator*, vol. 2 (1975), pp. 95-104, and also published a series of articles on the method in philately journals, see the listing in

Puzzles in Paper, cit., 2000, pp. 247-248. See also the images provided on-line in the site of the Thomas L. Gravell Watermark Archive at the University of Delaware. He subsequently expanded his interests and applications of the technique to more traditional watermarked materials, which led him to publish, with George Miller, *A Catalogue of American Watermarks, 1690-1835*, New York, Garland, 1979, which includes 734 images of watermarks, reproduced with DYLUX and printed in black and white. A second edition has subsequently appeared, see Thomas Gravell, George Miller, Elizabeth Walsh, *American Watermarks, 1690-1835*, New Castle, Oak Knoll Press, 2002, in which the number of watermarks documented rises to 1,057. This first work was followed by Thomas L. Gravell-George Miller, *A Catalogue of Foreign Watermarks found on Paper used in America, 1700-1835*, New York, Garland, 1983. A brief description of Gravell's method is provided in Rolf Dessauer, 'DYLUX, Thomas L. Gravell, and Watermarks of Stamps and Papers', in *Puzzles in Paper*, cit., 2000, pp. 183-185. Unfortunately, the graphic arts have since shifted into the realm of digital technology: the original makers of DYLUX, Du Pont, sold the rights to the product to Graphec LLC in 2008 and the fabrication of DYLUX paper as a brand has since been discontinued. Scouring around on the internet, at the time of writing some sources still had DYLUX paper in their catalogues, but the material does have an expiry date. Otherwise, in the trade, the material is more generically known as "Blue proofing paper" and can be obtained from specialist suppliers, such as the GWJ Company (see *website*).

As an alternative method, phosphorescence and infra-red imaging have been experimented in the field of art history. The first technique involves a mixture of ultra-violet and infra-red light derived from a phosphorescent pigment embedded in a plate, see Carol Ann Small, 'Phosphorescence Watermark Imaging', in *Puzzles in Paper*, cit., 2000, pp. 169-181. The second consists in placing a source of heat, normally a copper plate or panel heated to a temperature of about 40°C, behind a leaf or sheet of paper. Since the paper is thinner in coincidence with chainlines and watermarks, the warmth penetrates more easily and quickly in these point and can be photographed with an infra-red camera, see Meinschmidt-Märgner, 'Advantages and Disadvantages of Various Techniques for the Visualization of Watermarks', cit., 2009.

Digital methods were pioneered in the 1990s with exciting, and even extraordinary, results by a private firm, Fotoscientifica in Parma, Italy, owned by photographer and publicist Daniele Broia (1944-2013), which published a short pamphlet, available in either English or Italian, describing the method, see *La marca d'acqua*, [Parma, Fotoscientifica, 1997]. A parallel account in English is also available in Daniela Moschini, 'La Marca d'Acqua: A System for the Digital Recording of Watermarks', in *Puzzles in Paper*, cit., 2000, pp. 187-192. A superb set of the images obtained with this technique is visible in Conor Fahy, 'La carta dell'esemplare veronese del *Furioso* 1532', *La Bibliofilia*, vol. 100 (1998), pp. 283-300, also issued as part of the periodical's centenary in the volume: *Anatomie bibliologiche: saggi di storia del libro per il centenario de «La Bibliofilia»*, a cura di Luigi Balsamo e Pierangelo Bellettini, Firenze, Olschki, 1999 (*same paging*). The firm has also worked on the digital imaging of the 'Corpus chartarum Italiae', but Daniele's untimely death in November 2013 meant that he took the secrets of his method to the grave and put an end to his fascinating endeavour. Similar techniques have obviously been attempted elsewhere, see David L. Gants, 'The Application of Digital Image Processing to the Analysis of Watermarked Paper and Printers' Ornament Usage in Early Printed Books', in *New Ways of Looking at Old Texts II. Papers of the Renaissance English Text Society*, 1992-1996, edited by W. Speed Hill, Tempe, Medieval and Renaissance Texts and Studies, 1998, pp. 133-147. An *Advanced Paper Imaging System (APIS)* was developed in 2003 by the firm Solar Imaging Systems in Rochester, Kent, in which, relying on the principle that overprinting differs from leaf to leaf, a image of the watermark is constructed by superimposing different shots and obtaining a composite, see Ian Christie-Miller, 'The Paper of the *Grete Herball*, 1526', *The Quarterly*, n. 53, January 2005, pp. 26-29. In this last instance the research, based primarily on the unicorn watermarks in five copies of this book, makes no reference to the existence of twin watermarks nor to the necessity of distinguishing felt/mould sides of the sheet.

Advanced digital imaging is being experimented at the British Library by Christina Duffy, who also curates a lively blog at blogs.bl.uk/collectioncare. In a rather daunting display of digital expertise, she identifies an Eighteenth-century posthorn watermark on a piece of paper glued to the inner board of St. Cuthbert's Gospel at the British Library, see 'The 'Discovery of a Watermark on the St Cuthbert Gospel using Colour Space Analysis'', *Electronic British Library Journal*, 2014, article 2 (*online journal*). Otherwise, a "kit" to assist with the digital imaging of watermarks can be downloaded from the Bernstein website, but requires the user to obtain particular softwares before it can be employed.

[24]

Artists, Artists' Papers, and Copperplate Printing

Something of a problem here: the study of the paper used by artists for sketches from the Renaissance to modern times is hampered by the poor survival rate, to which should be added the fact that paper was often acquired in special sizes or formats and at times was coloured. We also have to bear in mind that artists will often draw on anything that happens to hand, since as a profession they were rarely flush with money and inspiration could happen on the spur of the moment.

The other more modern difficulty is that framed sketches make it difficult to see watermarks. Some work has nevertheless been done, with a useful overview provided in Albert J. Elen, 'Paper Analysis in Italian Drawing Books of the 15th and 16th Centuries', in *Le papier au Moyen Âge*, cit., 1999, pp. 193-202. A pioneering effort, in which the watermarks have been lit with a retro-light and nicely reproduced, is Jane Roberts, *A Dictionary of Michelangelo's Watermarks*, Milan, Olivetti, 1988, now continued in a project at the Dutch University Institute for Art History in Florence, see Henryk van Hugten, 'Watermarks in the Drawings and Manuscripts of Michelangelo Buonarroti', in *Paper as a Medium of Cultural Heritage*, cit., 2004, pp. 401-408. The watermarks present in the corpus of drawings of the Renaissance Italian artist Pisanello at the Louvre are described in Ariane de la Chapelle, 'Les papiers et les filigranes des dessins du corpus pisanellien du Musée du Louvre: état des recherches', in *Pisanello. Actes du colloque organisé au Musée du Louvre par le Service Culturel les 26, 27 et 28 juin 1996, établis par Dominique Cordellier et Bernadette Py*, Paris, La Documentation Française, 1998, pp. 711-745.

As far as England is concerned, a well-informed and attractively illustrated overview is provided in John Krill, *English Artists' paper: Renaissance to Regency*, New Castle, Oak Knoll Press; Winterthur, Winterthur Museum, 2002. A specific case study on a major artist by a very knowledgeable scholar is Peter Bower, *Turner's Papers: A Study of the Manufacture, Selection and Use of his Drawing Papers, 1787-1820*, London, Tate Gallery, 1990, followed by Idem, *Turner's Later Papers. A Study of the Manufacture, Selection and Use of his Drawing Papers, 1820-1851*, London, Tate Gallery publishing; New Castle, Oak Knoll press, 1999. The same author has produced numerous short articles on the paper used by British artists, mostly published in *The Quarterly*.

Copperplate printing, like blockbook printing, is a bibliographical rather than a paper matter, in which it is necessary to understand the interaction between two technologies. Letterpress printing with moveable type required formes to be set, printed off, and the type distributed back into the case, so the whole pressrun had to take place at the same moment. Copperplates, on the other hand, once engraved, could be kept for an infinite period of time. Since the metal wore quite quickly in printing, the plates had to be retouched, or sometimes corrected, generating different states, an expensive process; and likewise copperplate printing called for a thick, high-quality paper, especially wove, once it was available. All these factors ensured that publishers of large copperplate editions, such as the *Microcosm of London* (1808-10) or Audubon's *Birds of America* (1827-38), printed the letterpress in a single moment, but ran the plates off in a series of lots over time. Paper evidence therefore is invaluable in distinguishing these successive chronological layers, and scholars of prints have always been aware of its importance, as well as the many parallels with the technology of map-printing [26]. A good synthesis is the chapter on 'Paper' by Marie Christine Enshaian in the collective volume *Old Master Prints and Drawings. A Guide to Preservation and Conservation*, Amsterdam, Amsterdam University Press, 1997, pp. 37-60. A specific instance is the truly excellent catalogue of the images of Giovanni Battista Piranesi (1720-78), which includes ample information about the watermarks as part of the distinction between the successive impressions, see Andrew Robinson, *Piranesi: Early Architectural Fantasies. A Catalogue Raisonné of the Etchings*, Washington, National Gallery of Art-Chicago, University of Chicago Press, 1986.

[25]

Music and Musicology

Musicologists have often been pioneering in their exploitation of paper evidence in the study of composers' manuscripts. Specific applications in this field are Stephen Shearon, 'Watermarks and Rastra in Neapolitan Music Manuscripts, 1700-1815', in *Puzzles in Paper*, cit., 2000, pp. 107-124; Steven Zohn, 'Music Paper at the Dresden Court and the Chronology of Telemann's Instrumental Music', in *Puzzles in Paper*, cit., 2000, pp. 125-168. As far as individual composers are concerned, extensive work has been done on the manuscripts of Johann Sebastian Bach by Alfred Dürr, 'Zur Chronologie der Leipziger Vokalwerke J.S. Bachs', *Bach*

Jahrbuch, vol. 44 (1957), pp. 5-162; by Georg von Dadelsen, *Bemerkungen zur Handschrift Johann Sebastian Bachs, seiner Familie und seines Kreises*, Trossingen, Hohner, 1957; and Idem, *Beiträge zur Chronologie der Werke Johann Sebastian Bachs*, Trossingen, Hohner, 1958; and more recently, with specific reference to the watermarks, by Wisso Weiss, *Katalog der Wasserzeichen in Bachs Originalhandschriften*, unter musikwissenschaftlicher Mitarbeit von Yoshitake Kobayashi, Kassel, Bärenreiter, 1985, 2 vols.

The musicologist, who has had an enormous importance in showing the value of watermark evidence, properly collected and applied, to the study of composers' manuscripts, is Alan Tyson (1926-2000). His extremely important collection of essays, which brings together eighteen articles and lectures published or delivered between 1975 and 1986, is: *Mozart. Studies of the Autograph Scores*, Cambridge (Mass.), Harvard University Press, 1987, where he makes extensive use of paper evidence to date the music scores of an important and prolific composer. It is a volume that should be on the workshelf of any serious watermark scholar. A full-scale realisation of his research is available in Wolfgang Amadeus Mozart, *Neue Ausgabe sämtlicher Werke*, Serie X: Supplement. Werkgruppe 33: Dokumentation der Autographen Überlieferung Abteilung 2: Wasserzeichen-Katalog von Alan Tyson, Basel-London-New York-Prag, Bärenreiter Kassel, 1992. If you can reach the end of this bibliographical rainbow and get your hands on this double volume, divided into *Textband* and *Abbildungen*, it is a genuine pot of gold, comprising one of the most exhaustive and exemplary pieces of watermark research ever realised. One part describes 107 pairs of formes, albeit with some singletons, and their watermarks found in Mozart's autograph scores from 1761 to 1791; the other is formed entirely of large-scale draftman's reproductions of the layout of the said formes and their watermarks, making it possible to identify quarter-sheets and even smaller fragments. An extraordinary achievement! the only pity is that in its present version it is accessible only to specialists. The other objection is that it makes all other watermark scholars seem like dabbling amateurs!

Tyson applies the same method to the study of sketch-books of Ludwig van Beethoven, which were divided and dispersed shortly after his death, see Douglas Johnson, Alan Tyson and Robert Winter, *The Beethoven Sketchbooks. History, Reconstruction and Inventory*, Oxford, Clarendon Press; Berkeley, University of California Press, 1985. The watermarks in Beethoven's autograph letters are described in Joseph Schmidt-Görg, 'Wasserzeichen in Beethoven-Briefen', *Beethoven Jahrbuch*, 1966, pp. 7-74; see also Alan Tyson, 'Prolegomena to a Future Edition of Beethoven's Letters', cit., 1977.

In the field of music printing, watermark evidence is used as a key to separating look-alike reprints in the output of the Elizabethan and Jacobean printer, Thomas East, see Jeremy L. Smith, 'Watermark Evidence and the Hidden Editions of Thomas East', in *Puzzles in Paper*, cit., 2000, pp. 67-80. An engaging and thoroughly documented study relating to the English music book trade, which makes an ample use of paper-evidence, is Robert Thompson, 'Some Late Sources', in *John Jenkins and his Time. Studies in English Consort Music*, edited by Andrew Ashbee and Peter Holman, Oxford, Clarendon Press, 1996, pp. 271-298.

On the other hand, musicologists have a poor to bad record in communicating with other disciplines and also in comparing their methods with those in other fields. Signs that attempts are being made to overcome this barrier can be found in round-ups by Frederick Hudson, 'Musicology and Paper Study: A Survey and Evaluation', in *Essays in Paper Analysis*, cit., 1987, pp. 34-60; Ulrich Konrad, 'The Use of Watermarks in Musicology', in *Puzzles in Paper*, cit., 2000, pp. 93-106; and Jan LaRue, 'Watermarks and Musicology', *The Journal of Musicology*, vol. 18 (2001), pp. 313-343.

[26]

Maps and Cartography

The real interest for paper studies in this field has been in its application to copper-plate printing, when the watermarks can often separate different states of the plates and also establish the probable date of the impression. A pioneering article is that by Edward Heawood, 'The Use of Watermarks in Dating Old Maps and Documents', *Geographical Journal*, vol. 63 (1924), pp. 391-412.

