Guild of Book Workers Journal 2012

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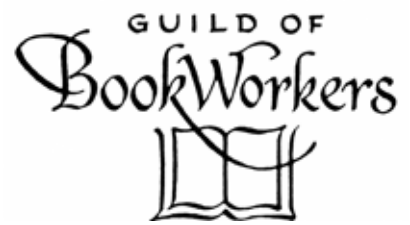

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On the front cover: ***A Book of Mediterranean Food*** (London: John Lehmann, 1950). First Edition. Binding by Shepherds, Sangorski & Sutcliffe, using katazome-shi endpapers in an effective blending of leather and paper colors.

On the back cover: Marbled paper by Pamela Smith, MarbleSmith. Turkish Stone overlayed with French Curls. This twice-marbled pattern was recently created for Chicago-area book artist Karen Hanmer and is exclusive to her work. Image by Pamela Smith.

Publication Policy

The *Guild of Book Workers Journal* is published annually and contains articles selected by peer review and editorial review processes.

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Page numbers in orange indicate peer-reviewed articles.

This paper meets the requirements of ANSI/NISO Z39.48-1992 (Permanance of Paper).

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Editor's Note

WHICH CAME FIRST, BOOKS OR PAPER? THE CLASSIC CHICKEN-and-egg question has an answer here: there is no doubt, books came first. But when paper entered the scene it changed the world forever, and its impact on books and the book crafts still reverberates. Even now, when the screen challenges the page at every turn, paper holds its own, and in the world of book arts, the paper arts are central to what we do.

This issue of the *Guild of Book Workers Journal* found its center of gravity around paper: process and techniques for making it—Aimee Lee introduces us to contemporary hanji and Tim Barrett to a fifteenth-century Italian paper mill; techniques for its decoration—Pamela Smith describes her blossoming as an edition marbler and Nancy Jacobi tells us about the history and designs of chiyogami and katazome-shi; how it can function in a binding structure—Katie Smith excavates an unusual in-boards paper binding; how it can be written on—Barbara Rhodes explores the many forms of invisible ink that have been devised over the centuries.

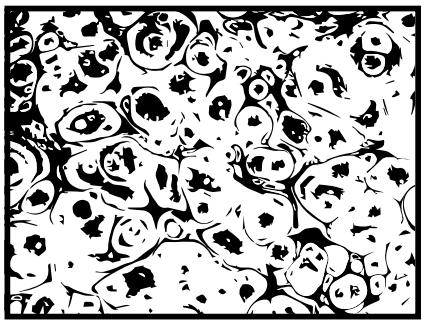
If paper is has long been at the heart of how we imagine a book, the idea of *bookishness* reaches far beyond what makes a page—or even the necessity of pages at all. Mindell Dubansky's pursuit of bookishness has taken her beyond books to "blooks," objects that look like books but aren't. We wrap up this issue with her gallery of blooks, which we hope will prompt new experimentation with the idea of the book—what it can evoke as well as what it can be.

THE GUILD OF BOOK WORKERS JOURNAL is only as good as its dedicated staff, and I want here to express my particular and deep gratitude to Chad Johnson, longtime typesetter for the *Guild of Book Workers Journal*, who has moved on to new commitments. Chad helped break me in when I was a new volunteer on the *Journal* committee. His was a thoughtful voice in the discussions that resulted in our redesign, and he elegantly realized our new typography and layout. I wish him the best of luck moving forward and am tremendously glad to have been able to work with him.

Pamela Smith, 1973, pulling a sheet of marbled paper

The Making of an Edition Paper Marbler

Pamela Smith



Pamela Smith is a fine printer and paper marbler. She resides in Abiquiu, New Mexico, and produces papers under her MarbleSmith imprint.

I doubt that anyone today sets out to become a paper marbler, much less an edition marbler. Imagine a recent college graduate listing paper marbling as a career goal. Such an ambition may have been better suited to the seventeenth, eighteenth, or even the nineteenth centuries, when handmade book production was the norm. I would guess that many among a handful of current production marblers were taken by surprise, smitten by the magic of this centuries-old process of transferring patterns of floating color from the surface of a liquid to paper. Like me, they were likely consumed by a terminal case of fascination, a fascination that more than thirty-five years later still has me in its grip.

It was the mid-1970s. I was young, new to my job as director of the Museum of New Mexico's recently launched working historic printing exhibition, located in the Palace of Governors in Santa Fe. I was immersed in anything related to finely printed and handbound books, especially the beautifully patterned papers that served as end sheets and sometimes as covers of these volumes. When the museum's gift shop manager encouraged me to produce marbled stationery sets for the store, I jumped at the chance to take my interest one step further.

With the help of British instructional pamphlets designed for school kids, I set out to teach myself. It was a process of reinventing the wheel. Far from the great centers of fine book production in this country, Santa Fe offered little support in the learning experience. And so I dutifully followed the steps laid out by Sydney Cockerell in the Russell Handicrafts Hitchin pamphlets and in educational booklets published by the Dryad Press.

Rainwater, the experts advised, is the ideal liquid for creating a marbling size (liquid upon which the color is distributed)—a challenge in the arid Southwest, where annual precipitation sometimes measures fewer than fourteen inches. I prayed for rain and caught every drip that fell from my flat roof.

Although a concentrated form of carrageen moss (Irish seaweed used as a thickening agent in the making of a marbling size) was available for instant blending, the instructions called for the use of the actual dried plant material. Weekends saw me hovering over the stove in my one-room apartment, stirring giant pots of boiling rainwater with fishy-smelling seaweed that drew neighborhood cats. When the tightly compacted dried seaweed quadrupled in volume during the cooking process, I was

encouraged by friends to apply the waste to my "lawn"—in New Mexico, nothing more than patches of weeds in vast stretches of bare dirt. To my horror, the grounds surrounding my home began to develop a white crust. Already alkaline, the additional sea matter pushed the soil up a notch on the pH scale.

I combed the art stores for watercolors that might work in my early experiments. The fruits of my efforts were entered in local arts and crafts fairs. This was the era of marbled chatchkes—pencils, ties, tennis shoes, T-shirts. I rode the wave with such innovative items as marbled wallets done on a synthetic material and laboriously stitched together on my child-size Singer sewing machine; marbled ornaments and pins that involved laminating two of the decorated sheets to either side of a piece of mat board, cutting the board into strips, and feeding them into a treadle-operated platen press to die cut complex shapes—dragons, birds, fish.

Some marbled chatchkes

This little production factory failed to hold my interest for more than a year or two. Though the craft fair circuit garnered enough funds to place a down-payment on the Abiquiu ranchette that would later become the site of MarbleSmith Studios, my focus was always directed towards finely printed and bound books. I was destined to become an edition paper marbler.

At the museum I was designing and printing limited edition letterpress books, some of which made use of the papers I created. Local publishers and blank book manufacturers began to request my work. Before long I was producing a series of patterns for Gus Velletri's Bookmakers supply firm, then located on I Street in Washington, DC, and later taken over by Cindy Mowery. I juggled two loves, spending five days a week at the museum as a printer and the remaining two in my own studio as a marbler.

But it must be said that my future as an edition marbler had much more to do with my temperament than with the logistics of my budding career as a book artisan.

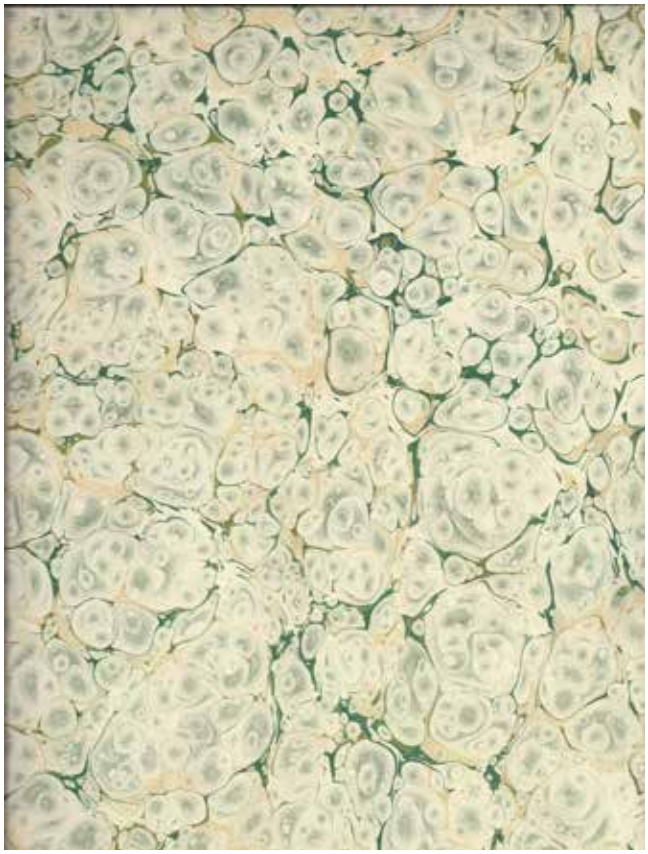
My future as an edition marbler had more to do with my temperament than with the logistics of my budding career as a book artisan.

The work of a production marbler is a painstaking process of matching color and pattern, and then repeating it all, over and over again. For the most part, this kind of volume marbling is done for fine printers and hand bookbinders involved in limited edition book production, and occasionally for dealers with a catalog of fine papers to sell. I already had the mandatory love of multiples, something I brought to my printing activities. In repetition I found a satisfying process of refinement that carried me through editions that, on one occasion, numbered 1,000 sheets. A quest for perfection, perhaps, always one step away.

The necessary patience came with time and brought stamina for long hours of standing over the marbling tank, creating and executing patterns, tweaking colors to match exactly, problem-solving when any of a myriad mysteries threatened progress.

In my years of experience I have come to know marbling as the pursuit of an elusive muse. The attempt to gently nudge free-floating colors into an aesthetic harmony and capture it all on paper offers little predictability, despite the edition marbler's attempts to duplicate efforts. The slightest flick of the wrist, angle of the arm, or flourish of the whisk can greatly alter the finished product. Marbling is a study in movement, one in which technical know-how becomes as important as artistic sense. And even then there are few guarantees.

After decades of using the same materials manufactured by the same firms, I occasionally experience radically new behavior in my supply of paints and



French shell

papers. Metallics completely wash from the sheet in the rinsing process. Paints refuse to hold a fine-line combing and erupt into random holes. Paper becomes finicky, resists the smooth rolling motion required to position it atop a floating pattern, and leaves stutter marks. French Shell designs, notoriously tricky to execute in multiples, are produced by adding a miniscule amount of olive oil to the paint. Too much oil and the color bursts across the surface of the gel; too little and the color contracts into dense, dark spots. Although most of these "problems" are discernable only in the eye of the master marbler, they are indeed unacceptable flaws.

Marbling is a study in movement, one in which technical know-how becomes as important as artistic sense.

But it is these very challenges that have kept me immersed in the process for so many years. As a former book designer, I most often envision marbled papers in the context of the book, where they work as an interpretive element, along with text paper, book cloth, illustrations, and so on. The job of the marbler, I believe, is to draw upon skills, knowledge, and artistry to produce papers that enhance subject matter, not merely accompany it. In other words, how can marbling's texture, color and movement, positive and negative spaces, traditional and nontraditional design together contribute to the language of a book, contemporary or otherwise? How can the edges of the sheet be pushed, the depths plumbed?

In an effort to bring this kind of relevancy to a paper created for a book on fly fishing I used olive-oil-infused watercolor for droplets of fish-like eyes that peered out from a zebra pattern in watery blues and greens; a graphic zigzag Native American rug pattern for a piece on a Southwest woodcut artist; and in response to a request for a "spooky nineteenth-century design," a fantasy marble with loosely combed thin lines that oozed rich black and blood-red veins.