The scholar who has applied watermark analysis to the study of maps in a continuous and convincing fashion, especially in the use of β -radiographs to acquire images, has been David Woodward, professor of geography at the University of Chicago up to his premature death, known also as the conceiver and inspirer of the immense six-volume *History of Cartography* (1987-2015). For a bibliography of his output, see Matthew H. Edney, 'David Alfred Woodward (1942-2004)', *Imago Mundi*, vol. 57 (2005), pp. 75-83, while, for writings specifically relating to watermarks and watermark evidence, see 'Watermark Radiography at the Newberry Library', *Mapline*, n. 15, (1979), pp. 1-2; 'New Tools for the Study of Watermarks on Sixteenth-Century Italian Printed Maps: Beta Radiography and Scanning Densitometry', in *Imago et mensura mundi*.

Atti del IX Congresso Internazionale di Storia della Cartografia, a cura di Carla Clivio Marzoli, Roma, Istituto della Enciclopedia Italiana, 1985, II, pp. 541-552; 'The Analysis of Paper and Ink in Early Maps: Opportunities and Realities', in *Essays in Paper Analysis*, cit., 1987, pp. 200-221; 'The Correlation of Watermark and Paper Chemistry in Sixteenth Century Italian Printed Maps', *Imago mundi*, vol. 42 (1990), pp. 84-93; and 'Martha and Mary, 1568-70. The Use of a Pair of Watermarks in Reconstructing the Venetian Map Trade', in *Looking at Paper: Evidence & Interpretation*, cit., 2001, pp. 134-138. A must for any bookshelf relating to paper is his 1996 catalogue of the watermarks – organized on the basis of the IPH classification – in the Italian printed maps 1540-1600 held in the Newberry Library at Chicago, in which the images of the watermarks are reproduced with β -radiography and as a result provide some high-quality images (see above [23]). One small regret about this study is the unwillingness to discuss some cases of twinship among watermarks, in particular two charming and graceful mermaids, whom in the previous articles of 1987 and 2001 he had baptized Mary and Martha (pp. 68-69).

[27]

Codicological and Manuscript Studies

Palaeographers and manuscript scholars, on the whole, know that paper has watermarks and quite often, especially in more recent, technologically orientated research, they describe them. And go no further. One agrees that it isn't easy, but it is possible to do better.

There are exceptions. The principle of paper-flow has been applied successfully to the analysis of Medieval as well as of early modern and contemporary authors' manuscripts. Discussions of method and examples are provided in Jean Irigoien, 'La datation par les filigranes du papier', in *Les matériaux du livre manuscrit*, Leiden, Brill, 1980, pp. 9-36; Paola Busonero, 'Le filigrane come supporto per la datazione: problemi e verifiche su un campione di codici greci datati', *Nuovi annali della Scuola Speciale per Archivisti e Bibliotecari*, vol. 7 (1993), pp. 297-323; and Alois Haidinger, 'Datieren mittelalterlicher Handschriften mittels ihrer Wasserzeichen', *Anzeiger der phil.-hist. Klasse der Österreichischen Akademie der Wissenschaften*, vol. 139 (2004), pp. 5–30. Another valuable general survey based on English and Scottish manuscripts, but applicable in a general sense, albeit maybe with too much faith in the dates supplied by Briquet and Piccard, is R.J. Lyall, 'Materials. The Paper Revolution', in *Book Production and Publishing in Britain, 1375-1475*, cit., 1989, pp. 11-29.

Moving to practical examples. The survey of watermarks containing papermakers' names by Jean Irigoien, 'Une série de filigranes remarquable', in *Le papier au Moyen Âge*, cit., 1999, p. 145, in which the practice is circumscribed to a short period beginning in 1305, allows him to demonstrate the impossibility of the date 1291-92 (*given as the year 6800 since the creation of the world*) declared by its Greek scribe in the colophon of Vatican Ms. Gr. 29 [12]. Paleographers are always terribly unwilling to believe that copyists sometimes tell lies or might have reasons for wanting to antedate a colophon, whereas bibliographers tend to have less faith in the morality of printers (*I wonder why*). In this case the most economical supposition is that the manuscript is a faithful copy, colophon and all, of an earlier codex, which has not survived.

An interesting instance of a scholar competently pursuing watermarks through the corpus of manuscripts of the same work is provided by William E. Coleman, *Watermarks in the Manuscripts of Boccaccio's Il Teseida. A Catalogue, Codicological Study and Album*, Firenze, Olschki, 1997. As with the *Decameron*, the *Teseida*, written around 1339-41, has a high percentage of manuscripts on paper, from which just over a hundred watermark-designs are reproduced with Briquet-style tracings, with however the indication that they are always taken from the mould side and, where possible, twins are identified (*so we approve*). The book is the offshoot of work towards a new critical text of the poem, edited by Edvige Agostinelli, which appeared in 2015 and is based on what has only been recently recognised as a Boccaccio autograph copy in the Laurentian Library in Florence (*ironically, it is one of the few manuscripts of the poem written on parchment*). I remain puzzled by the purpose of this volume, but, like high-quality figure skating, it is an art unto itself.

An intriguing early Sixteenth-century example is provided by ms. It. IX.369 of the Marciana Library in Venice, in the last gathering of which Marin Sanudo wrote out bibliographical descriptions of 31 printed chivalric romances. The paper employed is the same as that used inside his famous diaries between 1527 and 1530, but mostly in 1528, which makes it possible to assign the latter date to the document, see Neil Harris, 'Marin Sanudo, Forerunner of Melzi', *La Bibliofilia*, vol. 95 (1993), pp. 1-37, 101-145, vol. 96 (1994), pp. 15-42, in particular pp. 103-104.

In France in the Eighteenth century the manuscripts of Denis Diderot provide a good test case, see Paul Vernière, *Diderot, ses manuscrits et ses copistes. Essai d'introduction à une édition moderne de ses*

œuvres, Paris, Klincksieck, 1967, as in the Nineteenth century does the manuscript of Victor Hugo's *Les misérables*, see René Journet-Guy Robert, *Le manuscrit des Misérables*, Paris, Les Belles Lettres, 1963. Perceptive analysis of the importance of paper in the authors of French manuscripts of the Eighteenth and Nineteenth centuries is provided by Claire Bustarret, see in particular 'Paper Evidence and the Interpretation of the Creative Process in Modern Literary Manuscripts', in *Looking at Paper*, cit., pp. 88-94, also on the author's personal page on the Institut des Textes & Manuscrits Modernes (ITEM), which has a fuller bibliographical listing.

An absolutely splendid example of analysis, which should be studied by anybody working on a modern writer, is that of the manuscript of *Sons and Lovers* by D.H. Lawrence, first published in 1913. While writing the several drafts of the novel Lawrence used the same sequences of paper for his correspondence and thus makes it possible to establish a precise stratification of the different stages of his manuscript, see Helen Baron, 'Sons and Lovers: The Surviving Manuscripts from Three Drafts dated by Paper Analysis', *Studies in Bibliography*, vol. 38 (1985), pp. 289-328.

[28]

Blockbooks, Incunabula, and the One-pull Press

The most primitive form of printing, the wooden blockbook, certainly preceded Gutenberg, and for a long time the few surviving examples were believed to be mostly anterior to the invention of moveable type in the West. Watermark evidence, however, proved fundamental in showing that what survives belongs generally to the 1460s. A further complication involves the fact that, once cut, the blocks were kept and used to make subsequent impressions, sometimes distant in time, and again watermark evidence provides an important differential for the chronological stratification. Fundamental research done by Allan Stevenson in 1965-66 remained in an unpublished typescript after his death, but happily since has been made available: see 'The Problem of the Blockbooks', in *Blockbücher des Mittelalters. Bilderfolgen al Lektüre*, herausgegeben von Gutenberg-Gesellschaft und Gutenberg-Museum, Mainz, Verlag Philipp von Zabern, 1991, pp. 229-262.

With respect to manuscripts, Fifteenth-century printing represents the first, massive, industrial-style consumption of paper, and so the question of the identification of watermarks therein is a fundamental issue. Some early catalogues of incunabula provide copperplate tracings of the watermarks in the collection, for instance Eduard Bodemann, *Xylographische und typographische Incunabeln königlichen öffentlichen Bibliothek zu Hannover*, Hannover, Hahn'sche Hof-Buch-Handlung, 1866, describing three blockbooks and 243 incunabula, with 16 pages of tracings of the watermarks at the end of the volume (*which become the source for Briquet 3749*). Otherwise, despite pious declarations, with the exception of the two most recent volumes of the BMC, comprising Adrian K. Offenberg's analysis of *Hebraica* and Paul Needham's comprehensive survey for England (*a mere backwater, however, in the history of Fifteenth-century printing*), and with the further exception of the specific case studies discussed below [30], watermark research and incunabula studies have largely gone their own separate ways.

In one interesting application, paper evidence, looking at whether sheets in quarto editions were cut in half before printing, plays a large part in the study by Lotte Hellinga, 'Press and Text in the First Decades of Printing', in *Libri tipografi biblioteche. Ricerche storiche dedicate a Luigi Balsamo*, Firenze, Olschki, 1997, I, pp. 1-23, available also in Italian with the title 'Torchii e testi nel primo decennio della stampa' in the same author's *Fare un libro nel Quattrocento. Problemi tecnici e questioni metodologiche*, a cura di Elena Gatti, Udine, Forum, 2015, pp. 73-100. A new, and much revised, English version is included in Lotte Hellinga's collected essays: *Texts in Transit. Manuscripts in Proof and Print in the Fifteenth Century*, Boston-Leiden, Brill, 2015, pp. 8-36. A one-pull press is also the key to a curious feature in the printing of the 1472 Venetian edition of Boccaccio's *Filocolo*, where the paper stocks show how the edition was divided in two parts and printed simultaneously on two presses, see Neil Harris, 'Una pagina capovolta nel *Filocolo* veneziano del 1472', *La Bibliofilia*, vol. 98 (1996), pp. 1-21, reprinted in *Dalla textual bibliography alla filologia dei testi italiani a stampa*, a cura di Antonio Sorella, Pescara, Libreria dell'Università editrice, 1998, pp. 67-96 [see Chapter 7].

The detailed analysis of one incunable printed in Rome in 1475 shows, however, that a one-pull press was still being used, although the sheets were not divided before printing, see Neil Harris, 'Le *Epistolae in cardinalatu editae* del 1475: ritratto di una edizione', in Pio II (Enea Silvio Piccolomini), *Lettere scritte durante il cardinalato*, a cura di Ettore Malnati e Ilaria Romanzin, Brescia, Marco Serra Tarantola, 2007, pp. 59-85, of which an abbreviated version is available with the title 'Profilo di un incunabolo: le *Epistolae in cardinalatu editae* di Enea Silvio Piccolomini (Roma 1475)', *Ecdotica*, vol. 3 (2006), pp. 7-33.

[29]

The 'Runs and Remnants' Principle

This principle is so important it gets a separate paragraph.

It is expounded by Allan Stevenson in *Observations on Paper as Evidence*, cit., 1961, pp. 19-24; in more condensed form in 'Paper as Bibliographical Evidence', *The Library*, s. V, vol. 17 (1962), pp. 197-212: 201-202; and finally in *The Problem of the Missale Speciale*, cit., 1967, pp. 71-99.

An example of the 'runs and remnants' principle from my own casebook occurs with some sheets in the 1499 Aldine *Hypnerotomachia Poliphili*, which were reset to make up for some short-falls in the original print run. Although the edition is dated December 1499, the paper in the reset sheets belongs to a supply employed by Aldus in the late spring and early summer of the same year, which, if we were to take the evidence on its face value, would lead us to argue that the reset sheets were printed *before* the rest of the edition, something contradicted in any case by typographical evidence. It is more sensible to believe that, since the reset sheets were needed to make up imperfect copies, the printers of the make-up sheets, given the relative unimportance of the task, were told to make shift with the stray sheets lying round the workshop. See Neil Harris, 'Nine reset sheets in the Aldine *Hypnerotomachia Poliphili* (1499)', *Gutenberg Jahrbuch*, 2006, pp. 245-275.

[30]

Analytical Bibliography and Case Studies (Somewhat Autoreferential)

One distinctly promising sounding title, done by a scholar who has been establishing new standards for the application of paper evidence in the field of early English printing and Shakespearian bibliography, is R. Carter Hailey, *On Paper. The Description and Analysis of Handmade Laid Paper*, London, Pickering and Chatto, whose publication has been announced several times, even with a ghost publication date on 30 December 2012, but still has not appeared (*well, if you are going to study paper, you have to do it properly, so we approve*). Therefore keep an eye open for when it does. For the author's ongoing work, see the remarks about the Shakespeare Pavier quartos below.

A printed book, which employs a standard Sixteenth century print-run of 1,000 copies, counting waste, will use more than two reams of paper for the impression of each and every sheet. A press therefore is a consumer of paper on a large scale. In early Renaissance printing, when the cost of work was low and the quality of paper was high, it is plausible that quite often the purchase of the paper represented anything between 50% and 70% of the total expense for printing a book. The analysis of 471 entries in the ledgers of William Strahan shows that, even in the Eighteenth century, on average half the cost of printing was still represented by the paper, see Patricia Hernlund, 'William Strahan's Ledgers, II: Charges for Papers, 1738–1785', cit. (1969). It can be assumed therefore in principle (*exclusively and only in principle*) that a printer planned his paper purchases with care and exhausted one stock almost in its entirety before acquiring another (*but take note of Stevenson's definition of the 'runs and remnants' rule [29]*). Since paper was rarely purchased directly from a mill, but came through the offices of a paper merchant, who generally had several sources of supply, the new stock will probably be watermarked in a different fashion. Analysis of the paper flow in an edition, or (*much better*) in a group of editions printed contemporaneously in the same shop, can provide important information about the order of printing. Following on from his 1985 article on the Gutenberg Bible (*see below*), examples of such reconstructions are provided by Paul Needham, 'Concepts of Paper Study', in *Puzzles in Paper*, cit., 2000, pp. 1-36, looking at the test-cases of Pliny's *Historia naturalis* (1476) with 11 stocks of paper, Bruni's *Historia populi florentini* (1476) with four stocks, and Cessolis' *The Game and Play of Chess* (1474) with one stock. A similar operation, with perhaps a less convincing outcome, is provided by Paul F. Gehl, 'Watermark Evidence for the Competitive Practices of Antonio Miscomini', *The Library*, s. VI, vol. 15 (1993), pp. 281-305.

A word of warning however: Italian Renaissance printers, especially in the Fifteenth century, might well have applied the bibliographically felicitous principle of acquiring a high-quality, clearly watermarked paper-stock and exhausting it before buying in another (*except possibly for Aldus, but he always has to be different, doesn't he?*). In the much later English Renaissance, i.e. the one which only started when Italy had already finished, on the other hand, stocks of French paper were muddled by the paper merchant and further muddled in the printing shop, so that the analysis of the same makes about as much sense as the Mad Hatter's tea party, which might explain the coolness of the McKerrow-Greg-Bowers school of bibliography towards paper evidence. In order to run off what Thomas Bodley described as "baggage-books" (*the quartos*

of *Shakespeare and other sit-com writers of the age*), London printers used the cheapest paper they could get their hands on, including remnants of older runs and flawed sheets excluded from more prestigious books. It is hardly surprising therefore that very little of it makes sense and therefore, to paraphrase Douglas Adams, the principle of analysing the paper-flow is always right, it is the reality provided by the evidence that is wrong.

Important examples of research relating to printed texts, in which an especial emphasis falls on the paper evidence are the following, in approximate chronological order of the document or printed book studied:

- **1454.** Not unsurprisingly, the example that has attracted most attention and been the object of exemplary research has been the Gutenberg Bible, which was printed both on vellum and paper. The watermark evidence breaks the paper supply into four separate supplies, formed by an oxhead with a simple cross, two varieties of grape, and a full ox. The oxhead supply, however, shows a series of diverging states, since over a fairly short period of time the twin watermarks were removed from their respective moulds, presumably for cleaning or maintenance, and reattached, but exchanged in the process and in one case turned back to front. These alterations in state therefore permit a much more precise and detailed stratification. The paper evidence, together with textual analysis and information provided by the recipe of the ink, shows how the copy for the Bible was divided between as many as six compositorial units, which were worked on more or less simultaneously. Work on the paper evidence in the Gutenberg Bible is brought together and summarised by Paul Needham, 'The Paper Supply of the Gutenberg Bible', cit. (1985), which also includes some high-quality β -radiograph images of the watermarks, including the different states of the oxhead twins. Needham's work acknowledges his debt to the essay by Paul Schwenke written to accompany the 1923 Leipzig facsimile (*Johannes Gutenberg zweiundvierzigzeilige Bibel: Ergänzungsband zur Faksimile-Ausgabe*), while the analysis of the varying states of the bull's head watermarks had been significantly developed in the work on the Mainz *Catholicon* by Eva Ziesche and Dierk Schnitger (see below). In the mid-1980s the ink evidence of the Gutenberg Bible, obtained by a cyclotron milliprobe, was the object of a large number of articles, but most of it is brought together in Richard N. Schwab, Thomas A. Cahill, Robert A. Eldred, Bruce H. Kusko, and Daniel L. Wick, 'New Evidence on the Printing of the Gutenberg Bible: The Inks in the Doheny Copy', *Papers of the Bibliographical Society of America*, vol. 79 (1985), pp. 375-410, followed by a further contribution by Needham, 'Division of Copy in the Gutenberg Bible: Three Glosses on the Ink Evidence', pp. 411-426. On the source of the royal-size sheets employed for the edition, the long-standing opinion, going back to the Nineteenth century, is that they were made at Caselle, near Turin in Piedmont, and brought to Mainz by mule-train over the Alps and by barge down the Rhine. This interpretation has been challenged, however, by Isabel Feder McCarthy, 'Ad fontes. A New Look at the Watermarks on Paper Copies of the Gutenberg Bible', *The Library*, s. VII, vol. 17 (2016), pp. 115-137, who argues that the paper was made either on the French side of the Alps and/or in Basle. As has been noted above, the fact that the moulds employed tranchefiles favours this explanation.
- **1460.** Much discussion has been occasioned about the three impressions of the "1460" Mainz *Catholicon*, beginning with an article by Theo Gerardy, 'Wann wurde das Catholicon mit der Schuss-Schrift von 1460 (GW 3182) wirklich gedruckt?', cit. (1973), followed by Eva Ziesche and Dierk Schnitger, 'Elektronen radiographische Untersuchungen der Wasserzeichen des Mainzer Catholicon von 1460', cit. (1980), where the argument derives in large part from the watermarks and the paper. Twin watermarks with different states, detached and re sewn to their moulds, are brilliantly identified and tracked through a series of editions from the 1460s and early 1470s. Copies exist on three different paper-stocks. Of these one is compatible with the date in the colophon, i.e. 1460; the other two however were not extant at the time and the impressions thereon are now assigned to 1469 and 1472-73. The printing technique behind the *Catholicon*, which entailed keeping intact the type settings for some 700 folio pages, has been the object of an extended incunabulistic ping-pong match, initiated with the article by Paul Needham, 'Johann Gutenberg and the Catholicon press', *Papers of the Bibliographical Society of America*, vol. 76 (1982), pp. 395-456, which hypothesised a printing process involving two-line slugs. It was followed in: Walter J. Partridge, 'The Type-setting and Printing of the Mainz *Catholicon*', *The Book Collector*, vol. 35 (1986), pp. 21-52; Paul Needham, 'The Type-setting of the Mainz *Catholicon*: A Reply to W.J. Partridge', *ibid.*, pp. 293-304; Idem: 'The Catholicon Press of Johann Gutenberg: A Hidden Chapter in the Invention of Printing', *Wolfenbüttler Notizen zur Buchgeschichte*, vol. 13 (1988), pp. 199-230; Martin Boghardt, 'Die bibliographische Erforschung der ersten *Catholicon*-Ausgabe(n)', *Wolfenbütteler Notizen zur Buchgeschichte*, vol. 13 (1988), pp. 138-178, repr. in Idem, *Archäologie des gedruckten Buches*, herausgegeben von Paul Needham in Verbindung mit Julie Boghardt, Wiesbaden, Harrassowitz, 2008, pp. 394-425; Lotte Hellinga, 'Analytical Bibliography and the Study of Early Printed Books with a Case-study of the Mainz *Catholicon*', *Gutenberg Jahrbuch*, 1989, pp. 47-96; Paul Needham, 'Corrective Notes on the Date of the Catholicon Press', *Gutenberg Jahrbuch*, 1990, pp. 46-64; Idem, 'Further Corrective Notes on the Date of the Catholicon Press', *Gutenberg Jahrbuch*, 1991, pp.

101-126; Lotte Hellinga, 'Slipped Lines and Fallen Type in the Mainz *Catholicon*', *Gutenberg Jahrbuch*, 1992, pp. 35-40; Paul Needham: 'Mainz and Eltville: The True Tale of Three Compositors', *Bulletin du bibliophile*, 1992, pp. 257-304; Idem, 'Slipped Lines in the Mainz *Catholicon*: A Second Opinion', *Gutenberg Jahrbuch*, 1993, pp. 25-29; James Mosley: 'The Enigma of the Early Lyonnaise Printing Types', in *La Lumitype-Photon. René Higonet, Louis Moyroud et l'invention de la photocomposition moderne*. Actes du colloque, Musée de l'Imprimerie et de la Banque, Lyon, le 20, 21 octobre 1994, textes réunis et présentés par Alan Marshall, Lyon, Musée de l'Imprimerie et de la Banque, 1995, pp. 13-28. It takes a while to read through this extended debate, and even longer to understand it, but it is illuminating.

- 1473. Allan Stevenson, *The Problem of the Missale Speciale*, cit., 1967, which could also be called the confessions of a paper scholar. The tone is sometimes whimsical and anecdotal, impregnated with situational irony, but underneath the purpose is steely. Nevertheless it is the one book that any novice bibliographer venturing into paper studies and wanting to learn how you should go about the business *must* read. The problem was posed by the *Constance Missale*, or the *Missale Speciale*, an undated edition obviously printed in the Fifteenth century, employing a version of the smaller fount used in the Mainz Psalter of 1457. Scholars had therefore argued that it might even predate the Gutenberg Bible and thus be by default the earliest European printed book produced with moveable type. Stevenson's research began when the Pierpont Morgan Library in New York acquired a copy of the *Missale Speciale* in 1954 and, on examining the same, he understood immediately on the basis of the paper evidence that the book must belong to the early 1470s. As Archimedes necessarily realised after jumping out of his bath, the basic intuition of a discovery is one thing, amassing and presenting the proof, while not even wearing a towel, is quite another. In 1960, two German scholars, both major experts on paper evidence, arrived at a similar conclusion, arguing with reference to the watermarks found in archive documents that the *Missale Speciale* belonged to the early 1470s, see Gerhard Piccard, 'Die Datierung des *Missale Speciale* (Constantiense) durch seine Papiermarken', *Archiv für Geschichte des Buchwesens*, vol. 2, nn. 7-9 (1960), pp. 571-584; Theo Gerardy, 'Die Wasserzeichen des mit Gutenbergs kleiner Psaltertype gedruckten *Missale Speciale*', *Papiergeschichte*, vol. 10, n. 2 (1960), pp. 13-22. What Stevenson provided in 1967 was, however, the full picture, based not only on the recognition of the pairs of twin watermarks, but also how each watermark in its time played many parts, aging through a series of different states that made it possible to provide a very precise date, i.e. 1473, and a probable location, i.e. Basle. An extraordinary achievement.

- 1483. Two printed collections of *Sacre rappresentazioni* by Antonia Pulci, unsigned and undated, attributed to Antonio Miscomini in Florence have long been known to incunabulists. Although the *incipit* of the first volume has the date 1483, it was taken as the year of composition and in the standard repertories one collection was assigned to c. 1490-95 and the other to c. 1495 (*which is incunable speak for "I don't really know"*). Miscomini was active in Florence from 1481 to 1494, albeit with a seeming break from 1487 to 1489 when he appears in Modena; more importantly, the version of his 112R used these two collections of sacred dramas was extant only up to the end of 1491. Comparison of the watermarks is not conclusive, but their order and presence strongly suggest that the two collections went through the press more or less in parallel and so have the same date, which is likely to be close to the 1483 of the *incipit*, see Nerida Newbiggin, 'Antonia Pulci and the First Anthology of *Sacre Rappresentazioni* (1483?)', *La Bibliofilia*, vol. 118 (2016), pp. 337-361.

- 1491-92. A classic example of the application of watermark evidence to establish the date and place of production of an unsigned incunable is Adri K. Offenbergh, 'The Dating of the Kol Bô. Watermarks and Hebrew Bibliography', in Idem, *A Choice of Corals. Facets of Fifteenth-century Hebrew Printing*, Nieuwkoop, De Graaf, 1992, pp. 59-88.

- 1494-1515. Although it appears an obvious thing to do, charting the paper stocks in the output of a printer over a long period of time is a huge task and involves numerous practical difficulties. In fact, outside case studies aimed at resolving specific bibliographical problems, I know only one instance of the kind, not unsurprisingly, for Aldus Manutius the elder, in the catalogue of Aldines at the University of California, see: *The Aldine Press. Catalogue of the Ahmanson-Murphy Collection of Books by or relating to the Press in the Library of the University of California Los Angeles, incorporating Works recorded Elsewhere*, Berkeley, University of California press, 2001. Paper stocks are discussed in the 'Prolegomena', pp. 29-33; tracings of watermarks, keyed to the editions in which they are found and relating only to the first period of the press, are reproduced at pp. 575-635. Although there are no attempts to enter into the real intricacies of the watermark identification, or to distinguish twins, it is a useful general survey.

- 1510. Sara Centi-Neil Harris, 'Per il *De cardinalatu* di Paolo Cortesi: la copia "ideale", gli esemplari e i messaggi occulti', in *Catalogo degli incunaboli e delle cinquecentine della Biblioteca Comunale di San Gimignano*, a cura di Neil Harris, San Gimignano, Città di San Gimignano, 2007, vol. 2, pp. 29-50, use paper

evidence to discover the structure and what happened in the printing of this strange book [see Chapter 7].