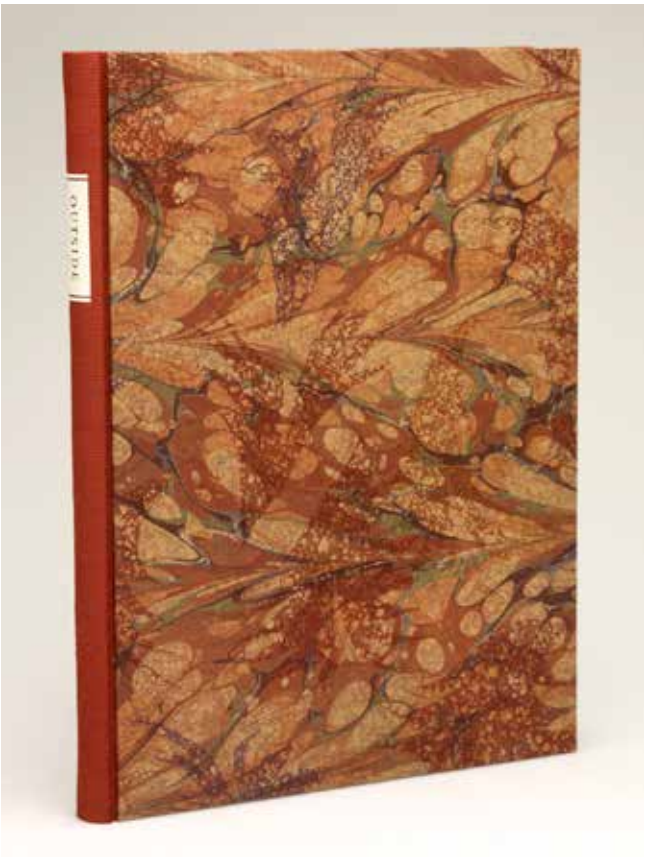
As well, I have developed delicate floral designs coaxed into shape with the use of eyedropper, stylus, and a variety of tiny combs; leaf patterns produced with floating stencils; traditional French shell patterns laced with metallic gold veins, and mica-infused

Oak Leaf

Italian hair vein rendered on dense black papers. A little chemistry and a lot of imagination enliven the world of edition marbling, limited only by the practicality of using complex techniques to produce multiple sheets.

Most of all, production paper marbling is a demanding discipline, sometimes involving the mundane, sometimes the extraordinary, and best described in the production schedule detailed below. This particular schedule references a job done at MarbleSmith in 2012 for Craig Jensen at the BookLab II bindery. The edition of sixty sheets was created for *Outside*, a collection of six short stories by Barry Lopez, featuring woodcut illustrations by Barry Moser and published by David Pascoe's Nawakum Press in Santa Rosa, California.

The twice-marbled pattern created for the book was inspired by the rich colors and textures of the Southwest landscape. It moves horizontally in tones of terra cotta, sand, and sage green. A waft of oak leaves drift across the stone-like pattern, recalling scrubby trees that cling to rocky terrain. The design evolved out of my own reading of the text and discussions with the publisher. Production began in the fall of 2012.



***Outside* by Barry Lopez and Barry Moser. Marbled covers by Pamela Smith. Image courtesy of Nawakum Press.**

SUNDAY, 1:00 TO 4:00 PM

Purchase ten gallons of filtered water from Abiquiu's general store (two miles away), transport from car to studio via wheelbarrow. MarbleSmith's private well is rich in minerals and thus the water unusable in the marbling process.

Mix color palette to recreate double marble, stone and oak leaf pattern. Color matching at the studio is done by eye. In the first step, paint is mixed with water only, applied in small amounts to paper, allowed to dry and tweaked until a rough match is achieved. Paints are mixed and stored in pint-sized Ball jars.

Mix one gallon of alum water. In this process ¾ cup of alum crystals is added to ½ gallon of cold and ½ gallon of boiling water, then left overnight before use. The solution acts as a mordant and is sponged over each sheet to be marbled.

MONDAY, 1:00 TO 4:00 PM

Mix five gallons of carrageenan solution. This gelatinous mixture provides a base or size upon which colors are applied during the marbling process. It is made by blending two tablespoons of the powdered seaweed with one gallon of water. The amount needed is calculated by the capacity of the marbling tank and the number of sheets to be produced. At best, the blending is a tedious but essential process lightened only by taking the *New York Times* Sunday crossword puzzle into the studio.

Check colors once again by reapplying small amounts to paper and leaving to dry. Make minor adjustments.

Cut paper skimmers. These invaluable little strips are used to clear the surface of the size after each sheet is marbled. The superior quality of *New York Times* newsprint makes it perfect for the task. In an effort to conserve the solution, I have abandoned the use of a skimmer board.

Dampen thirty-five sheets of marbling stock. Papers to be marbled are prepared by sponging the alum mordant over the surface. The dampened sheets are then grouped between pieces of plastic-wrapped book board. The stack of board and paper is weighted over night.

TUESDAY, 8:00 AM TO 1:00 PM

Set up studio for production—fill and level tank, cover all flat surfaces with plastic. Mix a few drops of dispersing agent into each color and give each a good stir. Suit up. The key to success in edition marbling is to be fully prepared, with all materials and supplies at arms reach. I have a variety of speckle-covered clothing to don for these sessions.

Prove colors on the surface of the marbling gel. Tones are greatly altered when the previously mixed paint is floated on liquid, thus a fair amount of tweaking is needed to achieve a match.

Proceed with the marbling of thirty-five sheets after palette is established. This process involves sprinkling colors on the surface of the gel, sometimes combing the colors in as many as six different directions, rolling a sheet of paper onto the surface of this floating pattern, lifting the printed sheet, and rinsing it before hanging the paper to dry. At MarbleSmith, sheets are draped over 3-inch PVC pipe suspended horizontally from the ceiling. The ample width of the pipe prevents creases from developing during the drying process.

Gather dry marbled sheets and place under weight.

TUESDAY, 1:00 TO 4:00 PM

Clean studio. This considerable task involves clearing all surfaces of paint, counters, whisks, combs, tank, buckets, floor, walls, disgarding spent solutions and readying the area for the next session. It is a key step in freeing the space from distractions and thus facilitating concentration.

Try to rescue my numbed mind from five hours of uninterrupted attention.

Mix another five gallons of carrageenan.

Dampen another thirty-five sheets of paper stock.

WEDNESDAY, 8:00 AM TO 1:00 PM

Repeat Tuesday schedule to marble an additional 35 sheets.

THURSDAY, 1:00 TO 4:00 PM

Acquire another ten gallons of filtered water from the Abiquiu general store. Blend five gallons of carrageenan.

Check palette for the oak leaf over marble. Make adjustments.

Apply alum mordant once again to 35 sheets of the marbled paper (stone pattern) and place under weight.

FRIDAY, 8:00 AM TO 4:00 PM

Repeat Tuesday schedule to execute oak leaf design, which overlays previously marbled stone pattern. Oak leaves are meticulously created with pipettes. Six to eight drops each of three different colors are placed onto the surface of the gel, combed, and then manipulated with a stylus to achieve the final shape.

Blend five gallons of carrageenan.

Apply alum mordant to remaining thirty-five sheets. Place under weight.

SATURDAY 8:00 AM TO 2:00 PM

Complete edition by executing oak leaf pattern on remaining 35 sheets.

Clean studio.

Marblesmith's maker's mark

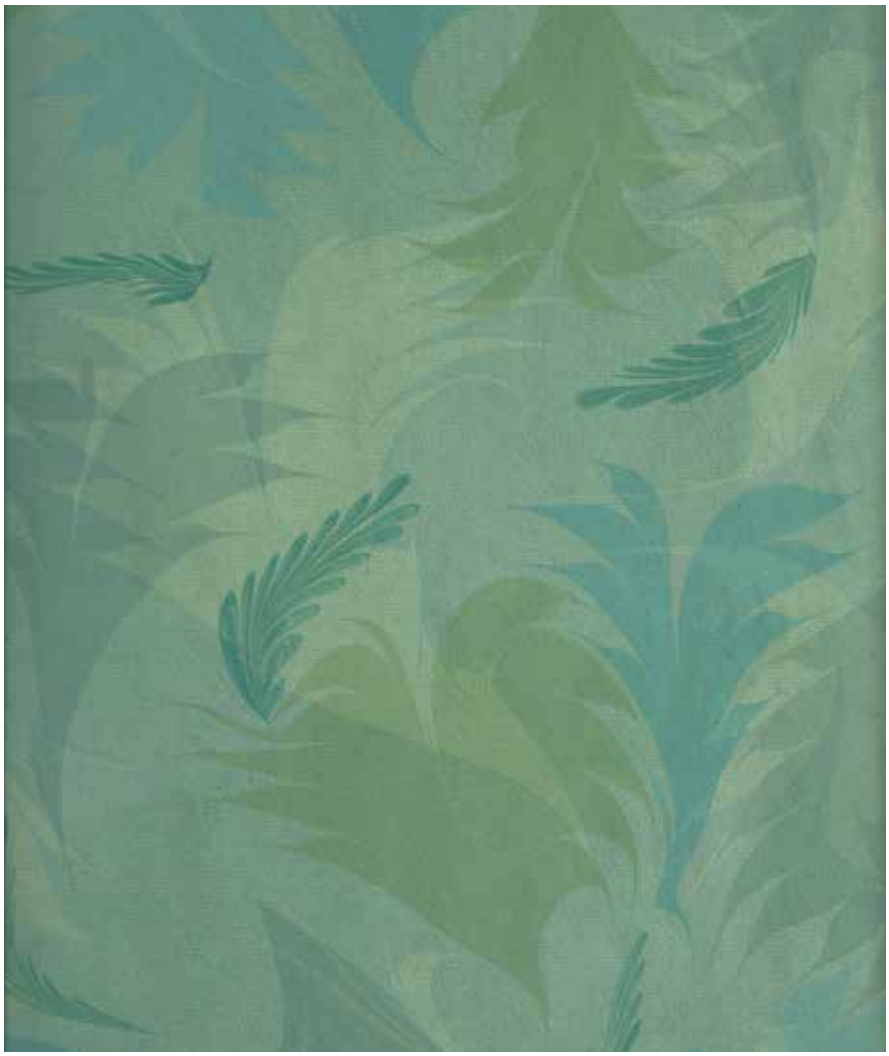
AS YOU MAY HAVE GLEANED IN READING OVER the work schedule, edition marbling is a physically challenging effort, one in which all-important consistency benefits from this kind of uninterrupted push. Practicing the art of marbling is a sort of meditation, a mantra, a concentration that in my own one-woman studio is unbroken by the sounds of telephone, radio, or the voice of a coworker.

That the process is easily grasped is a common deception. In all actuality, paper marbling is a skill that could require more than one lifetime to master. In my years of practice I have never stopped learning from the experience. A little-explored medium with plenty of room for fresh ideas, marbling is no longer shrouded under a cloak of secrecy. On the contrary, the world of edition marbling is wide open to anyone with the stamina and the passion to pursue this lovely, elusive muse.