- 1539. Neil Harris, *Bibliografia dell'«Orlando innamorato»*, Modena, Panini, 1988-91, I, p. 143, II, pp. 113-115, 225-234, describes the paper of all the editions printed by the Calvo brothers in Milan (1539-42) in order to reach the truth about the real date of the printing of the *Rifacimento* of Francesco Berni [see Chapter 7].
- 1551. Neil Harris, 'Per la storia bibliografica de *Le cose volgari et latine* di Agostino Beaziano', in *Suave mari magno ... Studi offerti dai colleghi udinesi ad Ernesto Berti*, a cura di Claudio Griggio e Fabio Vendruscolo, Udine, Forum, 2008, pp. 161-181, also published in *Tipofilologia*, vol. 1 (2008), pp. 17-29, reconstructs the reissue of this small Italian octavo, using watermark and countermark evidence to show that the two half-sheet *cancellantia* were printed together on the same sheet [see Chapter 7].
- 1590. Whether the date 1 January 1591 in the dedication to Spenser's *Daphnaida* should be taken as Old style (i.e. 1592) or New style is analysed on the basis of the paper flow in the editions printed in 1590-91 by Thomas Orwin, see Adrian Weiss, 'Watermark Evidence and Inference: New Style Dates of Edmund Spenser's *Complaints* and *Daphnaida*', *Studies in Bibliography*, vol. 52 (1999), pp. 129-154. The article is worth perusing also for the discussion of the method applied to the breakdown of complex job-lots of paper.
- 1590. The publication of the Gospels in Arabic by the Medici Oriental Press in Rome in 1590-91 involved a double issue, one only with the Arabic text and one with an interlinear Latin gloss. Bibliographical analysis shows, however, that, with exception of the very first sheet, a single setting of the Arab type was employed throughout, first to print the Arab only version and reset to print the bilingual text. As well as the typography, proof of the simultaneous printing of the two issues comes from the paper: most of the supply is on sheets watermarked with a crown, but some intrusions of other supplies take place in parallel, see Harris, 'Printing the Gospels in Arabic in Rome in 1590', cit., 2015.
- 1600. The edition of the *Vaticinia* by Girolamo Giovannini, published in Venice in 1600, which presents a complicated situation of variants in the first gathering, is described by Neil Harris, 'Un ammiraglio, un cane e i *Vaticinia*', in *Il libro italiano del XVI secolo: conferme e novità in Edit16*. Atti della giornata di studi, 8 giugno 2006, a cura di Rosaria Maria Servello, Roma, ICCU, 2007, pp. 43-92.
- 1610. The publication of Galileo's *Sidereus Nuncius* in Venice in 1610 changed forever the way man looks at the stars. An in-depth study of the complex internal history of the edition is *Galileo's O*, edited by Horste Bredekamp and published in Berlin, Akademie Verlag, 2011: volume one is *Galileo's Sidereus Nuncius: A Comparison of the Proof Copy (New York) with other Paradigmatic copies*, edited by Irene Brückle and Oliver Hahn, comprising essays by various hands, in particular one on 'The Paper' by Irene Brückle, Manfred Mayer, and Theresa Smith, pp. 127-142, and another on 'Watermark Distribution in Selected Copies', by the same three authors, with an inversion of Brückle and Mayer in the credits, pp. 149-151, while volume two is entirely the work of Paul Needham, *Galileo Makes a Book: the First Edition of Sidereus Nuncius, Venice 1610*. The catalyst for the project was the discovery of what for a period was considered the "proof copy", in 2005 purchased by the Martayan Lan Bookshop in New York, containing, instead of the usual copper-plate illustrations, drawings, thought to be from the hand of Galileo himself. Doubts about this copy nevertheless began to circulate in the years following its discovery, especially in an article of 2009 by Copernicus scholar, Owen Gingerich, who initially had authenticated and considered genuine the Martayan Lan copy. Some of these reservations derived from the seller of the book, the notorious bibliokleptophile, Massimo De Caro, whose despoiling of the Girolamini Library in Naples before too long would become public knowledge. In particular, Nick Wilding, a British historian teaching in the United States, became convinced that the item was a forgery and, while the publication was in press, pointed to some details that quickly convinced Needham. The outcome is an originally unforeseen and unintended, third volume: *A Galileo Forgery. Unmasking the New York Sidereus Nuncius*, edited by Horst Bredekamp, Irene Brückle, and Paul Needham, Berlin-Boston, Walter De Gruyter, 2014, which is a masterful *apologia* for the deception at the hands of De Caro, who remains the nastiest thing to have happened in book history and bibliography since Guglielmo Libri. For a very readable summing up of the whole *affaire*, see also Nicholas Schmidle, 'A Very Rare Book. The Mystery Surrounding a Copy of Galileo's Pivotal Treatise', *The New Yorker*, December 16, 2013 (*available online*). The stature of the scholars, the clarity of the analysis, and the pain of the apology make this book something that has to be read and shared. Within the new scheme of things, paper evidence plays a major part in unmasking the fraud. Microscope analysis, in particular, revealed that the paper of the forgery was formed of cotton linters (i.e. not just cotton, which at the beginning of the Seventeenth century would already be unusual, but highly refined cotton fibres, what we generally know as cotton wool), whereas the genuine paper is from bast fibre, i.e. the linen and hemp, made from the outer stalks of the plants involved, but as recycled rags. In the forgery the watermarks had been recognised as being similar to those of the original, but not the same: or rather they were made on separate half-sheets, with marks imitating the original. More

importantly, a single mould was used for each half-sheet, rather than an alternation of twin moulds. For a final judgement on the affair, well, time will tell. Personally, I am relieved that this particular item never ended up on my desk, and I am full of admiration for the honesty and sincerity with which this group of scholars admitted how and why they were conned.

- **1616.** For a massive analysis of the paper supply making up the 1616 folio of Ben Jonson's plays, see James A. Riddell, 'The Concluding Pages of the Jonson Folio of 1616', *Studies in Bibliography*, vol. 47 (1994), pp. 147-154.
- **1619.** On the Shakespearian 'Pavier Quartos', which provided a pioneering test-case for the use of watermarks in analytical bibliography, see Walter W. Greg, 'On Certain False Dates in Shakespearian Quartos', *The Library*, n.s., vol. 9 (1908), pp. 113-131, 381-409; Allan H. Stevenson, 'Shakespearian Dated Watermarks', *Studies in Bibliography*, vol. 4 (1951-52), pp. 159-164. The research of Greg and Stevenson has now been redone *ab origine* in an exhaustive article by R. Carter Hailey, 'The Shakespearian Pavier Quartos Revisited', *Studies in Bibliography*, vol. 57 (2005-2006), pp. 151-195, to which should be added the electronic piece 'A Catalog of Paperstocks in the Shakespearian Pavier Quartos (1619)', available on the website of the Bibliographical Society of the University of Virginia. The same author has also applied watermark analysis to other problems of Shakespearean bibliography, in particular to establish the dates of the only two quarto editions devoid of titlepage dates, albeit assigned to the first half of the 1620s on textual and typographic evidence, see 'The Dating Game. New Evidence for the Dates of Q4 *Romeo and Juliet* and Q4 *Hamlet*', *Shakespeare Quarterly*, 58 (2007), pp. 367-387.
- **1827.** The first edition of Manzoni's *Promessi sposi*, Milano, Ferrario, 1825-26, but actually published in June 1827, in octavo format, provides an interesting case-study, in which the placing of the watermarks makes it possible to identify fifteen otherwise invisible quarter-leaf *cancellantia*, see Neil Harris-Emanuela Sartorelli, 'La Ventisettana dei *Promessi sposi*: la collazione e i *cancellantia*', *Annali manzoniani*, n.s., 7-8 (2010-2015 [but 2017]), pp. 3-95, with an English-language synthesis by Neil Harris, 'The Manzoni Identity: *Cancellantia* and Final Authorial Intention in the First Edition of *I Promessi Sposi* (1825-1826)', in *Questioni filologiche: la critica testuale attraverso i secoli*. Atti della conferenza internazionale della Graduate Students' Association of Italian Studies (GSAIS), University of Toronto, Department of Italian Studies, 2-4 maggio 2013, a cura di Pamela Arancibia, Johnny L. Bertolio, Joanne Granata, Giovanna Licata, Erika Papagni, Matteo Ugolini, Firenze, Franco Cesati editore, 2016, pp. 41-69 [see Chapter 7].
- **1827.** The edition on sheets of double-elephant paper (69×102 cm) of Audubon's *Birds of America* (1827-38) contains 435 copperplates with variants of state. The bibliography of Waldemar H. Fries, *Double Elephant Folio. The Story of Audubon's Birds of America*, Chicago, American Library Association, 1973; new edition: Amherst, Zenaida Publishing, 2006, shows how successive impressions from the plates are identifiable through the dates in the Whatman watermarks (1830, 1831, 1832, etc.), see chapter 25, 'Questions of Internal Evidence', pp. 209-224, and Appendix K, 'Additional Variants found in Plate Legend and Watermarks' (pp. 421-439). Contrary to what Audubon himself affirmed, the edition is not in a folio format; technically it is a full-sheet or broadside, i.e. the sheet has not been folded at all.
- **1894.** In 1894 copies began to appear in *London* of a previously unknown edition of Elizabeth Barrett Browning's *Sonnets from the Portuguese*, dated 1847 with Reading as the place of publication. This was the most important of a string of forgeries, some three hundred titles, produced by literary scholar, Harry Buxton Foreman (1842-1917), and book-collector and bibliographer, Thomas James Wise (1859-1937). The demonstration by John Carter and Graham Pollard that these editions were forgeries, which was made public in their 1934 *An Enquiry into the Nature of Certain Nineteenth Century Pamphlets*, rested in part on the paper evidence. The paper used for the false pamphlets contained substances such as esparto grass and reconstituted wood pulp which were not available at the time of their supposed publication. Since Wise was still alive and considered a distinguished literary figure when the exposure took place, so as not to risk litigation, the real culprits were not named. Subsequent work has been done to reveal the full extent both of the forgeries and the scandal, see Nicolas Barker-John Collins, *A Sequel to "An Enquiry into the Nature of Certain Nineteenth Century Pamphlets"*, London, Scolar Press, 1983; John Collins, *The Two Forgers. A Biography of Harry Buxton Foreman and Thomas James Wise*, New Castle, Oak Knoll Press, 1992. As above with the much more recent Galileo episode, the need to overcome forgery, and the bitterness of the lessons learnt, ensured giant strides in the scholarship.

Dedicated Collections of Paper, Watermarks, and Tracings of Watermarks

A feature common to a number of museums, libraries and archives, is a collection formed by one or more scholars, who recovered samples of paper, or taken tracings of the same, and organised them on the basis of their watermarks. In the Nineteenth century, in particular, when watermark study was fashionable and led, among other things, to Briquet, a fair number of collections were formed, some of them considerable. For anyone actually involved in teaching the history of paper and of watermarks, a collection of antique sheets of paper, assembled by searching through bric-à-brac or disbinding unwanted printed books, is a valuable working tool. I freely admit to having put together a *filigranoteca* comprising several hundred items, mostly Tuscan paper from the Eighteenth and Nineteenth, for my own sublimely didactic purposes, as anyone who takes the course in Lyon will find out to their cost. Mind you, this is nothing compared to Peter Bower, whose collection, by his own admission, is in the order of 200,000 samples, see *Looking at Paper: Evidence & Interpretation*, cit., p. 12.

But, there is a difference between this modern operation, essentially conservative (*or at least taken from archives that no longer exist*), and some of the operations described here, which were akin to vandalism. No matter how much esteem one might have for pioneering paper scholars, often they removed, sometimes with the active connivance of librarians and archivists, blank leaves from Medieval and Renaissance volumes. Most of these bits of paper are half-sheets and therefore incomplete, while I still have to find an instance (*apart from my own virtuous self*), in which, where possible, the collector has sought out and arranged the collection on the basis of the twin watermarks. The nuisance is often compounded by the fact that no proper record is supplied about the date or location of the document that furnished the watermarked leaf. In general terms, to my knowledge, no in-depth census has been conducted of such collections and little is known about them. There is an additional disadvantage in the fact that, since they often consist in blank loose leaves of paper, cataloguers and librarians are at a loss about what to do with them. When I sought to track down some of the collections mentioned either by Briquet or elsewhere in the literature, in several instances I was told that the collection had no shelfmark and/or had not been properly catalogued. Random digging on my part has nevertheless assembled a sort of list, which can certainly be amplified.

Briquet himself, in the introduction to *Les filigranes*, mentions a number of instances, with praise for the collection formed by the Archives publiques in Bruxelles: “Le recueil ... préparé en vue de l'exposition internationale de Londres, en 1872, et qui forme 6 volumes contenant les spécimens de papier usités de 1326 à 1795, est un modèle du genre” (vol. 1, pp. xiv-xv). Within the repertory, and also in the unpublished watermarks in the Geneva archive, there are numerous references to this collection. Despite inquiries on my part, its present whereabouts are not known.

The most advertised of such collections in the critical literature, comprising some 300 items from 1293 to 1600, was that assembled by bishop Aurelio Zonghi in Fabriano in the latter half of the Nineteenth century, which was exhibited in Milan in 1881. He left it to Fabriano and parts of it are now on display in the city's paper museum. The same 300 items are described also in the subsequent catalogue of 1884, which lists 1,887 watermarks, obliging Labarre, when he reprinted the catalogues and added the tracings of the watermarks in 1953, to employ a double numbering [6e. Marches]. The watermarks belonging to the larger nucleus, which remained in possession of Augusto Zonghi, passed to his descendants in the Baravelli family. For a long time the whole collection was inaccessible to scholars: the owners made several attempts to sell the material, at an exorbitant price, which in 1951 led to the Italian state notifying the collection as not exportable. In May 2016, however, it was announced that the collection has been purchased by the Gianfranco Fedrigoni Foundation in Fabriano (*for future developments, see the website of the same*). A third collection, this time on a small scale, comprising 171 watermarks belonging to Andrea Gasparinetti and donated to Fabriano is the only one that has been the object of a published catalogue, see *Le marche d'acqua. Il fondo di filigrane di A.F. Gasparinetti*, Fabriano, Comune di Fabriano, 2001 (*the initiative deserves applause, but the photographs are terrible and spoil the whole result*). Digital copies of the watermarks in the smaller Zonghi collection and in the Gasparinetti collection are now available on line in the ‘Corpus chartarum Italiae’ project (*see below*); it is planned that the larger Zonghi collection will join them in due course.

An impressive, at least in terms of the physical scale, archive of tracings and watermarks is that assembled by the antiquarian Samuel Sotheby (1771-1842), founder of the famous auction house, and his son, Samuel Leigh Sotheby (1805-1861). The father's research into Fifteenth-century printing and into blockbooks, which included extensive work on watermarks, was edited by the son in two pioneering publications: *The Typography of the Fifteenth Century, being Specimens of the Productions of the Early Continental Printers*,

exemplified in a *Collection of Facsimiles from One Hundred Works, together with the Water-marks*, London, Thomas Rodd, 1845, and the subsequent *Principia Typographica. The Block-books, or Xylographic Delineations of Scripture History, issued in Holland, Flanders and Germany, during the Fifteenth Century, Exemplified and Considered in Connexion with the Origin of Printing, to which is added an Attempt to Elucidate the Character of the Paper-marks of the Period*, London, printed for the Author by W. McDowall, 1858. Donated to the Library of the British Museum, subsequently British Library, the full assemblage contains 31 volumes and boxes. Although much of the material comprises tracings, there are also many single leaves containing watermarks. Unfortunately, no in-depth study of the collection has been undertaken.

The collection assembled by Friedrich Anton Reuss (1810-1868), mentioned by Briquet (vol. 1, p. xv), is held in the manuscript department of the Universitätsbibliothek in Würzburg (*no pressmark*). It was acquired while Reuss worked at the library, probably in 1842, and is contained in five large boxes. As well as in Briquet (vol. 1, p. xv), it received a few fleeting mentions in the Nineteenth century, but otherwise has not been an object of study.

The Deutsche Buch- und Schrift Museum, which is an internal structure of the Deutsche Nationalbibliothek in Leipzig, now holds the collection of watermarks formerly at the Börsenverein der Deutschen Buchhändler zu Leipzig, including those of Gerard Van Hasselt and Albrecht Kirchhoff mentioned by Briquet (vol. 1, p. xv). It is made up of six boxes, the first two organised chronologically, the latter four geographically. The Museum owns further dedicated collections of paper and watermarks, which are described on the 'Historical Paper Collection' page of its website.

The Istituto Centrale per il Restauro e la Conservazione del Patrimonio Archivistico e Librario (*the former Istituto Centrale di Patologia del Libro, but what's in a name?*) in Rome a few years ago discovered that it owned a collection of a little over 4,000 watermarks. The precise source of the collection nor the identity of the original collector are not known, though large part of it came from the antiquarian bookseller, Pio Amori, in March 1940. They are held in 35 boxes with the grandiose title *Corpus Chartarum Italicarum* printed on the labels on the outside. The project seems to have dropped out of sight during the Second World War and remained so up to its recent rediscovery (*confirming the old adage that the best place to hide a book is a library*), see Paola F. Munafò-Viviana Elisa Nicoletti, 'La collezione di carte filigranate dell'Istituto Centrale per la Patologia del Libro', in *Gli itinerari della carta*, cit., 2010, pp. 175-184. After several attempts, in 2017, the catalogue of the collection, including very nicely executed digital images, went on line and can also be viewed through the Bernstein site. The virtual catalogue has been extended to include small collections of Zonghi and Gasparinetti at Fabriano.

In his well-known repertory of watermarks mainly from the Seventeenth and Eighteenth centuries [18], Frank Algernon Churchill frequently makes reference to items in his own personal collection. Unfortunately, it is not known whether this survives.

The Département des Estampes at the Bibliothèque Nationale de France (*site Richelieu*) has a collection of 'Papier – Marques de Fabriques', assembled by former curator, Achille Devéria (1800-1857), at pressmark LI.41-4° (*note that the indication provided by Gaudriault, Les filigranes, cit., p. 312, which is my source for this notice, wrongly gives the pressmark as "LI.41-petit folio" and describes it as a collection of tracings*). The paper is mostly French, from the Eighteenth and Nineteenth centuries, with in most cases the watermark cut out and mounted on some three hundred unnumbered sheets, some of which contain more than one mark. In general the shape of the watermark has been tipped in by pencil, which helps visibility, but also obscures the original lines. There are also a few instances of tracings and of decorated papers. Gaudriault further makes reference to collections of tracings made by two other former curators, Françoise Gardey and Maxime Préaud, but, despite inquiries on my part, it has not been possible to identify them.

The Réserve of the Département des Imprimés at the Bibliothèque Nationale de France (*site Tolbiac*) holds 18 boxes of watermarked paper (Rés. Atlas Q-31), which were purchased at the instance of former curator and paper scholar, Anne Basanoff, in the 1990s from an anonymous source. The collection is in some disorder and has not been worked on by the library at all, apart from working notes by Basanoff kept in the boxes, which (*inconveniently*) are not individually numbered. Most of it consists of unwritten half-sheets, in the main French from the Eighteenth and Nineteenth centuries, that have been ripped out of bound registers, without any indication of the origin or the date. So there is a great deal of duplication, though this could be helpful in identifying eventual twin watermarks.

The papermill and museum Richard de Bas [33], in the hills above Ambert, has a collection of 21 files of watermarked paper, mostly from the Eighteenth century. On request, the museum kindly furnished a copy of their handwritten inventory, containing drawings, as well as on the cover the useful annotation that "certains chercheurs indéclicats ont omis d'en rendre certains" (*which is a problem with many such collections*).

The Bibliothèque Municipale at Besançon owns two collections of watermarked paper related to production in the Franche-Comté, the first assembled by schoolteacher, Louis Borne (1872-1958), organised chronologically from 1560 to 1796, gifted to the library in 1960, and held at pressmark ms. Z 829; the second from doctor François Roland (1859-1926), organised by place of production, purchased from the family in 1970, and held at pressmark ms. Z 830.

Another interesting example is the collection of mainly Seventeenth-century watermarks in English documents and printed items assembled by Hove bookseller E. Williams and sold to Henry Folger between 1924 and 1927. They comprise 1,058 items dated between c. 1570 and 1699, now catalogued as Folger Shakespeare Library, ms. L.f.1-1058; see the description in the library's blog by Nadia Seiler, 'Watermarks & hidden collections', November 1, 2011.

Just in case anybody is interested in following it up, the Municipal archive at San Gimignano has a file with a small collection of watermarks, mainly Seventeenth and Eighteenth century, obviously put together with an intent to document the local industry (Colle Val d'Elsa is almost a next-door neighbour).

The Deutsches Museum in Munich has several important collections of paper samples, including a collection of some 15,000 items of coloured paper put together by Felix Huebel and the watermark collection of artist Ernst Kirchner (1880-1938). The latter is mentioned by Karl Theodor Weiss, *Handbuch der Wasserzeichenkunde*, cit., 1962, p. 311, while some specimens in the collection are described by Richard L. Hills, 'The Importance of Laid and Chain Line Spacing', in *Le papier au Moyen Âge*, cit., 1999, pp. 149-163. The holdings of the Deutsches Museum are described in a more general fashion in a brief article by Eva A. Mayring, 'Papierhistorische Resources and Collections: the Archives of the Deutsches Museum', *IPH Paper History*, n. 11 (2001), pp. 17-19.

A collection of some 7,300 samples of paper of industrial watermarks, i.e. printed with a dandyroll on a Fourdrinier machine (*or something similar*), has been assembled by Stefan Feyerabend and can be viewed on the website *Maschinen Wasserzeichen: Sammlung Feyerabend*.

A modern collection, comprising mainly some 2,000 sample books and other sorts of artists' paper, is held by the National Gallery of Art in Washington, see Judith Walsh-Marian Peck Dirda, 'An Introduction to the National Gallery of Art's Paper Sample Collection', in *Looking at Paper: Evidence & Interpretation*, cit., 2001, pp. 76-81. Likewise in Washington, but this time at the Library of Congress, is the study collection of Harrison G. Elliott (1879-1954), comprising some 4,500 specimens, mostly modern, but with approximately 300 early American examples. The collection also includes memorabilia and correspondence relating to Dard Hunter, who was a close friend of Elliott's.

The National Paper Museum Trust is held by the Museum of Science and Industry in Manchester and was curated for many years by Richard L. Hills. It comprises some 1,700 samples of paper, advertising, brochures, and other items relating to the trade. The catalogue of the same is not easily identified in the Museum's online database and the descriptions are decidedly skimpy.

As well as dedicated collections of watermarks, an increasingly modern phenomenon is archives of tracings and other material assembled by watermark and paper scholars. Above I have discussed (*at length*) the two largest and best known archive collections of tracings of watermarks, also for the scholars who created them, i.e. Briquet at Geneva and Piccard at Stuttgart. It is worth adding a third one, as yet relatively little exploited, or the The Loeber Collection of the Dutch Foundation for Paper History, housed at the Municipal Archives, Apeldoorn. As well as a huge amount of other material – 7,000 technical drawings, 15,000 photographs, etc. – gathered in forty years of travelling and research by Edo G. Loeber (1902-88), it also includes 18,000 tracings of watermarks. A microfiche catalogue was issued in 1992; it might be a good idea if this were reissued in some more up-to-date technology. A parallel collection, again on an impressive scale, is that of some 10,000 tracings left by Theo Gerardy to the Koninklijke Bibliotheek at The Hague, see Albert Elen, 'Die Wasserzeichensammlung Dr. Ing. Theo Gerardy', *IPH-Information*, n. 22 (1988), pp. 160–165.

In 'Papiers et filigranes des Archives de Gênes 1154 à 1700', cit., 1888, p. 28, Briquet mentions a collection of 115 tracings belonging to "M.^r Villa, antiquaire bien connu de Gênes et membre de la Société d'histoire de cette ville". In entry n. 3912 of *Les filigranes*, cit., 1907, he makes reference to the same collection, which seems however to have disappeared. An inquiry to the Archivio di Stato di Genova in March 2010 obtained the reply that there is no record of it today.

Another repertory, which has remained unpublished, but which is known to codicologists and occasionally cited in the literature, for instance by Heawood in his articles in *The Library* [6m], is the collection of tracings from the manuscripts in the library of Canterbury Cathedral assembled by Michael Beazeley to be found in

British Library, Add. Mss. 38637 and 38638 ('Tracings of Watermarks (1322-1667) from MSS. in the Library of Canterbury Cathedral, made 17 July, 1896-24 May, 1900, by Michael Beazeley, F.R.G.S., Hon. Librarian to the Dean and Chapter'), together with four notebooks of observations made during the research held at Add. Mss. 38639-38642.

Seven files of tracings of watermarks by Edward Heawood, most of them used for his well-known book of 1950 [18], were donated in 1944 to the Bodleian Library, Oxford (Ms. Eng. misc. c. 272/1-7).

Three boxes containing the tracings made by Pierre Delaunay for his 1997 book on the watermarks of the Auvergne [6c] were gifted by him to the Bibliothèque du Patrimoine at Clermont-Ferrand.

[32]

Other Sorts of Paper and Other Uses of Paper

Paper was of course born as a wrapping material, rather than as a writing or printing surface, while over the centuries the industry has constantly recycled used documents, indiscriminately pulping books and archive records. It has also developed special kinds of paper, which in turn have generated narrowly specialist bibliographies and scholarship. This section cries out for expansion, but here are some starters.

- *Blue Paper*. Used mostly for wrapping and packaging, but also popular with Renaissance artists, such as Vittore Carpaccio, see Wisso Weiss, 'Blaues Papier für Druckzwecke', *Gutenberg Jahrbuch*, 1959, pp. 26-35; Irene Brückle, 'Historical Manufacture and Use of Blue Paper', *Book and Paper Group Annual*, vol. 12 (1993) (*available on line*), and Idem, 'The Historical Manufacture of Blue-coloured Paper', *The Paper Conservator*, 17 (1993), pp. 20-31. From 1514, however, Aldus introduced the practice of printing a few copies in some print runs on blue paper, see Conor Fahy, 'Esemplari su carta reale di edizioni aldine, 1494-1550', cit., 2004, with an English version in 'Royal-paper Copies of Aldine Editions, 1494-1550', cit., 2005-06. The earliest of these editions appears to be the *Libri de re rustica*, dated May 1514, of which a copy in blue paper is held by the Pierpont Morgan Library in New York, see the illustration in the exhibition catalogue *Aldo Manuzio. Il Rinascimento di Venezia*, Venezia, Marsilio, 2016, pp. 290-291. For the two known copies on blue paper of the October 1514 Aldine Virgil, see H. George Fletcher, 'Jean Grolier's 1514 Aldine Virgil on Blue Paper', in G. Scott Clemons-H. George Fletcher, *Aldus Manutius. A Legacy More Lasting than Bronze*, New York, The Grolier Club, pp. 27-31. The other Renaissance Venetian printer who occasionally produced copies of his editions on blue paper was Gabriele Giolito, in particular of Ariosto's *Orlando furioso* in 1543 (*copy at the Biblioteca Nazionale Centrale di Firenze*) and 1553 (*copy at the Houghton Library, Harvard*).

- *Coloured Paper* (see also *Blue Paper*). Printing on different types and colours of paper became a fad between the end of the Eighteenth and the beginning of the Nineteenth centuries, although modern cataloguing and bibliographies tend to pay little cognizance to the fact. One useful early list can be found in Thomas Hartwell Horne, *An Introduction to the Study of Bibliography, to which is prefixed a Memoir on the Public Libraries of the Antients*, London, for T. Cadell and W. Davies, 1814, vol. 2, Appendix II 'Brief Notice of Works Printed on Paper of Different Colours', pp. xiv-xx.

- *Cartoon Paper*. The vast paper sheets used to pattern Renaissance frescoes had to be assembled from much smaller pieces and required skilled workers for the task, see Carmen Bambach, 'The Purchases of Cartoon Paper for Leonardo's "Battle of Anghiari" and Michelangelo's "Battle of Cascina"', cit., 1999, pp. 105-133.