Leaf pattern created with the use of miniature combs and stylus

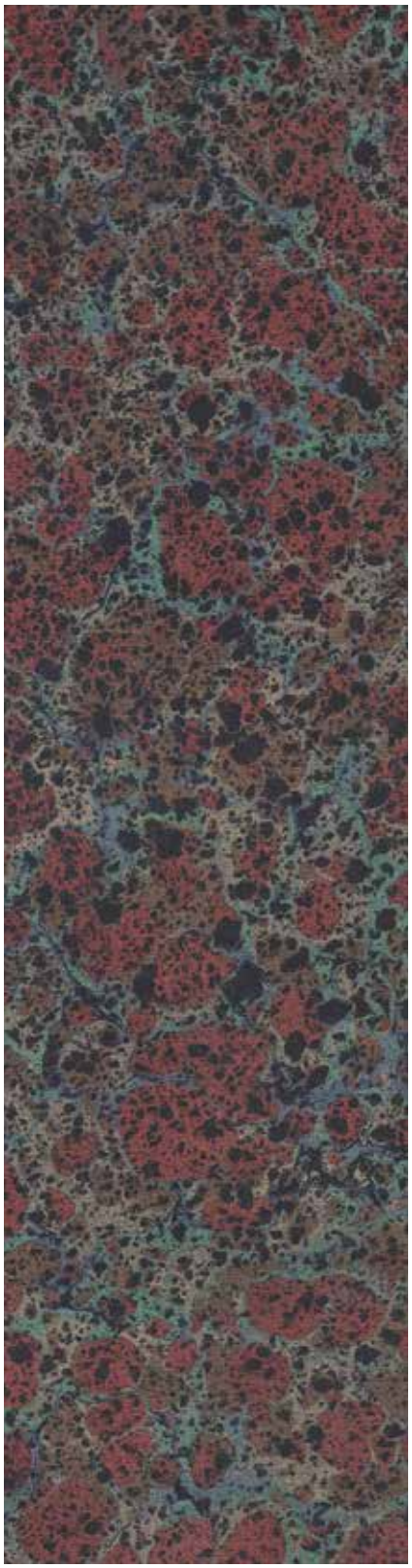
Twice marbled sheet done on black Hahnemuhle Ingres paper

Fall leaves, double marbled

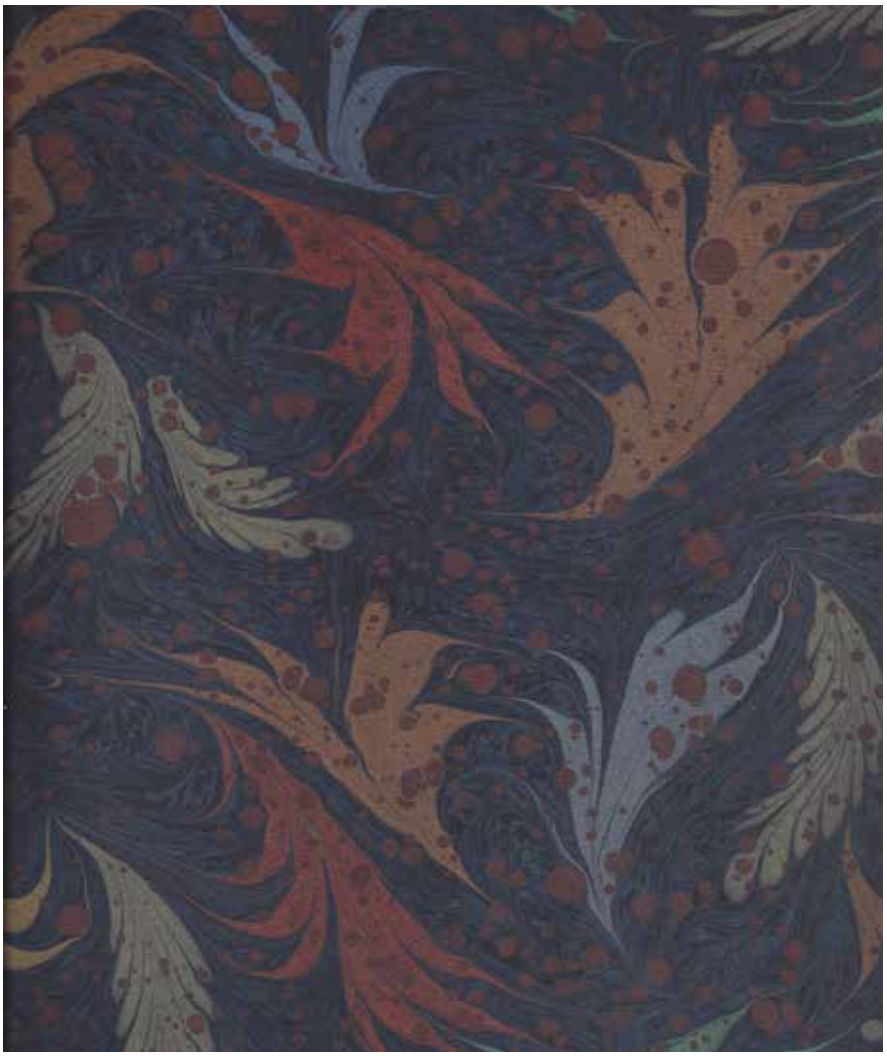


Ghost marble done on green Hahnemuhle Ingres paper

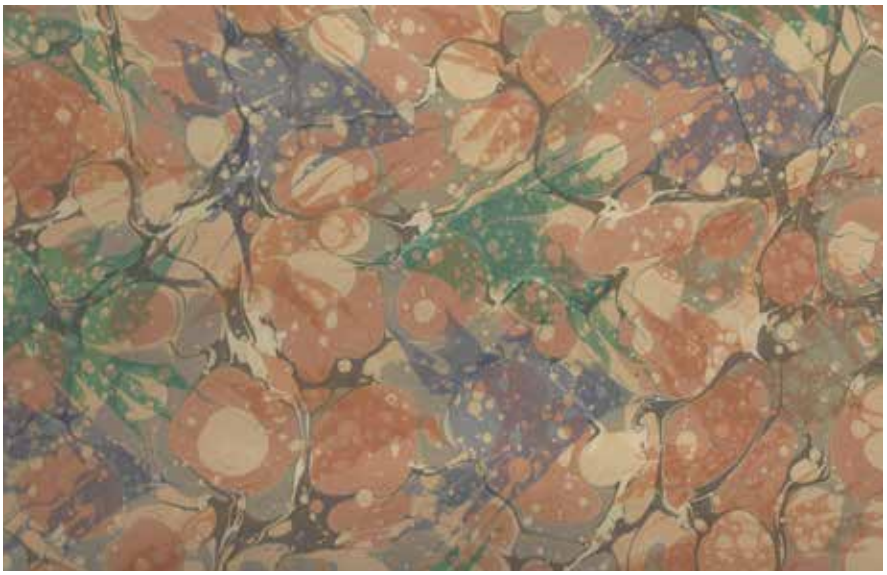
Combination combed pattern with small green leaf accent



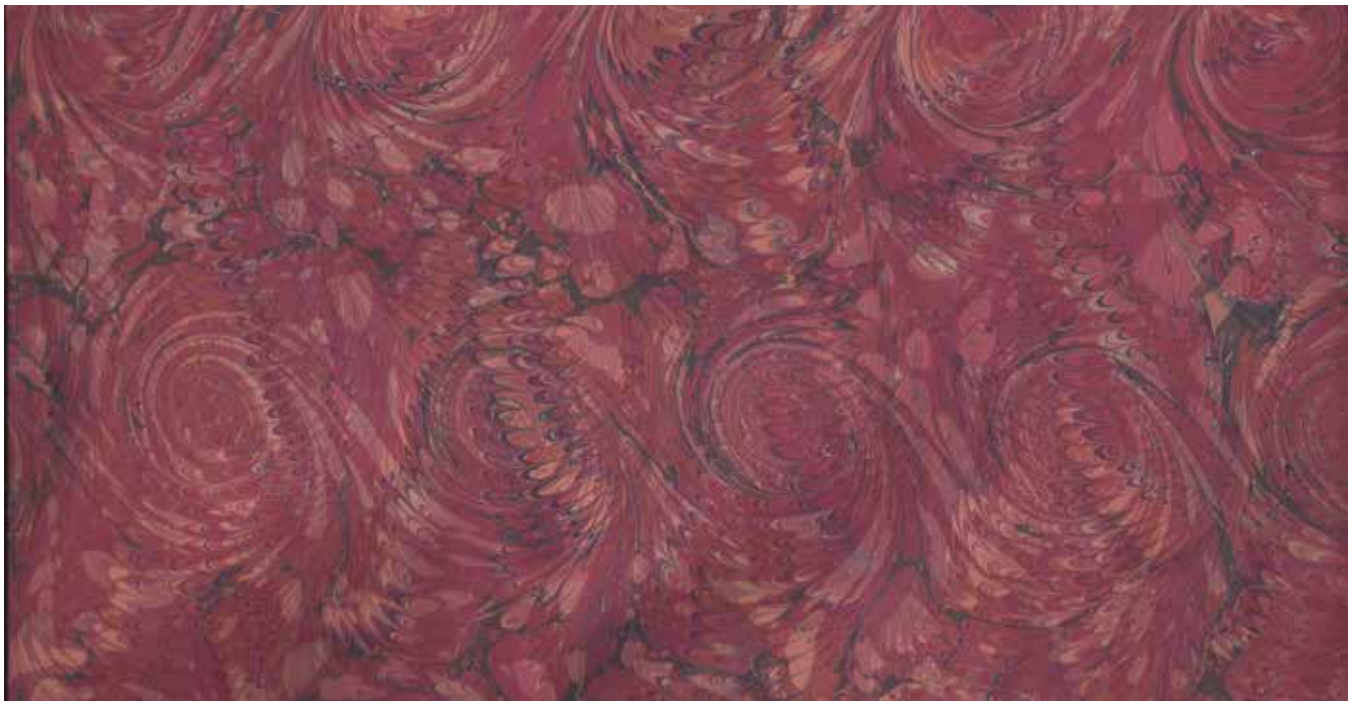
Mica-infused watercolors on black Hahnemuhle Ingres paper



Oak leaves rendered from mica powder/watercolor mixture on Hahnemuhle Ingres, black



Turkish Stone pattern over marbled with oak leaves, after a 19th century sheet



Double marble—Turkish Stone with overlay of French Curls (or Nest of the Nightingale, as the pattern was known in the Middle East)

Presentation marble done in four separate applications

In Korea, representations of mandarin duck couples are gifted at weddings as symbols of marital fidelity and fertility. Most are carved of wood and painted bright colors, but I saw an eighteenth-century woven paper version in a museum catalog and was immediately taken. Though I was originally trained to make symmetrical forms of basic vessels and other functional objects, I was determined to figure out how to weave a duck. Several ducks later, the endless permutations of form and gesture provide rich challenges that my hands are eager to meet. Photo by Stefan Hagen.

Hanji in the Hands: korean papermaking methods and creative uses

Aimee Lee

one of the most gratifying aspects of teaching korean paper arts is seeing the ripples of interest that manifest in new interpretations of tradition. When I began my hanji (Korean paper) research in earnest eight years ago, I remember finding one article in English online, a handful in print, and one painting on hanji in an exhibit in Berkeley. The landscape has changed considerably: there are now a number of books in print, exhibitions devoted to Korean paper manipulation, and the wider spread of workshops and classes related to hanji. There are enough artists working with these techniques to perceive a subset within the art world, a few that I have selected to introduce here. Hanji itself as a term is being used more frequently, though I must add that it is often used as a qualifier for the word paper, which is incorrect. The noun hanji encompasses both "Korean" and "paper." Hanji is sufficient to indicate Korean paper, just as we say, "supermarket," and not, "supermarket market."

technicalities aside, what is hanji? Its literal translation is "Korean paper," though I have used it to describe paper made by hand in Korea (which is only a portion of the paper made in Korea, as plenty is made by machine). The majority of this paper is made in a style that many people consider Japanese, though controversy exists over exactly how Japanese the technique is, with some researchers believing that it in fact originated in Korea. This technique requires a bamboo screen enclosed between an upper frame, or deckle, and a lower supporting frame with ribs, and is called *ssangbal tteugi* (in Korean) or *nagashi-zuki* (in Japanese). This is an evolution from the older technique of *webal tteugi*, which uses a similar bamboo screen and supporting frame, but no upper deckle. The screen in Korean is called a *bal* ("screen") and the supporting frame a *bal teul* ("screen frame"). Korean papermakers today use mostly *ssangbal tteugi*, with only a handful still practicing *webal tteugi*, and even then, only occasionally in their practice or for special orders. I have charted differences between formation methods below:

Aimee Lee is an artist, author, and researching papermaker. She is the Morgan Conservatory's resident artist and Korean paper expert, home of the only hanji studio in North America. Her BA is from Oberlin College and MFA from Columbia College Chicago. Award-winning* Hanji Unfurled *is the first English-language book about Korean papermaking, and she expects her next book to focus on jiseung, paper weaving. Her extensive teaching, writing, and exhibition experience is available with hanji resources on aimeelee.net.