- *Decorated paper*. The problem here perhaps involves definition, since catalogues and other descriptions of decorated papers take as their prime source the coloured end-papers in books. In many cases the colour is acquired by marbling, brushing, sponging, or sprinkling the paper, rather than by a printing process, usually involving woodblocks, which can include gauffering or embossing. A useful trilingual guide is Susanne Krause-Julia Rinck, *Bunt Papier: ein Bestimmungsbuch; Decorated Paper: a Guide Book; Sier Papier: een Gids*, 2nd revised and extended edition, Stuttgart, Hauswedell, 2016 (1st edition: 2009). Otherwise the field is dominated by French writings on the subject, see Marie-Ange Doizy, *De la dominoterie à la marbrure: histoire des techniques traditionnelles de la décoration du papier*, préface de Geneviève Guillemot-Chrétien, Paris, Art et métiers du livre, 1996; André Jammes, *Papiers dominotés: trait d'union entre l'imagerie populaire et les papiers peints (France 1750-1820)*, Paris, Éditions des Cendres, 2010; Marc Kopylov, *Papiers dominotés français ou l'art de revêtir d'éphémères couvertures colorées livres & brochures entre 1750 et 1820*, Paris, Éditions des Cendres, 2012; Idem, *Papiers dominotés italiens. Un univers de couleurs, de fantaisie et d'invention, 1750-1850*, Paris, Éditions des Cendres, 2012. A useful English-language round up is: *Decorated Book Papers, being an Account of their Designs and Fashions*, edited by

Hope Mayo, 4th edition, Cambridge, Houghton Library, Harvard College Library, 2007, while in Italy important studies taken from the collections of the Casanatense Library in Rome have been produced by Piccarda Quilici, see her *Carte decorate nella legatoria del '700 dalle raccolte della Biblioteca Casanatense*, Roma, Istituto poligrafico e Zecca dello stato, 1988. A small catalogue for the exhibition of decorated papers in the Achille Bertarelli collection in Milano is: *Le carte decorate della Raccolta Bertarelli*, a cura di Alberto Milano, Elena Villani, Milano, A. Mondadori arte, 1991. Another attractive tome, for the Musei civici in Modena, is by Michela Gani, *Carte decorate*, Modena, Franco Cosimo Panini, 1993.

The Italian decorated paper industry was dominated by the Remondini family in Bassano, see for a general picture of the firm's history: Infelise, *I Remondini di Bassano*, cit., 1990. Specifically about decorated paper, with some nice images, is the tri-lingual tome *Guziranje. Dalla Schiavonia veneta all'Ongheria con le stampe dei Remondini = z Beneškega na Ogrsko s tiskovianami Remondini = from Venetian Schiavonia to Hungary with the Remondini Prints*, Stregna, Comune di Stregna-Passariano, Regione autonoma Friuli Venezia Giulia, Centro di catalogazione e restauro dei beni culturali, 2009. A large number of woodblocks and related matrices, also for printing wallpaper, are on display in the small, but engaging, Remondini museum in Bassano, just up the road from the famous bridge. Otherwise most producers have remained anonymous, except for an instance in which a warp in the record, or the survival of the sample book of Carlo Vittorio Bertinazzi (1731-1801), has created the opportunity for the extensive study of Gianna Paola Tomasina, *"All'uso di Francia" dalla moda all'industria. Carte decorate, papier peint e tessile stampato nel sec. XVIII. La bottega Bertinazzi (Bologna 1760-1896)*, Bologna, Pàtron, 2001. The sample book is also reproduced in Kopylov, *Papiers dominotés italiens*, cit., 2012.

Techniques of printing in gold were a speciality of Germany, in particular Augsburg, and are described in Christiane F. Kopylov, *Papiers dorés d'Allemagne au siècle des Lumières, suivis de quelques autres papiers décorés: Bilderbogen, Kattunpapiere & Herrnhutpapiere (1680-1830)*, Paris, Éditions des Cendres, 2012, again, as with the other volumes in this series, splendidly illustrated.

- *Forgeries*. Watermarks are a very good way of uncovering (or preventing) forgeries, as anybody who has tried printing their own banknotes may have discovered to their cost. But of course watermarks in their turn can be forged, mainly by professional rivals. Large quantities of paper signed "Whatman" were turned out by German, Austrian, and Italian mills at the end of the Eighteenth and beginning of the Nineteenth centuries, see Peter Bower, 'The White Art: The Importance of Interpretation in the Analysis of Paper', in *Looking at Paper: Evidence & Interpretation*, cit., 2001, pp. 5-16: 12-14. For a more forensic approach, see the same author's 'Beating the Forger: Case Studies in Forensic Paper Investigation', *ibid.*, pp. 154-170.

- *Large Paper*. While it is well known that early printers, beginning with the Gutenberg Bible, often produced part of a run on parchment, it is less certain when the fashion of executing part of a press-run, often for dedication purposes or for copies reserved for the author, on a different sized sheet began. Not unexpectedly, the Aldine shop proved pioneering in this practice. The earliest documented instance, so far, is the 1499 *Hypnerotomachia Poliphili*, for which three copies have so far been recognised as being on a larger and thicker paper. For that held by the Archbishop's Library at Udine, which also presents unusual set-offs, see Neil Harris, 'L'*Hypnerotomachia Poliphili* e le contrastampe', *La Bibliofilia*, vol. 100 (1998), pp. 201-251, issued also in the volume: *Anatomie bibliologica. Saggi di storia del libro per il centenario de «La Bibliofilia»*, a cura di Luigi Balsamo and Pierangelo Belletini, Firenze, Olschki, 1999 (*same paging*). The other two copies are at the Museo Poldi Pezzoli in Milan and at the Pierpont Morgan Library in New York (*this last with only the first book on large paper*). There are however reasons for thinking, like so much to do with the *Hypnerotomachia Poliphili*, that the episode is somewhat strange and should be considered anomalous. From a little before the death of the great Aldus himself, large-paper and blue-paper copies became a standard feature in the Aldine catalogue, see the description of the phenomenon by Conor Fahy, 'Esemplari su carta reale di edizioni aldine, 1494-1550', *La Bibliofilia*, vol. 106 (2004), pp. 135-172, with a slightly different English version in 'Royal-paper Copies of Aldine Editions, 1494-1550', *Studies in Bibliography*, vol. 57 (2005-2006), pp. 85-113, with a list of identified copies and their distinguishing watermarks. Excepting the *Hypnerotomachia Poliphili*, the earliest edition, so far identified, which has a separate run on large paper is the *Arcadia* of Jacopo Sannazaro in 1514: the same is remarkable also for having copies printed on vellum and on blue paper. The importance of the large paper copies for textual purposes in a masterpiece of Italian literature, Ariosto's 1532 *Orlando Furioso*, which also has a separate run on parchment, is brilliantly explained by the same author, see: *L'Orlando furioso del 1532: profilo di una edizione*, Milano, Vita e pensiero, 1989, pp. 119-123.

In most cases, the identification of large-paper, as distinct from ordinary paper, copies rests on the bibliographer's eye, experience, and judgement. Occasionally, however, archive documents reveal the existence of separate runs and sometimes even the number of copies: for instance, the 1542 Blado edition of

Theophylactus in Greek (Edit16 CNCE 24534) had a print-run of 100 copies in “carta mezana”, 1,205 copies in “carta bastarda”, and four copies in parchment, see Leon Dorez, ‘Le cardinal Marcello Cervini et l’imprimerie à Rome’, *Mélanges d’archéologie et d’histoire*, vol. 12 (1892), pp. 280-303. Although the parchment copies are known, no modern work has been done to distinguish the other paper types.

Running off a small number of copies on larger sheets sometimes led Renaissance printers to find rather unusual imposition solutions, as is shown by the occasional survival of the point-holes in otherwise unexplainable positions, see Jean-François Gilmont, ‘Une édition aldine sur grand papier: à propos de l’ancien exemplaire de Renouard d’un commentaire de Paul Manuce (1547)’, in *Calames et cahiers. Mélanges de codicologie et de paléographie offerts à Leon Gilissen*, sous la direction scientifique de Jacques Lemaire et Emile van Balberghe, Bruxelles, Centre d’étude des manuscrits, 1985, pp. 49-54, revised and reprinted with the title ‘Une édition de Paul Manuce sur grand papier’, in Idem, *Le livre & ses secrets*, Genève, Librairie Droz; Louvain-la-Neuve, Université catholique de Louvain, Faculté de Philosophie et Lettres, 2003, pp. 140-150.

In the late Seventeenth and Eighteenth centuries, different paper sheet-sizes or qualities are sometimes signified in printed books, in which the distinction is advertised by including an asterisk or a dagger in the direction line of the first recto of each sheet, see Brian McMullin, ‘Paper-quality Marks and the Oxford Bible Press 1682-1717’, *The Library*, s. VI, vol. 6 (1984), pp. 39-49; Wallace Kirsop, ‘Paper-quality Marks in Eighteenth-century France’, in *An Index of Civilisation. Studies of Printing and Publishing History in honour of Keith Maslen*, edited by R. Harvey, W. Kirsop and Brian J. McMullin, Melbourne, Centre for Bibliographical and Textual Studies, Monash University, 1993, pp. 55-66. Pioneering bibliographers of the Eighteenth and Nineteenth centuries were also much better than nowadays at noticing a different support on large paper, so it is worth keeping an eye on their writings.

- *Marbled Paper* (see also *Decorated Paper*). Like many other things mentioned here, the art of marbling paper was first discovered in China, spread to the Arab world, and eventually reached Europe. True marbled paper involves capturing the pattern created by a resinous gum on the surface of a vat of water, but in modern times industrial reproductions abound. See Marie-Ange Doizy-Stéphane Ipert, *Le papier marbré: son histoire et sa fabrication*, Paris, Éditions Technorama, 1985; Richard James Wolfe, *Marbled Paper: its History, Techniques and Patterns, with Special Reference to the Relationship of Marbling to Bookbinding in Europe and the Western World*, Philadelphia, University of Pennsylvania Press, 1990.

- *Packaging and Wrapping*. According to Dard Hunter, the oldest testimony of paper used for packaging purposes goes back to the Cairo market in 1036. A good, non-specialist summary is Diana Twede, ‘The Origins of Paper-based Packaging’, *Conference on Historical Analysis & Research in Marketing Proceedings*, vol. 12 (2005), pp. 288–300 (available on-line). Every time one strips the wrapping off a ream of A4, it goes into the bin by the photocopying machine. But reflect. In five centuries time that wrapping will be a rare and precious historical object. Wrappings from reams of paper are recorded from the late Sixteenth century: some examples are reproduced in Churchill, *Watermarks in Paper*, cit.; a total of 52 items, covering the period 1570-1864, are listed in Tschudin, *The Ancient Paper-mills of Basle and their Marks*, cit., 1958; eight more are reproduced in Lindt, *The Paper-mills of Berne*, cit., plates 1-8; while a couple of Milanese examples held at the John M. Wing Foundation in Chicago are described in Stevens-Gehl, ‘Giovanni Battista Bossi and the Paper Trade in Late Sixteenth-Century Milan’, cit., 1994. Not easy to find, but with lots of attractive illustrations, is Henk Voorn, *Old Ream Wrappers. An Essay on Early Ream Wrappers of Antiquarian Interest*, North Hills, Bird & Bull Press, 1969. And just in case you wanted a completely different sort of wrapping, have you ever thought about the bits of paper around oranges and lemons in the fruit shop or in the market? They have a long history, see Antonino Buttitta, Salvatore Lupo, Sergio Troisi, *From Palermo to America. L’iconografia commerciale dei limoni di Sicilia*, Palermo, Sellerio, 2007. They come no juicier!

- *Papercuts*. The more trivial the theme, the more serious the book! Felicitas Oehler, *Querschnitt. Schweizer Scherenschnitte aus fünf Jahrhunderten*, Berne-Stuttgart, Haupt, 2013, available also in a French translation: *L’Art du papier découpé. Cinq siècles d’histoire*, Lausanne, Ides et Calendes, 2013, albeit only dealing with Switzerland, is authoritative and comprehensive. And some of the material illustrated is quite remarkable!

- *Stationery*. Geeky and passionate is James Ward, *Adventures in Stationery. A Journey through your Pencil Case*, London, Profile Books, 2014.

- *Wallpaper*. Wallpaper can be handpainted, washed with a colour, or printed or stencilled. Young ladies who stuck the equivalent of Donny Osmond posters to the wall of the house goes back to the Renaissance and accounts for the poor survival of many pre-Gutenberg prints. The industry was revolutionised at the beginning of the Nineteenth century by the invention of the Fourdrinier machine, which allowed wallpaper to

be fabricated on long rolls. For a general history, a useful introduction is Alan Victor Sugden-John Ludlam Edmondson, *A History of English Wallpaper, 1509-1914*, London, B.T. Batsford, 1926; otherwise the literature is inevitably vast. One highly recommended source is the website of the Musée du Papier Peint in Rixheim.

[33]

Paper History and Paper Museums

Just throwing the terms “paper” and “museum” into Google will throw up some intriguing results. As has happened with the printing industry, the rapid disappearance of long-standing manufacturing procedures has led people to try and save the memory of the same by establishing specialist museums or maintaining old factories in their former condition. From this point of view paper has the disadvantage that former mills were generally sited out of town, sometimes in very remote spots indeed (*as in Richard De Bas*), and thus can be reached only through a long car or coach ride. Some of the smaller structures have a somewhat virtual existence and therefore the precise state of affairs should be checked with a telephone call or pre-booking before undertaking a long journey. In other cases, most notably Fabriano, a town with a papermaking tradition has created a facility in a building that has nothing to do with paper, but which is at least conveniently placed (*the museum, not Fabriano itself, which is in the middle of nowhere*).

Modern paper factories, sometimes on the site of a much older mill, occasionally have a historical section and can be visited, though usually booking has to be made well in advance and is only available to groups. A list of these can be found on the website www.paperonline.org; in more general terms a list of paper collections and museums, including contact details, can be found on the well-maintained site of the Association of International Paper Historians (*which is excellent in this respect and to which I defer*). On the other hand, the IPH tends to ignore the fact that sections dedicated to paper feature often in printing museums, such as the Gutenberg Museum at Mainz, which dedicates a whole room to the history of paper, or in museums dedicated more generally to the history of science and technology. Major libraries with museum sections for visitors also tend to have items dedicated to paper and the history of paper.

Are paper museums worth visiting? Generally, yes, though what one gets told should be treated *cum grano salis*. Do-it-yourself papermaking at the vat, which some of them offer as an experience, generally employs a porridge-like pulp which makes it easier for a tourist to get a whole sheet out and onto the felt; also these displays rarely employ two moulds in tandem.

In terms of priority, not only for the scale of the operation, but also as centres for documentation and research, the three best destinations are Basel, Capellades, and Fabriano, but many of the smaller set-ups are in exquisitely beautiful locations. In this listing, I restrict the indication to paper museums or mills pure and simple, or at least those centres where the paper element seems dominant. I should add that I have managed to visit relatively few of these museums, although most of them have websites that provide further information and allow you to decide whether they are worth seeing or not.

Austria.

Steyrermühl, Österreichische Papiermacher Museum. A bit far from everywhere, but in a beautiful bit of Austria. Displays papermaking at the vat; also has sections dedicated to printing and the history of the local fire brigade.

Belgium.

Alsemberg, Herisem Paper Mill. Former paper mill going back to 1536, later a cardboard factory, not too far from Bruxelles.

Malmedy, Musée National du Papier. Small town on the edge of the Ardennes. Not much on the website, but the gastronomy is probably good.

Czechoslovakia.

Velke Losiny, Paper Mill. Apparently the only structure of its kind in Eastern Europe. The mill goes back to 1591, while the museum was founded in 1987. Offers papermaking at the vat and has a museum section.

Finland.

Quite a few ongoing paper mills have museum sections and can be visited, usually by booking in advance.

Jaala, Verla Groundwood and Board Mill. Industrial structure, transformed into a museum in 1972 and placed on the Unesco World Heritage List in 1996.

France.

The various mills that maintain hand papermaking are concentrated in the South and South-West and need a car.

Ambert, Richard de Bas. Really in the hills above Ambert, the only survivor of the once impressive Auvergne paper industry, activity on the site goes back to the Fourteenth century and the building has conserved its original stamping mill. Papermaking at the vat is demonstrated, though visitors do not get to try their hand. Good website and well worth a visit; also boasts a large shop with paper-related souvenirs, which should keep the family happy.

Angoulême, Musée du Papier d'Angoulême. Definitely the largest and most impressive French set-up. Founded in 1988, the museum is in an industrial complex, which was formerly a paper-making mill, subsequently transformed into a factory specialised in making cigarette papers. As well as providing many insights into the history of industrial papermaking, it has its own publication and exhibition programme.

Annonay, Musée des Papeteries Canson & Montgolfier. Two great names of the papermaking tradition. The museum, however, has had a somewhat chequered existence, so verify opening times and what is available before going.

Couze, Moulin de Larroque. The only survivor of a traditional paper-making area.

Esquerdes (Saint-Omer), Maison du Papier.

Fontaine de Vaucluse (Avignon), Moulin Vallis Clausa. Traditional paper mill on the river Sorgue, attached to a working factory, restored and reopened in 1973, with a large shop. See website.

Nersac (Charente, not too far from Angoulême), Moulin de Fleurac. Former wheat mill transformed into the reconstruction of a traditional paper mill.

Paris. The Musée des Arts et Métiers has a section dedicated to the history of papermaking with some interesting scale models.

Puymoyen (Angoulême), Moulin du Verger. Activity on the site goes back to the Sixteenth century, but the present-day mill – created by Jacques Brejoux – has a modern set of imitation Medieval stampers. From 2007 it has organized practical paper-making courses held in September.

Rixheim (*outskirts of Mulhouse*), Musée du Papier Peint. The museum, opened in 1983, is in the building of a former wallpaper factory established at the end of the Eighteenth century. Not about paper in the strictest sense of the term, but still a fascinating collection with frequent temporary exhibitions, and an inviting website.

Germany.

Düren, Papiermuseum. Part of the larger Leopold Hoesch Museum and opened in 1990. Has a new building, but no real website at the time of writing.

Mainz, Gutenberg Museum. Albeit dedicated principally to the history of printing, a significant section describes the history of paper.

Italy.

Amalfi, Museo della Carta. The tradition of paper-making in Amalfi goes back to the very beginnings of the industry in the West. The last mill there closed in 1969, but through the obstinacy of Nicola Milano was transformed into the present-day museum. It is small, but in one of the most beautiful places in Italy. Worth a visit, and don't forget to sample the *limoncello*.

Fabriano, Museo della Carta e della Filigrana, established in 1984. Together with Basel, this museum is among the largest and most impressive of its kind and is well worth a visit. The website, which has photographs of city employees dressed in Medieval costume making paper, is also worth exploration. Much more recent is the archive and museum of the Miliani papermill, slightly out of centre on the South-west side of the city: the factory has recovered and restored a lot of its disused machinery, including its original stamping mills, and has a huge collection of papermaking moulds on display (*visitable only by appointment*).

Mele, Il Museo della Carta di Mele. Founded in 1997 in a former papermill, 30 minutes from the centre of Genoa. It is a small set-up, which has had a somewhat erratic existence, but now seems to be on a more stable footing. The surrounding scenery is absolutely beautiful.

Pescia, Museo della Carta. Actually at Pietrabuona, some miles up the valley from Pescia, this small museum is in a former paper mill. Activities are fairly limited.

Toscolano. The Museo della Carta di Toscolano Maderno was founded in 2007 and is housed in a former papermill in the hauntingly beautiful Valle delle cartiere. Though the set-up is small, and has few genuinely original items, it has a Fourdrinier machine and a nice section on the history of printing. Also, leave yourself time for a long, reflective walk.

Valstagna, Museo delle cartiere di Oliero. Once rented by the Remondini family in nearby Bassano; also possible to visit the caves just round the corner.

Japan.

Mino, near Nagoya in central Japan, the Mino Washi Paper Museum (Japanese Paper Museum).

Tokyo, The Paper Museum, Asakayuma Park, Tokyo. Founded sixty years ago, obviously with an emphasis on Oriental techniques, but also in possession of an impressive library.

Spain.

Capellades, Museu Moli Paperer. Some 60 south-west of Barcelona, the former Eighteenth-century papermill is now part of a larger museum dedicated to the history of science and technology. The complex still has a working water wheel and stampers.

Switzerland.

Basel, Schweizerisches Papiermuseum. Sited in a former papermill on the bank of the Rhine, this museum is a must for anyone interested in paper-history, also for tradition of Tschudin scholarship it represents. For an introduction, see Peter Tschudin, *Basler Papiermühle. Schweizerisches Museum für Papier, Schrift und Druck*, Basel, Basler Papiermühle, 2002.

United Kingdom.

Frogmore Paper Mill, Apsley, Hemel Hempstead. Famous as the first place to have installed a working Fourdrinier machine, thus the address in Fourdrinier Way. Still a working mill with a no-longer-active 1895 Fourdrinier machine and a well-conceived visitor centre. Allows visitors to try their hand at making paper at the vat.

Maidstone, Kent. No longer a paper mill after its closure in 1976, and not even a museum, but the site of Whatman's Turkey Mill still stands at a ten-minute walk from the centre of Maidstone, as a part of an industrial complex that also organises receptions, meetings and even weddings. See website at <http://www.turkeymill.com/about-us/view/139/history>.

United States.

Atlanta, Georgia Tech, Robert C. Williams Paper Museum, which includes as a (*large*) part of its holdings the Dard Hunter collection of instruments, samples and books about the history of paper and papermaking. Also Margaret Mitchell's house is only a block or so away ("*Tomorrow is another day*", even for scholars of *watermarks*).

Brookline, Massachusetts. International Paper Museum at the Carriage House. The collections and tools of Elaine and Donna Koretsky. Opening times are fairly restricted.

Chillicote, Ohio. The Mountain House and the Dard Hunter Studios are still running and can be visited.

[34]

Learned Societies and Associations

Paper studies always suffer from the handicap that, unless somebody actually gets into the archive or wherever, in order to measure sheet-sizes and classify watermarks, what is produced is of little worth. Apart from the great exceptions of Briquet and Stevenson, both of whom were exceptionally mobile, the best work has been done by scholars working on a local basis, trawling through the contents of archives or libraries in a more restricted area, of which the most celebrated example is Piccard. In other words it's the individual that counts.

Nevertheless, a good deal has been achieved by free, and freewheeling, associations of scholars with a common interest in paper who meet to talk (*and eat and drink*). The International Association of Paper

Historians (IPH), albeit with ups and downs, has proved particularly effective in bringing people together and its conferences are well worth attending (*although they do require one to be rigorously polyglot, but, as such events go, the sheer variety of participants makes them infinitely less boring than most academic conventions*). It also coordinates a number of national associations, about which more information can be found on their website.

Among the latter the British Association of Paper Historians has been particularly active and publishes its own attractive and highly recommended journal, *The Quarterly*. Almost a hundred numbers have so far been produced from 1989 to 2016, with a penchant for recovering engaging snippets of historical information. For a full contents list, see the website.

Not exactly a learned association, since it was really a publishing enterprise, but of extraordinary importance in the history of paper studies was the Paper Publications Society. Founded by Émile Joseph Labarre (1883-1965), its best-known series, the *Monumenta chartae papyraceae historiam illustrantia*, even in the era of internet has a stable place on rare-book room shelves and without it ... well, no Zonghi, no Heawood, no Jubilee edition of Briquet. Paper studies would be back in the dark ages! In particular the collaboration of the Oxford Slavonic scholar, John Simon Gabriel Simmons (1915-2005), was instrumental in obtaining the translation of works in Russian and other Eastern European languages, most importantly the books of Vladimir Mošin, which were published in the series. On its history, intimately woven up with the life of its founder, see Bé J. van Ginneken van de Kastele, 'A History of the Paper Publications Society (Labarre Foundation)', in *IPH-Yearbook*, vol. 4, (1983-84) pp. 207–228, and on the figure of Labarre: J.S.G. Simmons, *Émile Joseph Labarre, 1883–1965*, Hilversum, The Paper Publications Society, 1965; Richard L. Hills, 'É. J. Labarre, 8 December 1883-10 June 1965', in *IPH-Information*, n. 17 (1983), pp. 134–135.

[35]

The World-wide Web (*If you can find it*)

The WWW is of course paper's main competitor and intended replacement. And so it is dangerous for paper historians to venture therein, given the ambiguity of certain items of terminology. I was delighted, not so long ago, to find on one authoritative website dedicated to paper studies (*I'll be nice for once, and won't name it*), in the bibliography section, the description of a "Robust 3D DFT video watermarking", which sounds interesting, except that when one looks at the contents relating to "Security and Watermarking of Multimedia Contents", well, it ain't about paper at all, not by the remotest stretch of the imagination.

Of course one can dream of roaming through an electronic universe populated by gorgeous genuine watermarks, but in the present state of affairs the situation is unsatisfactory. Websites dedicated to paper and to watermarks mushroom at an alarming rate and, as is the rule of the net, connect up (*and also disappear without the slightest warning*). But attempts to harness them to some serious purpose come with a word of warning.

For the most part watermark catalogues and electronic resources do not always marry together. The very high-quality images and the rigorous cataloguing procedures that should be the basis of any such project act as a deterrent, while the knowledge of the secondary bibliography in many cases appears limited to Briquet, not always cited correctly, and a few other randomly selected items. It is perhaps unfair to pick out one instance, when there are so many others crying out to be slated, but it is a nice project, with enormous potential, which has failed to grasp the issue. Take a look, therefore, at the website of the Archives Municipales in Toulouse [link to: <www.archives.mairie-toulouse.fr, archives-en-ligne, les filigranes anciens>]. The digital images are very pretty, but that is about all that can be said. Otherwise some promising initial work needs to be backed up by fuller technical information, i.e. sheet-size, identification of the twin watermark (*which in an archive of this sort must always be possible*), felt or mould-side recognition, and whether the watermark is located in the left or right-hand side of the mould. A quick glance at the online Briquet shows 178 entries from Toulouse, apparently almost all from the Archives Municipales. Briquet did not live in a parallel universe; he looked at the same documents we still have. Why not do something about those?

However, to every bad general rule, there is a wonderful exception. In this particular case it is the *Watermarks in Incunabula printed in the Low Countries* project conceived and transformed into electronic substance by Gerard van Thienen (1939-2015), on whose personality and achievements see Paul Needham, 'IDL, ILC, WILC: Gerard van Thienen's Contributions to the Study of Incunabula', *Quaerendo*, vol. 36 (2006), pp. 3-24. This resource might have been missed by many scholars interested in paper and watermarks, since quite understandably the idea of learning about Dutch Fifteenth-century printed books is greeted with

underwhelming enthusiasm. The site is hosted by the Koninklijke Bibliotheek, The Hague, and provides in real terms perhaps the biggest single step forward since Briquet. It is exemplary not only for the quality of its images (*many of them obtained by electron radiography*), but also for the bibliographical work preceding the same, i.e. the images are taken from the mould side, we are told whether they are 'left' or 'right', and twin marks are regularly identified. So worth a visit, even if you don't like Dutch books (*or mayonnaise on your chips*).

Other web sites? Well, the list could be endless, but I am going to limit myself to a few suggestions, after which you are free to fend for yourself.

First, in terms of its ability to interact with the user, the site of the International Association of Paper Historians is chatty and friendly (see [34]). It has a questions and answers page, where help can be sought about weird problems concerning paper, that get sensible answers, or sometimes weird answers, and it provides ample information about recent publications and ongoing events in the world of paper studies, including its important annual congress. It also acts as a jumping-off point for the several national associations, where the amount of activity and the quality of the websites are very variable, but all certainly worth looking at. I particularly recommend that of the British Association of Paper Historians (BAPH), which has a lot of interesting material, as well as the index of its journal, *The Quarterly*.