	Ssangbal Tteugi	Webal Tteugi
Definition	Twin screen scooping	Single screen scooping
Vat size	Just large enough to clear *bal teul*	Three times wider than *bal teul*, 1.5 to 2 times longer than *bal teul*
Rigging	None for small sheets. For larger sheets, at least two ropes attached to *bal teul* that are suspended from bamboo poles near the ceiling	One rope tied to middle of the back support bar of the *bal teul*, suspended from a crossbar above the vat
Sheet formation	Predominantly shaken in one direction, towards and away from the papermaker (front to back), perpendicular to the bamboo splints in the *bal*	Flowing motion of slurry over the *bal* in both directions, first perpendicular to bamboo splints (front to back, *apmuljil*) and then parallel (side to side, *yupmuljil*). Sometimes finished with slurry thrown off in a diagonal, reminiscent of some Chinese techniques
Lamination	None: one-ply unless greater thickness is desired	Laminated: two-ply unless less or greater thicknesses are desired (ranges from one- to four-ply)
Multiple sheet formation	More than one sheet can be made at once if the top deckle is partitioned with additional wooden walls	Only one sheet can be made at a time on the *bal*
Screen (*bal*) dimensions	Wider than high because a shorter height of *bal* makes it easier for the papermaker to scoop up the slurry and throw it across its height quickly; wide *bal teul* are fitted with handles closer to center that hands can grasp comfortably	Higher than wide because width is limited by the human wingspan. The front edges of the *bal* are held in place by the thumbs. A wide *bal* would require a very wide vat, which is impractical
Screen (*bal*) borders	Bare bamboo splints are flush at each side of the *bal;* edge sticks on top and bottom are also bare	Bamboo splints on sides, as well as edge sticks on top and bottom of *bal*, are covered by sewn fabric
Screen (*bal*) chain lines	Chain lines run in one straight line from top to bottom	Chain lines are staggered at the center of the *bal* so that the top half has chain lines that are offset between the chain lines of the bottom half
Number of sheets produced	Each round at the vat produces one or more sheets of paper	Each round at the vat produces one ply of a two-ply sheet, requiring two rounds for a fully-laminated sheet
Grain direction	Predominantly in one direction	Multi-directional

Shin Hyun-se demonstrates *webal tteugi* (photo by the author)

Shin Hyun-se demonstrates *ssangbal tteugi* (photo by the author)

ONE OF THE NAMES FOR HANJI in Korea is *baekji*, translated literally as "one hundred paper." This refers to the idea that there are 99 steps required to make hanji, and the 100th step occurs when the buyer touches the paper. 99 steps may be a slight exaggeration (somewhere in the 70s is more accurate), but it communicates exactly the labor involved in making this strong and lustrous paper. The common question, "How long does it take to make a sheet of paper?" can never be answered to satisfy either the person asking or the person responding. It could easily take a week, a month, a lifetime to make a sheet of hanji, because it is so inextricably bound up with the cycles of nature and with labor that comes from a history of agriculture, which require instinctual and bodily knowledge that is nearly impossible to quantify. However, most people are not able to experience these cycles and processes, so I have listed a primer of steps below:

HARVEST PAPERMAKING FIBER

Broussonetia papyrifera and the indigenous *Broussonetia kazinoki* are two species of the trees most often used in Korea to make hanji, known colloquially in English as the paper mulberry tree, in Japanese as *kozo*, and in Korean as *dak.* They look more like shrubs when used for papermaking, because they are harvested each year after the regular harvests of food crops. This ensures strong but not overly tough fiber, and encourages tree growth for the next season. After the *dak* leaves have fallen and the sap has drained for winter rest, one-year-old shoots are harvested by hand. Each shoot is cut away close to the gnarled root structure at a 45-degree angle with a sharp sickle and bundles are stacked with the cut ends piled together for ease in steaming and stripping.

Additionally, the plants required for formation aid in the papermaking process are also harvested in the fall. Formerly classified as part of the hibiscus family, *Abelmoschus manihot* seeds are planted in early spring and grow throughout the year until they are dug up in the fall for their roots. Called *hwangchokgyu*, these roots are pounded to yield a clear mucilage that is essential to hanji making.

PROCESS PAPERMAKING FIBER

After *dak* shoots are felled and bundled, they are steamed for about two hours so that the outer bark pulls away from the inner woody core. While still hot, workers grab the cut ends and pull the bark away, keeping it in one intact piece. After stripping, workers manually scrape away the two outer layers of bark, called black bark (the brown flaky layer that we see on the tree) and green bark (the middle layer), to reveal the inner white bark. After bleaching the white bark by drying it outside in direct sunlight, it is soaked and cooked in an alkaline solution. Traditionally, this solution is made from plant ash lye, but most papermakers in Korea use soda ash (sodium carbonate) unless working on special orders that require plant ash. This solution neutralizes elements in the bark (e.g., gums, pectins, lignins, and waxes) that will acidify over time if left intact, softening the bark and preparing it for further processing.

An employee at Shin Hyun-se Traditional Hanji scrapes the outer layers of bark away from the inner white layer (photo by the author)

After cooking, the bark is rinsed and then picked over by hand, piece by piece, to remove any remaining specks of dark bark or discoloration from wounds. This incredibly tedious practice, traditionally performed by women even to this day, ensures strong white paper that has not been weakened by harsh chemical bleaches. Now the bark is ready for beating, traditionally done by hand with wooden bats, literally reducing the wide bark strips to a pulp. Today, all mills use mechanical beaters to perform this task in a fraction of the time required by hand beating. These *naginata* beaters are different from those used in western papermaking, with several curved knives that tease apart the long *dak* fibers rather than cutting them short, as a Hollander beater does.

Sheet formation

The well-hydrated pulp that exits the beater is added to a large vat that has already been partly filled with clean water, free of metal deposits. After agitating the vat vigorously with long bamboo rods, the twice-strained mucilage is added to the vat. This formation aid distributes the fiber evenly and slows the draining time of water to help the papermaker manipulate the slurry on the *bal* without having the fiber clump on the screen. The papermaking tools (both *bal* and *bal teul*) are wet, and the *bal* has been soaked so that its bamboo splints have expanded to their full size. With both sheet formation methods, the general idea is the same: slurry is scooped onto the screen, moved across it, and discharged. The papermaker repeats this action several times in a given sheet to create laminated layers within one thin sheet, giving it remarkable wet strength.

Once the papermaker is satisfied with the thickness of the sheet, it must be removed from the *bal* to another surface to free up the *bal* to make the next sheet. This process, called couching, requires a stable, flat surface next to the vat covered with a wet felt. The *bal* is placed onto the couching table with the wet sheet facing down, and then lifted away. The wet sheet sticks to the couching table, and subsequent sheets stick to the prior sheet of paper in a rapidly growing stack of wet paper called a post. To distinguish one sheet from another, a thread is placed between each sheet (for non-laminated paper) or every two sheets (for laminated paper) at the top edge of the post.

Mr. Shin lays down the *bal* with the fresh sheet face down (photo by the author)

Mr. Shin removes the *bal* from the post of paper (photo by the author)

Pressing, Parting, Drying

After a post of paper is complete, it is covered with another felt and a board, then placed into a hydraulic press. Traditionally, stones were placed onto the board over a course of days to press excess water out of the paper. A winch system followed, then a screw press, and now both manual and mechanized hydraulic presses are most commonly used in Korean mills. The purpose is the same: to gradually press away water. Once the side of the post is hard to the touch, pressure is relieved and the post removed for parting. The threads placed in the couching process are pulled away one at a time to release the top edge of each sheet. This edge, still damp, is stuck onto a straight rod, which pulls each sheet away evenly from the post. Sheets are brushed onto wooden boards (taller than a standard door), or onto heated steel plates that accommodate three to five 2-by-3-foot sheets at a time. Once a sheet is dry, it is peeled away from the drying surface.

An employee at Shin Hyun-se Traditional Hanji parts the top sheet from the pressed post. Note green threads at the edge of the pack (photo by the author);

Finishing

The most expensive hanji is further treated after drying with *dochim*, a hammering technique that imparts a surface sheen and compacts fibers to reduce ink bleed on these usually unsized sheets. A stack of dry hanji, with occasional damp sheets interleaved throughout, is held under a hammer that raises and lowers at a constant rate, allowing time to move the stack around so that every portion of the surface is hammered.

An employee at Shin Hyun-se Traditional Hanji brushes the parted sheet of hanji onto a smooth wooden board to dry (photo by the author)

I have written extensively about this process in my book, *Hanji Unfurled: One Journey into Korean Papermaking*, and recommend it for anyone interested in further details.

MANY PEOPLE ASK what is special or different about hanji, as opposed to other papers (most specifically, Japanese papers). I usually say that it is strong and beautiful, and that it becomes even more strong and beautiful after being manipulated by hand. This strength comes from the quality of *dak* used, its long fibers, and the way that it is processed and eventually transformed into hanji.

One deceptively simple method of changing the nature of hanji is *joomchi*, a method that can texture

Mr. Shin performs *dochim* to hammer the dried hanji (2008, photo by the author)

paper through wet and dry massaging and crumpling of a single sheet, leading to a stronger substrate that is smaller than the original full sheet but can drape like fabric or mimic the toughness and flexibility of leather. Joomchi is also used to fuse more than one sheet together using water and constant handling. This takes advantage of the long fibers in hanji that shift and flex rather than tearing, and the magic of hydrogen bonding, which causes multiple sheets to become one without any adhesive.

A more advanced technique is paper weaving, or *jiseung*, which transforms strips of hanji into rope-like cords that are twined around each other in a method akin to ancient basketry. Jiseung objects sealed with lacquer, pastes, oils, and other finishes become watertight and can be used as cups, bowls, furniture, and a myriad of other functional objects.

Historically, hanji has been used for purposes obvious to paper (government edicts and documents, relief printing, books of all kinds, painting, and calligraphy), in architecture (wall and ceiling paper, covering for sliding wooden latticework doors and windows, and oiled flooring paper), on the body (as insulation, armor, shoes, rain hats, and clothing for the training of Buddhist monks), and in ritual use (spirit paper to be burned, lanterns and flowers for holidays, and talismans in shamanic rites). It absorbs water and holds oil-based ink beautifully, accepts brush and pen, and is strong enough for relief and etching processes using either a press or hand printing. Hanji can also be sliced into strips that are then spun or twisted into thread strong enough to sew and weave. In conservation, its strength and lack of dominant grain direction make it ideal for certain repairs and mountings.

To exhibit an array of hanji's qualities, I defer to the artwork that contemporary artists are making with hanji or Korean paper techniques. I wanted to highlight several U.S. artists who are making significant inroads in their own work with hanji and/or Korean traditions, especially those whose names are not immediately linked with these traditions. For that reason, I have chosen to leave my artwork outside the scope of this article, though readers are welcome to explore it at aimeelee.net.

I have always believed that innovation and evolution keep tradition vibrant and relevant, and have selected work that ranges from soil to plastic, yet maintains a connection to hanji. I liken the hanji infiltration to the slow and then sudden creep of invasive plant species, except that in the art world, the invasion does not crowd out the competition. Rather, it encourages more innovation and expands the way we see both paper and its possibilities.

The brief examples that follow of contemporary artwork by artists who use hanji and the techniques developed over hundreds of years to manipulate it are only a sampling of the growing interest and commitment to expanding the materials and methods available to artists today. We are still traveling on the road from the acceptance of hanji into the papermaking lexicon to its use outside of paper circles, but the journey continues to yield remarkable sights and adventures.

A HANJI GALLERY

(All images courtesy of respective artists)

Paper as textile: Joomchi textures of Bill Lorton

TRAINED AS A FIBER ARTIST, Cleveland-area artist Bill Lorton works extensively with the joomchi technique, a method of texturing and fusing paper (I compare it to felting) that has a long history in Korea. He initially began working with joomchi because it was important to him to preserve this obscure craft tradition, which is part of his daughter's heritage. He says, "Over time, the potential for innovation with joomchi has offered a continuing appeal for me. The prospect of breaking new ground, making joomchi do unexpected things, and teaching those innovations to others keeps me engaged with it." His current joomchi-based work is rooted in Korean history, though he uses a range of Asian papers, and his joomchi pieces examine the role of textile-based iconography. http://billlorton.blogspot.com/

A Mended History in Six Parts: Part Five **by Bill Lorton, 2013. Thai Unryu, ramie, thread. 29.5 x 21 inches**

A Mended History in Six Parts: Part Six, **by Bill Lorton, 2013. Thai Unryu, ramie, thread. 28.5 x 22 inches**

A Mended History in Six Parts: Part Five, **by Bill Lorton, 2013. Thai Unryu, ramie, thread. 29.5 x 21 inches**

Private adornment: Nancy Raasch's paper jewelry

NANCY RAASCH WORKED for many years as a graphic designer in North Carolina specializing in print design, and has used a huge range of papers for over 40 years. She now specializes in paper jewelry, after being strongly influenced by Catherine Nash (Japanese paper casting) and Jiyoung Chung (joomchi). She says, "I love the process of joomchi and hanji making because the variations are limitless. Joomchi is a tactile manipulation of fibers that can result in unexpected and painterly results. I love the process of…building art pieces to wear." Captivated by the engineering aspects of making paper jewelry, she cuts, casts, and manipulates paper that is often finished with acrylic varnish, with colors that come from either colored hanji or pigmented pulp for paper she makes on her own. This practice also accomodates her hands' ability to work after extensive chemotherapy for chronic cancer—paper suits her best after many experiments with other materials. http://www.raaschdesign.com.

Gray & Orange Joomchi Bells Necklace **by Nancy Raasch, 2013. Hand-felted mulberry paper with granite linen thread. 9 x 9 x 3 inches**

Artist-made Giverny Necklace **by Nancy Raasch, 2013. Artist-made kozo/narcissus paper dried on wood, freshwater pearls, silver wire. 9 x 9 x 3 inches**

Gold/Orange Joomchi Necklace, **by Nancy Raasch, 2013. Hand-felted mulberry paper stitched with black Guttermann thread with silver findings. 9 x 9 inches**

Hanji and the book: Sammy Lee's oeuvre

DENVER-BASED SAMMY LEE WORKS primarily in book arts, though her experience as part of the 1.5 generation (those born in Korea who immigrated to the States before adulthood) provided an intimate relationship with hanji. She explains it best: "I was exposed early to the Hanji material as a child growing up in Korea. It was readily accessible for a child's calligraphy practices, folding and crafts. This material from my mother country also carries 'maternal' qualities I appreciate. Hanji is warm, soft to touch, and delicate, yet at the same time tough and resilient. Also it is a very forgiving material for mistakes, as I have often patched accidents or stretched wet fibers of hanji like leather to cover miscalculations. I have printed, painted and felted Hanji to achieve both aesthetic and practical goals for making artist books. Sometimes as covers, pages, liners, or hinges, I find hanji very versatile in my book art practice." She uses felted hanji on book covers, plain hanji as a surface on which to print, and further manipulated hanji to construct boxes that refer back to her graduate training in architecture. These structures always open into miraculous worlds of narrative, color, texture, and design. http://www.studiosmlk.com

***Fantasy & Nonsense* by Sammy Lee, 2012. Cover: hanji collage with joomchi methods. 6 x 8 x 0.5 inches**

***The Soil: Water, Fire, Metal, Flesh, Soil* by Sammy Lee, 2011. Artists' book inspired by the life works of OkSang Lim; intaglio on handmade paper. 9 x 9 x 9 inches**

***Soil & reflection* by Sammy Lee, 2012. Artist book about personal exploration on the soil as subject, material and inspiration; collection of monoprints on hanji. 4.25 x 6.25 x 0.5 inches**

Another tool in the sculpture kit: fiber manipulation by Melissa Jay Craig

A MATURE SCULPTOR and paper manipulator in her own right before she encountered hanji, Melissa Jay Craig is already pushing Korean paper techniques further than previous practitioners could have imagined. She lives in Chicago and is often on the road to teach and serve as a resident artist. On these trips, she learned *webal tteugi* with myself at the Morgan Conservatory and made artwork side-by-side at Haystack with Jiyoung Chung. Craig says, "What appealed to me initially about hanji was first a fascination with the webal sheet-forming technique (which is far, far more difficult than it looks!). Second was discovering the strength the fully unfurled fibers give to the thin, finished sheets. I always, always seek the strongest papers for my work…and hanji takes all the characteristics I love about the [kozo] fiber much further. I also use a lot of very overbeaten abaca and indigenous fibers like milkweed which exemplify a dichotomy that is both a conceptual and physical underpinning of my work: a delicate, fragile appearance that is in fact incredibly strong." Her experiments with joomchi have proven to stiffen paper, even as it creates holes in it, and have provided a way to adhering fibers elegantly to paper without adhesive. http://www.melissajaycraig.com/

***Reap* by Melissa Jay Craig, 2012. Handmade paper: cast kozo and kozo hanji, kozo fiber joomchi, procion dyes, hemp cords. 11.5 x 6 x 4.5 inches**

***Speak For Yourself* by Melissa Jay Craig, 2012. Handmade paper: cast kozo and kozo hanji, kozo fiber joomchi, procion dyes, hemp cords, linen thread. 10 x 7 x 5.5 inches**

Melissa Jay Craig, *Reap*,2012. Handmade paper: cast kozo and kozo hanji, kozo fiber joomchi, procion dyes, hemp cords. 11.5 x 6 x 4.5 inches

Weaving across media: Sara Parkel's transformed book

SARA PARKEL IS AN ARTIST in New York City who learned jiseung techniques from me at the Center for Book Arts as a Van Lier Scholar. She had been working on a project about plastic bags and the problematic imbalance between the convenience of the product and its harmful effects on the environment. After learning the challenging techniques of spinning, cording, and weaving hanji, she applied these methods to plastic bags to make plastic yarn for a textured cover. She says, "Appropriating Korean spinning and weaving techniques allowed me to make an entire book out of plastic. As a printmaker and book artist, I aim to find an integration of content, form, and materials." The pages of the book are laminated layers of grocery bags, letterpress printed with wood type, and this one-of-a-kind book reflects her ongoing concerns with ecology and sustainability. http://thefilterpress.com/

***Baggage* by Sara Parkel, 2012. One-of-a-kind artist book; woven plastic bag cover, wood type on laminated plastic bags. 7.5 x 4.5 x 0.75 inches**

***Baggage* by Sara Parkel, 2012. One-of-a-kind artist book; woven plastic bag cover, wood type on laminated plastic bags. 7.5 x 4.5 x 0.75 inches**

***Baggage* by Sara Parkel, 2012. One-of-a-kind artist book; woven plastic bag cover, wood type on laminated plastic bags. 7.5 x 4.5 x 0.75 inches**

Violence made palpable: Julie Sirek's garments

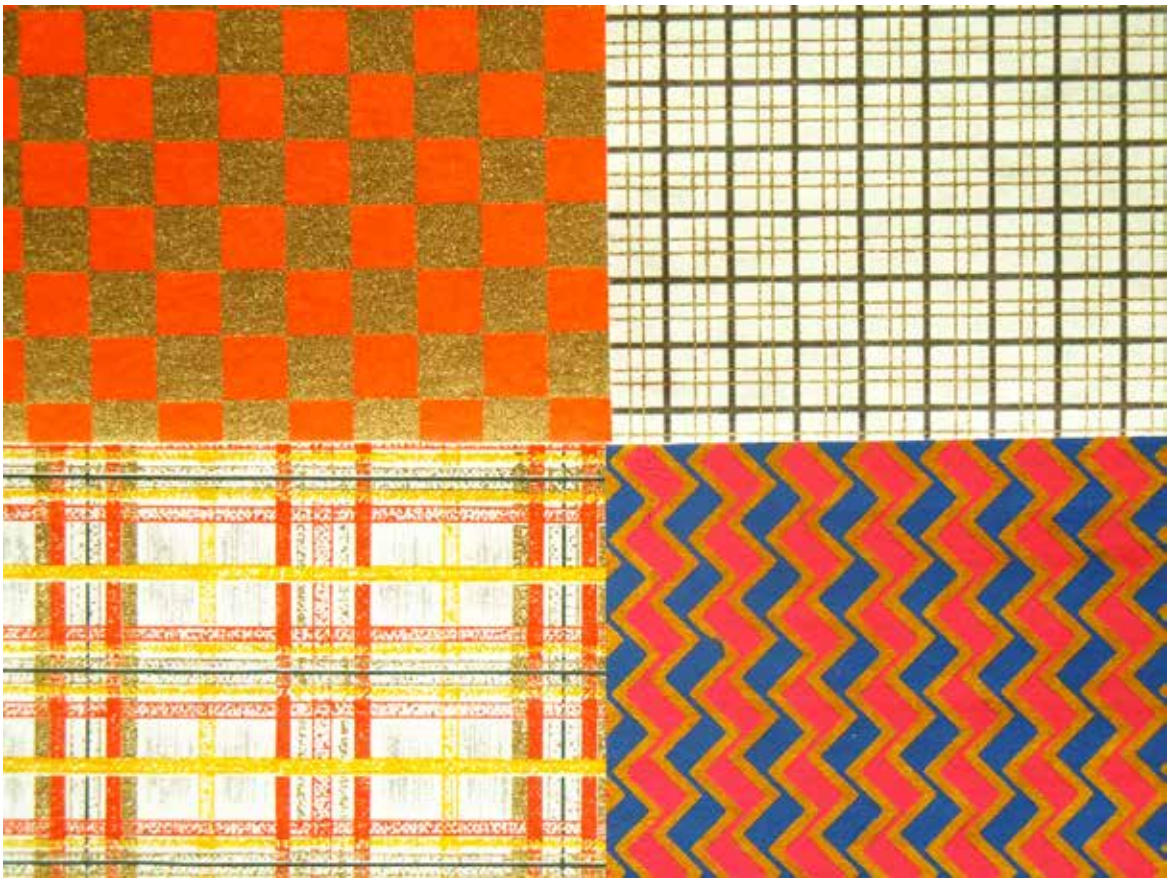
JULIE SIREK STARTED MAKING PAPER at the Minnesota Center for Book Arts in the 1980s, studied joomchi with Jiyoung Chung, and was an intern for Cave Paper in Minneapolis. Even before she encountered hanji, her artwork has remained constant: "Domestic violence touched my life at an early age and thematically inspires my work. I frequently use the image of 'dress' to represent the soul, the intimate, and the hidden. For the victim of domestic violence, this is the place where the pain is intense, remains silent and is internalized. My primary source material is hanji, whose complex structure enables me to create sculptural pieces without the use of glue or armatures. My work has a handmade quality where the boundaries between paper, textile and sculpture collide. Through a process called Joomchi, I am able to create a cloth-like paper/textile that has a delicacy and conveys a compassionate feeling for the fragility of human life." She usually creates the dresses and then manipulates them with joomchi techniques, but occasionally reverses the order. Sometimes, she creates yardage of pieced and joomchied paper that is constructed into dresses, finished with further handling to achieve ghostly webs. http://juliesirek.com/

***Dissolving Dream* by Julie Sirek, 2012. Hanji, thread, buttons. 34 x 17.5 x 5 inches**

Dissolving Dream **(detail) by Julie Sirek, 2012. Hanji, thread, buttons. 34 x 17.5 x 5 inches**

Secrets In My Closet **by Julie Sirek, 2012. Hanji, dye, thread, buttons. 29 x 20 x 3 inches**

Slipping Away Julie Sirek, 2013. Hanji, dye, thread. 60 x 17 x 4 inches



Antique geometric patterns, currently popular in chiyogami and contemporary design

CHIYOGAMI AND KATAZOME-SHI

THE HAND-PRINTED PAPERS OF JAPAN

NANCY JACOBI

THE CURRENT WORLDWIDE POPULARITY OF THE DECORATIVE papers of Japan—chiyogami and katazome-shi—would suggest that they are designs hot off the contemporary press. Stripes, dots, checkerboards, multiple lines of geometric shapes, and flowers—these patterns fit perfectly into the current mode for simplicity, repetition and graphic order. In fact, the origins of the patterns printed today on paper by both silkscreen and stencil often go back 1300 years. They follow the religious, political, and social history of Japan through its motifs and symbols, and back even further still to their roots in China.

Chiyogami is a word used specifically for a genre of Japanese papers with repeat graphic designs, often with auspicious symbols, meant to be cut and formed into decorative objects. The patterns were reproduced originally by woodblock from the mid-eighteenth century, and since the 1950s by silkscreen. The derivation of the word is not exactly known, but it is thought to have come from either an expression meaning "a thousand generations" or from Chiyoda, an area of Tokyo, the city in which chiyogami flourished in the eighteenth and nineteenth centuries.