Second, is the site of the Bernstein 'Memory of Paper' consortium (*'Bernstein' is not a name, but the German term for 'amber', or an allusion to the capacity of paper to conserve information in time. Nice idea, but googling the project invariably throws up Leonard Bernstein of West Side Story fame*). This impressive, mainly German and Dutch, project involves nine partners, i.e. the Austrian Academy of Sciences as lead partner, together with the Archives of the State of Baden-Württemberg in Stuttgart (*for the Piccard archive*); the Graz University of Technology; the Centre National de Recherche Scientifique, University of Paris I (*for the online Briquet project*); the Deutsche Bucherei in Leipzig (*for the secondary bibliography on the history of paper*); the Dutch University Institute for Art History in Florence (*for research on artists' papers*); the Delft University of Technology; the Koninklijke Bibliotheek in The Hague (*for the paper in Dutch incunabula project described above*); and the University of Liverpool. As ever in European research projects in the humanities, these various bodies make strange bedfellows, and some omissions are regrettable, such as the absence of significant Italian or Spanish partners. Although a huge amount of material is available, the database has to be examined with care, since there are considerable differences in the way the material is being collected and presented. Just to give two examples: Stuttgart has put on line the enormous archive of tracings collected by Gerhard Piccard, while The Hague, as has just been mentioned, is applying electron radiography to the charting of watermarks in Dutch incunabula, so methods and the quality of those methods are in contrast. These defects are to some extent inevitable, since the watermark search-engine acts as a meta-opac, which, with a sophisticated software, interrogates numerous databases, not all of them directly involved in the project. In 2009 I remarked that "since the prosecution of the project depends on EEC funding, at the time of writing activity seems to be in abeyance"; checking the site *ab initio* in 2016, the impression that there has been little activity seems confirmed: for example, the bibliography of the secondary literature has not been updated in the last six years (see [0] above). An inquiry to the project manager received a courteous reply that the project is still ongoing, in particular in adding new watermark sites to its portal, and that the partners meet on a biannual basis, most recently in 2016. The conference papers and presentations published on the site are worth a browse, though, as ever, it is difficult to find any reference to the fact that watermarks are twins.

An important, and praiseworthy, feature of the Bernstein project is the way in which it has sought to reach a wider, less specialist public with an attractive travelling exhibition (*with visits between 2006 and 2014 to Stuttgart, Vienna, Fabriano, Rome, Milan, Turin, Bergish Gladbach, Vercelli, Varallo, Horn, Baden bei Wien, and Steyermühl*). The enterprise has also given rise to a catalogue *Ochsenkopf und Meerjungfrau. Wasserzeichen des Mittelalters*, edited by Peter Rückert, Stuttgart, Landesarchiv Baden-Württemberg, Hauptstaatsarchiv, 2006 (72 p.), updated with a new version in 2009 (128 p.). This first edition was followed by a second in Italian in 2007: *Testa di bue e sirena. La memoria della carta e delle filigrane dal Medioevo al Seicento*, Stuttgart 2007 (96 p.); by a third in English in 2009: *Bull's Head and Mermaid. The History of Paper and Watermarks from the Middle Ages to the Modern Period*, Stuttgart and Vienna 2009 (128 p.); and by a fourth in Spanish: *Cabeza de buey y sirena. La historia del papel y las filigranas desde el Medioevo hasta la Modernidad*, Stuttgart-Valencia-Vienna, The Bernstein Project, 2011 (165 p.). As the number of pages shows, the work has almost tripled in size in its jaunts around Europe. The Turin stage in the spring of 2009 gave rise to a spin-off version of the Italian catalogue, with the title *Cartiere e filigrane piemontesi; prospettive di ricerca* (38 p.), available in pdf. on the Bernstein website. Above all as an introduction to the study of paper and watermarks, these beautifully illustrated friendly volumes come highly recommended.

One useful feature of the more recent versions is potted biographies of eminent scholars of paper and watermarks. In the Spanish edition, these are: Carlos Antonio de Laserna Santander, Vinzenz Franz Werl, Manuel Rico y Sinobas, Aurelio Zonghi, Friedrich Keinz, Charles-Moïse Briquet, Francisco Bofarull y Sanz, Nikolai Petrovich Likhachev, William Algernon Churchill-Edward Heawood, Karl Theodor Weiß, Wisso Weiß, Theo Gerardy, Gerhard Piccard, Gonzalo Gayoso Carreira, Oriol Valls y Subirá, Gerard van Thienen, Alois Haidinger. Of course this list is rather incomplete, lacking Philip Gaskell, Andrea F. Gasparinetti, Dard Hunter, Jean Irigoien, Émile Labarre, Allan Stevenson ... to name but a few. However, watermark studies are so dispersive that it is a good start. Having praised the catalogue, its defects should be noted: there are glaring discrepancies in the various approaches and the essays are very variable in quality: most troublingly, to my mind, the text contains only fleeting references to the fact that watermarks are twins (*is this an enduring criticism on my part?*).

Third on my list, for the quality of the first-hand research involved, as well as the extremely helpful didactic approach, including several links to videos [36], some dating back in time, showing paper being made at the vat, is the website at the University of Iowa: 'Paper through Time. Nondestructive Analysis of 14th- through 19th-Century Papers', where the principal investigator is Timothy Barrett, see <<http://paper.lib.uiowa.edu>>. Although the approach is formidably technical, the project wears its learning lightly.

Fourth, and truly last, if you have an idle moment, have a look at "Carta a mano nelle Ande Onlus", founded in 2008 at Chimbote in Peru, whose story is told in a book by Angelo Moncini, *La cartiera nel deserto*, Como, Progetto Chimbote-Carta a mano nelle Ande Onlus, 2010, and reprints. Nice photos, a wonderful story, and a deserving cause.

[36]

Films, Videos, and Youtube

Plenty of films, videos, and other items showing the papermaking process have been made over the years, some with a serious academic purpose, also with the desire to document a dying process; others for fun, and yet others to promote paper museums and paper-related tourism. Some have been thrown into Youtube, and thus usefully link up with each other (*it is just a matter of finding the right vein*). So, here, in approximate order of antiquity, are some of the more professionally produced and historically important items I know about.

- 'Nella città dei maestri cartai di Fabriano'. A film documentary made for Italian state television (RAI) in 1958 by Armando Pizza and Adriano Maestrelli, showing papermaking in the Miliani factory in Fabriano. What is remarkable is that it shows the traditional stampers and work at the vat. The first Youtube upload also has input from Fabriano identifying the people who appear in the video. Uploaded 2 September 2012; 35 minutes. <https://www.youtube.com/watch?v=TOoP4VStx88>; or, with English subtitles: <<https://www.youtube.com/watch?v=Ss-zmnSszco>>
- 'Papermaking at Hayle Mill, England, in 1976'. Recovers a film made for Anglia TV, as part of a series entitled *Bygones*, showing the Barcham Green papermaking factory in Maidstone, Kent, the last in England, which has since closed. An exceptionally interesting document, also for the 1976 haircuts and the polyester shirts with wide collars. Uploaded 5 January 2011; 15 minutes. <https://www.youtube.com/watch?v=Xs3PfwOltto>
- 'Fabriano antica capitale europea della carta', a cura di Giancarlo Castagnari; fotografia e montaggio di Angelo Rossi, 1994. Touristy, but nicely turned out video, in Italian, produced at the time to promote the city's new Museo della carta e della filigrana, and published as a VHS. Uploaded 6 September 2012; 30 mins. <https://www.youtube.com/watch?v=haKCsdIQeDI>
- Marco Haage, 'Il genio nella carta'. Short film, made for the Italian state television (RAI), in about 2005, and published at the time as a DVD containing also a short booklet. It describes the basic process of papermaking, filmed at the Museo della carta e della filigrana in Fabriano. Uploaded 12 September 2007; 17 minutes. <https://www.youtube.com/watch?v=ODRQWQRsKuM>
- 'La carta ritrovata' by Marco Ciomei. Film made in Italian in 2006 in the ruined papermills of Villa Basilica, near Pescia in Tuscany, with the testimonies of the former employees. Uploaded 5 December 2015; 25 minutes. <https://www.youtube.com/watch?v=vt2y6fhDpEA>
- 'How Paper is Made'. Nicely confectioned video showing Oriental-style papermaking with interesting footage of Elaine and Donna Koretsky of Carriage House Paper, as well as of the Jang Paper Mill in South

Korea. Made in 2011; uploaded 24 March 2015; 20 minutes. <https://www.youtube.com/watch?v=bBcq0t50A9w>

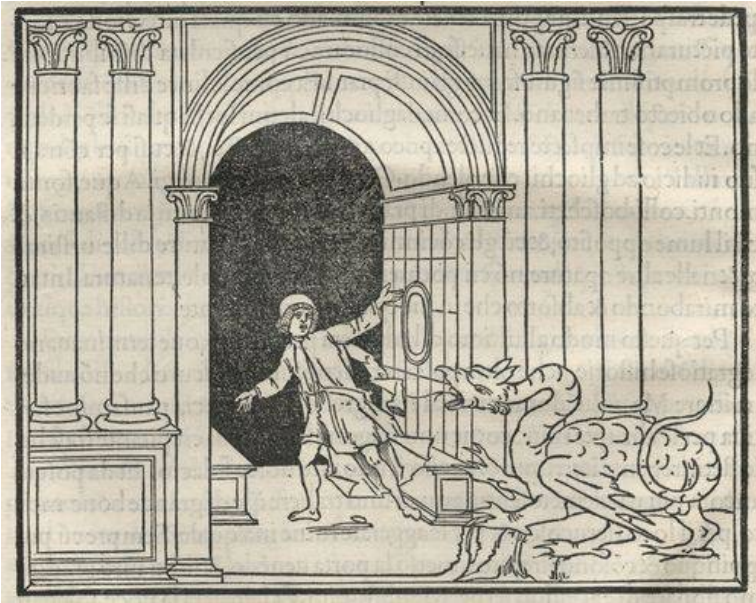
- 'Fare la carta a Mele. Papè pestou'. Promotional video in Italian for the Museo della carta at Aquasanta, near Genoa, founded in a former paper mill in 1997. Uploaded 23 July 2011; 8 minutes. <https://www.youtube.com/watch?v=cETymcA4yCI>
- Ray Tomasso, 'Papermaking and the History of Paper'. Well-produced academic video, a bit slow-paced at times, made for the Colorado University at Boulder Libraries. Published 28 November 2011; 57 minutes. <https://www.youtube.com/watch?v=JPqjLzAnSIM>
- 'Traditional Papermaking Process'. Short video showing papermaking at the Richard de Bas mill in the hills above Ambert in France. Uploaded 25 May 2012; 2 minutes. <https://www.youtube.com/watch?v=lltkdyE1OG0>
- Stephen Mann, 'Introduction to Papermaking. History of Papermaking'. Rather academic lecture on the papermaking process and its history, possibly a bit short of pretty pictures. Uploaded 14 July 2012; 20 minutes. <https://www.youtube.com/watch?v=ioDEYljT2c4>
- Avi Michael, 'Chancery Papermaking'. Shows the papermaking activity at the University of Iowa's Center for the Book directed by Timothy Barrett (*the one with the gray hair*). Serious demonstration of the proper use of twin moulds at the vat. Uploaded 28 May 2013; 12 minutes. https://www.youtube.com/watch?v=e-PmfdV_cZU
- 'Archivio Storico Cartiere Miliani. Il racconto'. Film made in Italian in 2014, by the local independent television company Marche TV, to promote the newly created Fondazione Gianfranco Fedrigoni Istocarta, consisting in a lengthy interview with curator, Livia Faggioni. 27 minutes. http://istocarta.it/it/256/marche_tv_archivio_storico_cartiere_miliani_il_racconto

And that is that.

THE END

(*About time too ...*)

Exit pursued by dragon ...



Hypnerotomachia Poliphili, Venice, Aldus Manutius, 1499, f. d3v. (BmL Rés Inc 1047)

Biography of the Author (up to now)

Neil Harris is Professor of Bibliography and Library Studies at the University of Udine in Italy. He was born in Uganda, at the time a British Protectorate, in 1957, and went to school in England. After a first degree in English Language and Literature at Balliol College, Oxford (1980), he migrated to Italy to get as far away from Mrs Thatcher as possible (*it wasn't personal*). A year or so later, he returned to academia in order to do a Ph.D. in Comparative Literature at the University of Leicester, where he wrote a thesis on the classical and Renaissance epic paradigms in Milton's *Paradise Lost* (*actually a more original piece of research than it sounds here*), completed in 1986. Most of the work thereon was done while cheerfully living in Florence, where he has continued to reside more or less since, albeit he now also has a place in Udine. A penchant for bibliography, discovered while trying to understand how Milton read and understood Renaissance Italian authors, led to a second doctorate, this time at the Scuola Normale Superiore in Pisa, duly completed in 1990. What therefore had its beginnings in a lengthy, learned footnote became an abiding passion (*so stay away from footnotes! They can have unforeseen outcomes!*). The rather surprising consequence of all this industry was the two-volume, six-hundred page *Bibliografia dell'Orlando Innamorato* (1988-91), or a very extended footnote, which explored at length the publishing history and the protean manifestations of Boiardo's extraordinary poem (*all in Italian, by someone who a few years previously didn't know a word of the language*). In 1992, on the strength of all this effort, he was appointed Associate Professor at Udine, and was promoted to a full chair in 2002; from 2008 to 2015 he also served as head of Department (*but does not wish to talk about that*). He has continued to work extensively on the publishing history of the Italian chivalric poem, following in the footsteps of his mentor, Conor Fahy, with research on the *Morgante* and the *Orlando Furioso*, while his more recent work includes studies of the printing of the Aldine *Hypnerotomachia Poliphili* and various explorations of the tricks of the trade used in the publication of Sixteenth-century Italian editions, but not only. He has also followed numerous cataloguing projects of early printed material in Italian libraries and contributed introductions and critical essays to the published versions, in particular to that of San Gimignano (2007). At present, together with Cristina Dondi of the University of Oxford, he is engaged in publishing an edition of the *Zornale* of the Venetian bookseller, Francesco de Madiis.

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