Katazome-shi means literally stenciled (*kata*) paper (*gami*). This technique for printing on paper through hand-cut paper stencils, with starch as a resist, was first developed by the textile artist Keisuke Serizawa during the Mingei (craft) movement of the early twentieth century. Later, in 1948, Kyoto native Haruo Kuriyama created a collection of stylized, bolder patterns to be printed on larger paper, based on the traditional motifs used in chiyogami but inspired by Serizawa's new exciting visual vernacular. It is these designs, still printed today, that we refer to as katazome-shi.

TRACING THE HISTORY OF PATTERNS that still appear on Japanese decorative papers today, we can see how the universal appeal of the designs is due to their evolution through the centuries and the Japanese ability to rework and combine motifs that have significance, updating them with consummate skill. As a result, many of the patterns have a contemporary feel, a level of visual comfort for the viewer, and a refined beauty that could

Nancy Jacobi is the president of the Japanese Paper Place in Toronto, which she founded in 1978 after a year of teaching English in Japan. Today the company supplies exclusively Japanese paper in hundreds of variations to artists, craftspeople, and conservators around the world. Her repeated visits to papermaking villages and studios for chiyogami and katazome-shi production over 35 years have given her first-hand knowledge of the history, processes and challenges of the industry.

Stylized "Snow on bamboo" katazome-shi pattern

Early influences on pattern from textiles: shibori , kasuri, and sashiko (stitched pattern)

only come from a culture where great attention has been paid to aesthetics and the closely observed nature of things.

Major influences on patterns that still appear in today's Japanese decorative papers include ancient Chinese culture, Buddhism, the favored motifs of Japan's feudal nobility, important celebrations, literature, and Kabuki theatre. The earliest Japanese patterns, however, were taken from the world of textile, mimicking the weaving and dyeing of cloth, *shibori* (tie-dye) *kasuri* (ikat) and *sashiko* (stitched pattern) among them. Appearing as designs in their own right or as background for other more prominent motifs, their appearance in today's decorative papers is a reminder of the ancient association between textiles and patterning in Japan.

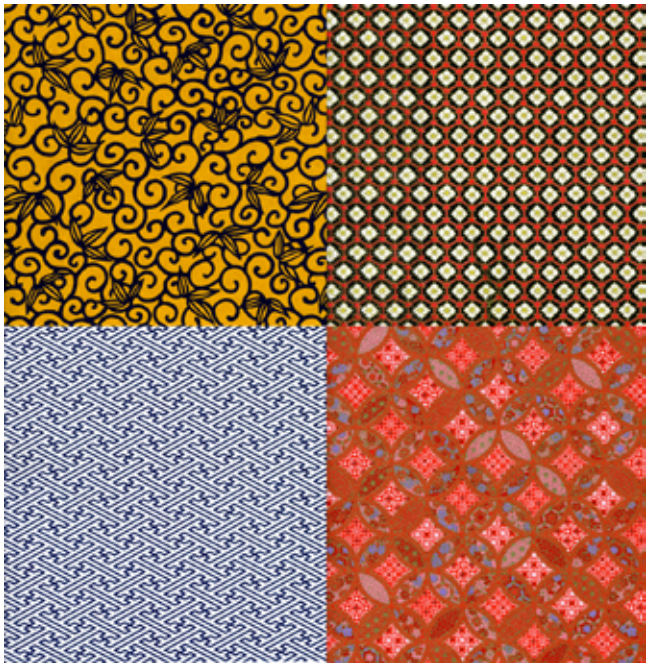
Many of the designs we think of as typically Japanese actually originated in China and made their way across the sea with the fervor of the Nara period (710–794) for everything Chinese. The hexagonal tortoise shell, the plum blossom, and the chrysanthemum, symbols of longevity and endurance, have been reworked from their Chinese beginnings but retain their significance and recognizable forms on Japanese papers today. Other designs like the Chinese arabesque (*karakusa*) was a favorite decoration of the Imperial court in Nara. Today its appearance as a design element in many chiyogami prints is often altered—softer or more curlicued or smaller—so its Chinese origins are not always obvious.

During the early Nara period, many patterns were adopted from the T'ang dynasty in China as decoration for the court nobility, whose elaborate costumes were a perfect canvas for these woven auspicious status symbols, including the pine, bamboo and plum blossom—"the three friends of winter." In Chinese symbolism, the trio represented the scholar-gentleman's ideal character, and the motifs to this day figure prominently in chiyogami designs.

The long Heian period (794–1185) was marked by a combination of elegant aesthetics and constant wars led by the Samurai. A new kind of pattern emerged then, motivated by a desire for recognition of power, either at court or on the battlefield. Family crests, or *mon,* were designs usually enclosed in a circle, rendered simply so they could be identifiable on a larger scale and from a distance by the enemy. Symbols

that appeared frequently in the *mon* of Heian nobility and warriors, and to this day on the decorative papers, are bamboo for resilience, mountains for unsurmountability, and ferns for longevity (as they remain green in the snow). Unlikely as they seem, the dragonfly and the butterfly in the *mon* of warriors became talismans for victory.

Other *mon* took their symbolism from Buddhism, another Chinese import, including the *rimbo,* or sacred wheel, and the swastika *(manji)* emblem of eternity, as well as from Shintoism, including oak and gingko leaves—trees often found in Shinto grounds. All of these continue in their revised forms, to be part of the chiyogami visual language.



Chiyogami patterns of the earliest influences, clockwise from upper left: *karakusa*—Chinese arabesque; tortoise shell symbolizing longevity; *shippo*—seven treasure circles; *manji*—Buddhist swastika symbolizing eternity

With the rise to power of the formidable Fujiwara family in the tenth century, communication was suspended with China. From this time on, Japan became aware of its own distinct culture, which had a strong reverence for nature and placed high importance on beauty. The Japanese now sought images that would reflect their own customs and predilections rather than China's. Cherry blossoms, representing the fleeting nature of life, replaced plum blossoms as the favored flower, and hollyhocks rather than peonies graced many kimonos. The folding fan (*sensu*), a distinctly Japanese invention, was preferred over its Chinese counterpart, the round flat fan (*uchiwa*); the iris became an important military symbol. All were purely Japanese images that still appear in many stylized variations in contemporary chiyogami.

Throughout Japanese history, and in the decorated papers of today, striped patterns reveal an astounding range. In Heian times and later in the Edo period (1603–1867), laws were passed restricting the wearing of certain sophisticated striped patterns to the nobility, limiting the common man to simpler stripes in his garb. Perhaps to circumvent the restrictions, many took on the challenge of creating stripes that fell between the lines of the law. However it happened, the number of striking and varied stripe patterns that appear in chiyogami is staggering.

But it was in the Edo era, when peace was restored and the arts lost their elitist limitations, that visual representation through woodblock print became a national obsession. With the rise of Kabuki theatre and the depiction by artists of the actors in costume

Katazome-shi with *mon* patterns

Modern chiyogami of purely Japanese motifs: masculine symbols of iris, samurai helmet and boys' day banner; cherry blossom for the fleeting nature of life

A handful of the wide variety of stripes in the vast chiyogami repertoire

in these prints, certain patterns became the rage. The checkerboard pattern formerly referred to as *ishi-datami* (paving stones) and of minor incidence was worn in a big bold version on stage, in 1741, by a prominent actor named Sanogawa Ichimatsu. The pattern became a sensation, sought after as a motif on fabric, household utensils, clothing, accessories, and chiyogami. Thereafter known as ichimatsu, the pattern is produced to this day in endless variations of scale and color on both chiyogami and katazome-shi.

Umbrellas, common on the Kabuki stage, often contained the names of prominent actors or of certain ladies in the pleasure district. Summer kimonos showed bold rope-like patterns worn by the same ladies of the Yoshiwara district. Both patterns also remain very popular on today's hand-printed papers.

In the new capital of Edo, today known as Tokyo, which lacked the formality of the former capital, Kyoto, life had a freshness and sense of fun. With the flourishing of woodblock printing and its ability to produce multiples, *ukiyo-e* prints became popular—images of the "floating world," which captured the atmosphere of the hedonistic city and travelling life of the Edo period. In this context, chiyogami made its entrance. Graphic patterns formerly seen on textiles now appeared printed by woodblock on small sheets of paper in lively colors, bought by women and children of the emerging middle class, who transformed them into *anesama* (flat paper dolls), origami, book covers, and other small pleasures.

Of increasing interest to this new audience, chiyogami designs developed from single traditional symbols to multiple colored layers of patterning. Soon they began to depict everyday objects: children's toys, household furnishings, carpenters' tools. These did not replace the historically still-relevant symbols such as cherry blossoms, cranes, waves, and bamboo, but they were often combined as the end of the Edo period welcomed newness of all kinds. Designed by some of the artists who were creating the *ukiyo-e* prints, including Hiroshige and Eisen, chiyogami were also examples of carefully considered and successful woodblock prints—though graphic rather than narrative and intended for a very different purpose. Original pieces are now scarce, since from the beginning they were mainly sold to be used by the purchaser as material for the creation of another object.

As Ann Herring states in the informative *Chiyogami: Hand-printed Papers of Japan*,

> Despite its obvious visual beauty and sophisticated levels of design, its primary uses were decorative, functional and commercial rather than consciously "artistic"…. Its ephemeral nature has made it very difficult for people to appreciate its long history, while its continuing availability has caused the public at large to take it for granted (1998, 12).

Other examples of nineteenth-century chiyogami were used by artists and merchants in various fields as reference material for pattern and color possibilities. Some were meant for children, designed as learning tools with household objects to identify; others with simple graphic *komon* patterns—goldfish, folding fans, peonies, and flowing water—could be made up into colorful touches for the home.

The original images for printing chiyogami need only be the size of one repeat, an eighth the size of the finished sheet. It might be created as a painting or a digital drawing. The complete image is broken down so that a separate screen in the full sheet size is shot for each color to be printed. The base paper—in most cases now made specifically for chiyogami by machine in Japan, designed to be strong when wet and folded—is temporarily pasted to a board and moved to the first color station. The ink is squeegeed onto the screen. The printer then lifts the board and paper to a drying rack. Once dry, each board will be moved to the next color station, where it will be locked into place and the second color applied. This will be repeated as many times as there are colors—sometimes twelve in one pattern. The registration is always perfect: no overlapping, no unevenness of color, regardless of how many colors have been applied.

Contemporary inks are made with synthetic high-quality pigments to prevent fading, and mixed with a binder to give an even and lasting layer of color. This produces a hard-wearing surface but makes the necessary cleaning of the screens after each printing a demanding task, especially in the summer, when inks dry more quickly. Storage of these screens is a serious challenge to the studios, some of which offer more than a thousand designs, each with multiple color options.

Sanogawa Ichimatsu II wearing the checkerboard pattern, an overnight design sensation caused by its appearance on the Kabuki stage

Inspired by Edo period Kabuki design, this katazome-shi pattern, uses the names of famous courtesans from the pleasure district on umbrellas.

"Hamamatsu" woodblock print by Utagawa Hiroshige, an example of the popular genre which gave rise to patterned chiyogami, also designed by accomplished artists including Hiroshige

Increasingly patterns became mixtures of auspicious symbols: cranes for longevity with flowing water for fleeting life; pine, plum and bamboo symbols of perseverance mixed with numerous traditional *komon* patterns for design elements

Printing with strengthened paper stencils on leather and cloth was refined by the end of the sixteenth century and popular during the Edo period, and through the Meiji period (1868–1912) and up to the 1960s, chiyogami continued to be printed by dedicated woodblock studios in both Tokyo and Kyoto. However, it was the technique of using paste as a dye-resist, developed in the early twentieth century, as mentioned above, by textile artist Keisuke Serizawa, that took multicolored stencil printing to new heights, including printing on highly absorbent *kozo* paper. Until that time a separate woodblock had to be carved for each color in the print and carefully inked by hand. Serizawa drew inspiration from the Okinawa-based *bingata* aesthetic of leaving more white space and using bright colors. His designs were usually printed on smaller paper, sometimes a single print of a collection of items or motifs, or a page of a calendar, or designed especially to cover a round fan with one image. They were generally works unto themselves, not intended to be cut up as the woodblock chiyogami was.

In 1948, Haruo Kuriyama, a Kyoto gentleman with an entrepreneurial spirit and a love of the bold updated designs and techniques that Serizawa had introduced, married into a kimono cloth-printing family. Sensing the diminishing demand for kimono fabric as Japan adopted Western fashion after the war, he was the first one to realize that the same studios that produced kimono fabric could be used to create more contemporary repeat patterns on large sheets of handmade paper to be cut and used for paper craft—the paper we know as katazome-shi.

Katazome-shi starts with hand-cut stencils mounted onto a screen and frame, one stencil for each color in the full size of the paper. A paste resist is applied on the first stencil, which will cover the areas to remain undyed in the final print. Then soybean juice is spread on the whole surface of the handmade paper to increase absorption and as a size to prevent spreading of the inks. One by one, the other stencils are laid down and the dyes brushed on, color by color. When complete, the paper will be gently sprayed with water to wash away the resist without damaging the surface, exposing the undyed sections. Finally each sheet will be brushed onto stainless steel heated dryers, where it will slowly be dried to remain flat. As

a result, these papers take a long time to make and are expensive, but the depth of color absorption and the contemporary charm of the bolder stylized traditional patterns make them irresistible to many.

Following on Kuriyama's insight, new chiyogami studios sprouted up in former kimono workshops in and around Kyoto throughout the 1960s and '70s, and several studios began printing chiyogami by silkscreen on larger sheets, making it faster and less expensive to produce. Hundreds of new patterns incorporating and updating the venerable motifs of old poured out of the studios and were avidly consumed.

As women in this period found more time on their hands, crafts based on chiyogami, and home-based schools to teach them, swept the nation. Elaborate three-dimensional dolls, multi-drawered boxes, and endless accessories made the popularity of chiyogami soar. Still sporting the revered symbols in updated configurations, chiyogami was now available in the typical *kikuban* size of handmade paper (37 inches x 25 inches).

The 1970s and '80s were the heyday for silkscreened *chiyogami* production, which flourished in Japan until the economic bubble burst in 1991. Ironically, the decline coincided with the discovery of chiyogami and katazome-shi by the world outside Japan. Impressed by the vibrancy of the inks, the perfection of the registration of multiple colors, and the beauty of the original designs, craft workers on the lookout for interesting and workable materials embraced these iconic papers around the world. Bookbinders, lamp and furniture makers, stationery designers, and artists doing collage, sculpture, and jewelry began to use it in unique ways.

KURIYAMA'S KYOTO STUDIO STILL EXISTS TODAY and continues to produce katazome-shi on large sheets of handmade Japanese kozo blend paper, 37 x 25", sold as decorative paper for discerning craftspeople. While the contemporary market for *chiyogami* in Japan is at a virtual standstill, it is the demand for it outside the country that keeps his and a handful of other studios humming.

In North America, chiyogami and katazome-shi have become accessible through art supply and paper stores, especially those which teach some book arts. Other popular uses include boxmaking, decorative

The last layer of ink having dried, the chiyogami is pulled off the board to which it was temporarily pasted. (Photo by Takao Moriki)

Screens brought to the studio from storage for their use on a given day. Each chiyogami studio is challenged by the storage of their hundreds or thousands of screens needed for the range of patterns offered. (Photo by Takao Moriki)

An array of katazome-shi patterns from the 1980s, many no longer available, as stencils wear out after many years of use. Exact numbers of studios still producing chiyogami and katazome-shi are difficult to determine, however. The industry guards its secrets carefully, as competition for survival is a serious matter. But there seem to be only two studios left in Japan making katazome-shi and about five producing chiyogami, mainly in and around Kyoto as of 2014.

The paste resist on a sheet of katazome-shi is removed with water spray and gentle massage, exposing the white undyed areas.

origami, and high-end embellishtments.. Catherine Burkhard, a Guild of Book Workers member and teacher of bookbinding and conservation in Dallas, Texas, has been a constant user of these papers for years, encouraging her students to share her enthusiasm. "I like them for their sheer beauty, their strength and the ease of working with them," she says. "I can trust their content to mould wonderfully around a book cover or box edge. The incredible variety of pattern means you'll always find something perfect to work with for any project. "

In London, Japanese decorative papers have been made available through Shepherds Bookbinding for over twenty years. This ready availability has helped spread their usage far beyond their typical application as covers and end sheets in books. Shepherds' well-honed design and binding expertise has resulted in their extensive line of books, boxes, and stationery products covered with Japanese decorative papers. Included are a popular range of classic books, which are bound in leather and use Japanese decorative paper not only as end sheets but as slipcases. Rob Shepherd's passion for antique books feeds into his interest in custom bindings, which also often sport katazome-shi or chiyogami end sheets and sleeves. Rob explains the attraction to these papers: "You can feel the quality when you are binding with them, and the range of brilliant patterns and color available is exciting." Also through the Shepherds store, upscale London restaurants the Wolseley and Bob Bob Ricard have discovered the effectiveness of Japanese chiyogami designs in large stretches of wallpaper.

In Leuven, Belgium, Hilde Goedleven in her business Bleu Celeste combines leather with chiyogami that she treats with konnyaku (Devil's tongue root) starch to strengthen and waterproof it. She then stitches them together to create strong handbags, baby shoes, waste baskets, and bowls.

In France, the popular craft genre known as *cartonnage* is devouring chiyogami at a tremendous rate. As the Egyptians adhered layers of linen and papyrus to put mummies to rest—this was the origin of the term—so the French layer chiyogami to create all manner of decorative furnishings—shelves, boxes, baskets, bags, lamps—at a serious clip. In Switzerland, Finland, Holland, Germany, Turkey, and South Africa, other innovative uses are inspired by the vibrancy and

practicality of Japanese printed papers. Bookbinders around the world are consistently drawn to them, and the combined taste of different countries keeps all types of patterns continually in production by the grateful studios.

The Japanese Paper Place in Toronto has been importing and distributing Japanese hand-printed papers for thirty-five years. Starting in 1978 with five each of a handful of katazome-shi patterns on 100 percent kozo handmade papers, its warehouse now stocks over 900 chiyogami variations and 190 katazome-shi. Selections are made from thousands of patterns presented in a multitude of sample books, each option still printed by hand in those few studios in and around Kyoto.

In the early years of the business, the sample books contained only designs reflecting the traditional motifs that had evolved over the years. Every once in a while, a new funky pattern would show up—lambs and cows on bright lime backgrounds; owls; rocket ships. But overwhelmingly, the "new" sample books we receive are still heavily weighted to patterns of cherry and plum blossoms, fans, pine boughs, and cranes, those age-old symbols that suggest prosperity, long life and perseverance. Scattered among the representational patterns are the *komon*, small graphic patterns that go back to the textiles and decoration of the Heian period, looking remarkably modern.

We do periodically ask for specific patterns to be made (sitting birds, for example), and occasionally request the spatial stretching out of a design or variations of an existing design using colors popular in the West. Certain studios are quite willing to oblige, open to what the world outside Japan's borders wants, while others understandably want to keep the chiyogami aesthetic sensitive to its roots in old Japan as an expression of the symbolically rich culture from which the craft emerged.

With modernization in Japan unbridled in so many spheres—fashion, art, technology, architecture—it is extraordinary that these decorative papers are still being made by hand incorporating the traditional motifs. The studios there are nervous: young Japanese are not interested in chiyogami, and katazome-shi, which they associate with their grandmothers' time and the old-fashioned crafts they made. Much hope for its future rests with artists in the West as the

Combined with leather, chiyogami gives a feeling of lightness yet strength to book covers as in this example from Guild of Book Workers member Catherine Burkhard.

Offering thousand of variations, sample books like these fill the office shelves of The Japanese Paper Place

Bowl made by Hilde Goedleven, with *konnyaku*-treated *chiyogami* stitched to grey leather

The small scale of patterns used in chiyogami and katazome-shi make them suitable choices for book covers in a variety of sizes and inspire usage in differing ways around the world, including the samples shown here from France, England, Canada and Austria.

paper's availability becomes more widespread and new ideas are developed for its use. How fortunate that today's bookbinders, designers, craftsmen of all kinds, and those who appreciate beautiful materials have access to these remarkable designs, so traditional and yet so new. In using them, we pay tribute to the handful of intrepid studios in and around Kyoto who still produce, by hand, sheet by sheet, the stunning decorative papers known as katazome-shi and chiyogami.

Sources and Further Reading

Conversations and correspondence with industry members in Japan since 1978, especially 2013–2014.

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_____. 1989. *Designer's Guide to Japanese Patterns 3*. San Francisco: Chronicle Books.

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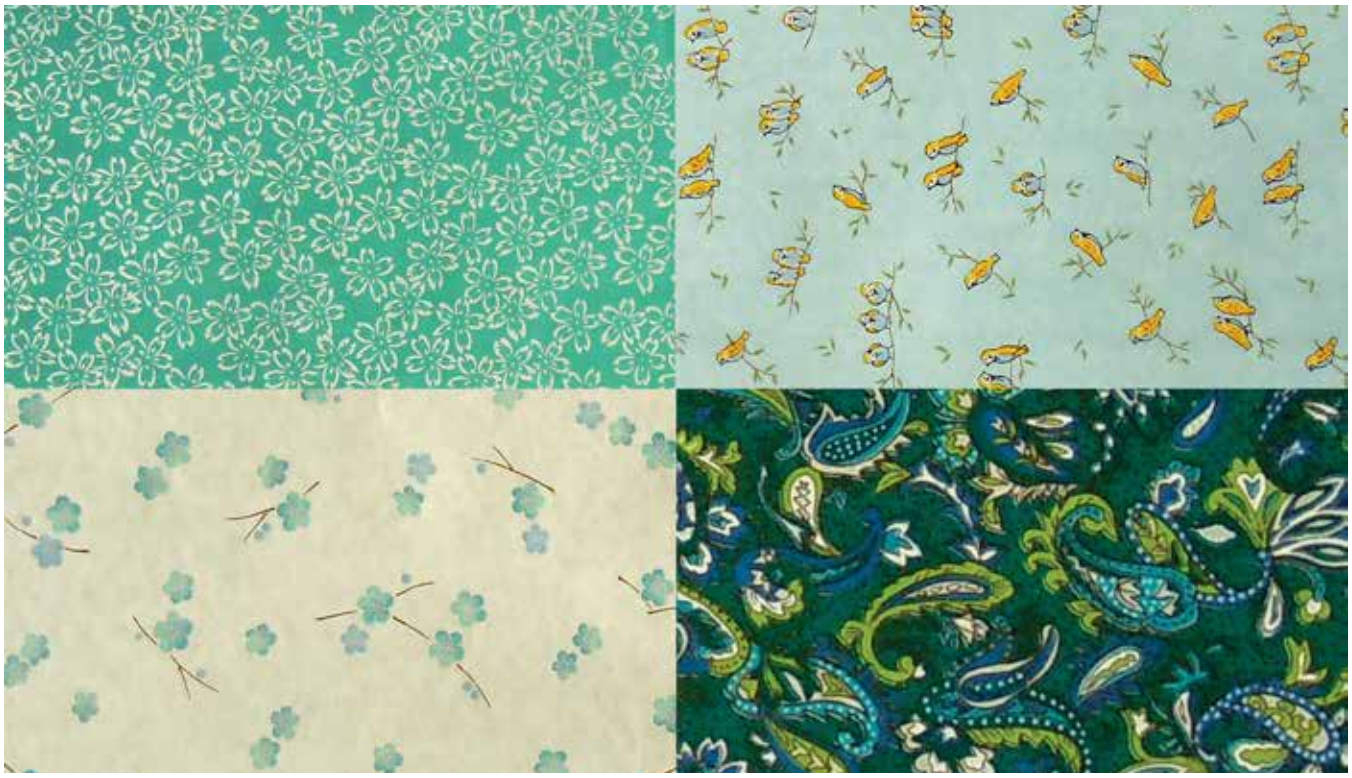
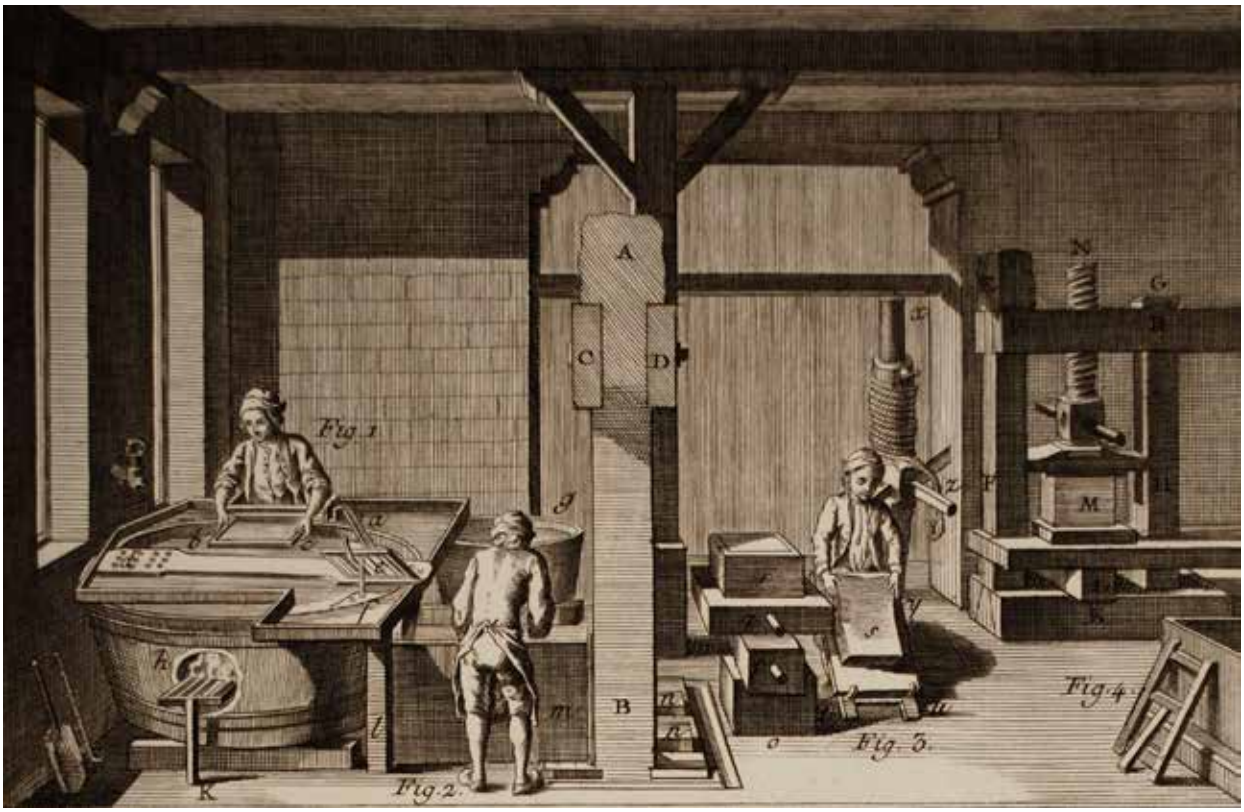
Hibi, Sadao and Motoji Niwa. 2001. *Snow, Wave, Pine Traditional Patterns in Japanese Design.* Tokyo: Kodansha.

Not every studio produces only traditional auspicious designs. Clearly inspired by contemporary life and modern imagery, new patterns continue to surprise and charm users, particularly outside Japan.



Indulging the taste of western users, these patterns combine the typical scale of chiyogami images, with requests from abroad for sitting birds, paisley, greater space between the plum blossoms, and the color turquoise.



Mid-eighteenth-century French three-person vat team at work. Artisans in Tomas's era are believed to have made paper using almost identical teams of three. From *Encyclopédie; ou Dictionnaire raisonné des sciences, des arts et des métiers*, Diderot & d'Alembert. Paris, Briasson [etc.] 1751–65. (Plates Vol. 5)

Recommendations for establishing a paper mill, Tomaso of Pinerolo, 1407

Tim Barrett

THIS IS A FICTIONAL DOCUMENT. THE VOICE OF THE WRITER IS THAT OF a skilled Italian papermaker named Tomaso who grew up in the craft as a young person. He worked in the rag loft with the women as a child, moved down into the vat room as an apprentice, eventually served as a vatman for twenty years, and toward the end of his career became well established as a skilled paper mill foreman, renowned for his knowledge of the intricacies of the craft.

The report, let us say, has been commissioned by a French venture capitalist of sorts who wants to establish a paper mill in France in the very early fifteenth century, when such enterprises are still rare in his region of that country. Moreover, the investor is intent on the production of fine quality writing papers. He has the foresight to pay for the best advance research possible before he makes what amounts to an enormous financial commitment to purchase land and water rights; build a dam, mill pond, mill, and water wheel; install equipment; and hire skilled craftsmen and -women. The capitalist has paid well for the report, so Tomaso has been forthcoming about trade secrets and pitfalls of the craft.

An historian familiar with the period might argue that Tomaso, because of his social standing, would not likely be literate and capable of preparing a written report. We can suppose, then, that the report he submits has been dictated to someone with an education and some knowledge of the field, who has transcribed Tomaso's verbal recommendations and translated his prose from working-class spoken Italian to proper written French.

The Western hand papermaking techniques still in use today appear to be very similar to those described below. However, old linen and hempen rags used as a raw material, and the fermentation of rags, beating with stampers, washing during beating, loft drying, and gelatin sizing used routinely in the past, are now uncommon if not exceedingly rare.

This document was originally prepared as advance reading for a seminar at Yale University's Beinecke Rare Book and Manuscript Library on March 6, 2014, sponsored by the Yale Program in the History of the Book.

Timothy Barrett's background includes two years at Twinrocker Handmade Paper, a Fulbright Fellowship in Japan, and part-time study at Western Michigan University's Department of Paper Science and Engineering. His research on early European handmade papers has been funded by the National Endowment for the Arts, the Kress Foundation, the Institute for Museum and Library Services and a MacArthur Fellowship. Barrett is author of two books, six videotapes and 25 articles on the history, technique, and aesthetics of hand papermaking. He joined the University of Iowa Center for the Book in 1986.

Dear Sir,

It is with some reluctance that I agree to provide these recommendations to you, not because you have failed to compensate me adequately, which you most certainly have. Nor am I concerned about revealing secrets of the trade, for I believe such things are gradually shared by craftspeople in the normal course of their lives like geese flying across frontiers. My worry is connected with the simple truth that success in papermaking depends not on advice, but much more on having long experience at the craft. True, you have consulted me because others say I have such experience, but even if I am very skilled at papermaking, there is a great limit to how much of it I can put down in words. I trust you will bear this truth in mind and therefore take every opportunity to share what I provide here with those skilled at papermaking in your own country. Only they will know the importance of what I advocate and be able to advise you in making your decisions. I remain your servant and steadfastly stand behind all that I describe below.

Tomaso of Pinerolo, in Italy
The first day of March, 1407

ON SELECTING THE LOCATION OF A MILL

It is natural, in anticipation of building a mill of any kind, to have local millwrights recommend a location providing a year-round water source that can be controlled by a dam and pond, which can themselves in turn be constructed at minimum cost. While these are reasonable priorities for the milling of grain, the sawing of timber, or many other trades that depend on the water wheel for power, it is not the first consideration in locating a paper mill. In making the finest grades of white paper, which I understand is your intention, a nearby source of *pure* water must be the first concern. This fact is often missed by those unfamiliar with the craft. They see water as a temporary host of the fine fibers that form the sheet, and once that sheet is made and pressed and dried, they surmise, the water is done with and of no consequence in the final quality of the paper. Nothing can be further from the truth. All that is good or bad in the water that comes in contact with the rags is taken on by the fibers and remains in the paper forever. We can see this most clearly when any bits or pieces of vegetable matter or grit, no matter how small, find their way into the water used to process the rags. The paper will suffer in quality. So too is the case with other unseen qualities of the water. They accumulate in the paper and contribute to its long life or its rapid demise, depending on the nature of the water. Choose your mill site based on the consistent availability of pure water. If a spring giving the best quality water exists some distance away, the water can be brought to the mill by pipes. Sand traps, settling ponds, and filters made of rags can be used to help insure the purity of the water before it reaches the first step in papermaking. Without good water, fine paper cannot be made. It is best to think of the water used to make paper as an actual ingredient in the finished sheet. One must always bear this in mind when making fine paper.

All that is good or bad in the water that comes in contact with the rags is taken on by the fibers and remains in the paper forever.

REGARDING CONSTRUCTION OF THE MILL

As you are investigating a site for your mill, I recommend you engage the best millwright and building experts you can find. They should be experienced in paper mill construction and operation. Such skilled individuals will demand a higher price, but money well spent now will be a wise investment for decades to come. A paper mill is a complicated structure. Initially the incoming rags must be kept dry or they will be ruined by moisture. Once they are sorted and ready for papermaking, they are intentionally wet to begin the fermentation process. During beating in the stampers, more water is worked into the fiber. Water will be everywhere. Subsequent steps, however, are designed to get the water *out* of the paper. The drying loft must be equipped to control the moisture in the air over a wide range of weather conditions. Therefore the mill must be built for the full range of conditions from completely wet to very dry. Workspaces must be designed accordingly. An excellent millwright who has

specialized in mills for grinding grain is of little use in building a paper mill. Build your mill with the best paper mill artisans available and outfit it with the best papermaking equipment and toolmakers that can be found.

ON RAGS

Many will tell you that of all the craftspeople you hire to run your mill, the vatman—the person who forms the sheets—is the most important. Or they will say it is the man who ferments and beats the rags, or those who size and burnish the paper. These people are all essential in fine papermaking, but their skills would be of little value if it were not for highly skilled workers in the rag loft. In my experience, the quality of the paper is tied directly to the quality and the sorting of the rags. Hiring an experienced rag loft foreman is therefore a top priority. Why is this of such importance? The rags that come into the mill, even if they are purchased from a highly reputable supplier, will always vary in characteristics from rag to rag. The sorters in the loft must therefore, by feeling the rag, tearing it, and cutting it into small bits, discern which pieces of cloth are of an *equal* fineness. If they vary in strength and tenderness, then even after fermentation and beating in the stampers, the more tender rags will be quickly reduced to a fine pulp while any even small piece of a stronger rag in the mix will resist beating and remain as threads and knots, spoiling the entire batch of pulp that could otherwise be perfect for making fine writing paper. Excellent quality paper can only be made from quality rags sorted by highly skilled workers.

ON FERMENTATION

We love our wine and our cheese. Do we trust the fermentation of wine or the aging of cheese to unskilled workers? Only if we are coarse folk who do not care about the quality of what we put into our mouths. So it is with the fermentation of the rags in making fine paper. Some unfamiliar with the craft will say, "in this step the rags are left to rot" or "the rags are heaped in a pile, and wet, and allowed to decompose until toadstools grow on the mound." These observations fail to appreciate the delicate aspect of this step in the process. In the beginning, the fermentation will consume all manner of impurities in the rags: bits of food, bodily fluids, and other contaminants that are not fibers. Thus, fermentation is in part a cleansing step. As fermentation continues, the rags are gradually made more and more receptive to beating in the stampers. But here is where the skill comes in. If the fermentation is allowed to progress for too long, a larger percentage of the original whole will be lessened and the finished paper will be too weak. A skilled attendant of rag fermentation will know when to stop and move the rags to the stampers.

Do we trust the fermentation of wine or the aging of cheese to unskilled workers? So it is with the fermentation of the rags in making fine paper.

ON STAMPER BEATING

This is the last step in fiber preparation but it requires the most finesse. In making good writing paper, the papermaker strives for a certain uniformity in the pulp. The fibers must be shortened to give even formation quality; that is to say, the finished sheet, when held to the light, is even and uniform. It is free of thick and thin or cloudy areas, knots, and clumps. This quality can be attained by increased time in the stampers, but prolonged beating has two disadvantages. Every hour in the stampers costs the mill owner money. He will want to see one batch finished and the next added to the stamper pits as soon as possible. At the same time, prolonged beating time results in pulp that does not drain as fast. Because the vatman, coucher, and layer finish their day as soon as the required number of posts are completed for the day, they want the pulp to drain faster, and thus to be beaten less. So the man in charge of the stampers has everyone making his life difficult—he must finish the pulp as soon as possible, but he must make sure he has gone long enough that the finished paper will show excellent formation quality. His job is not an easy one. The mill owner must implore the other workers to have patience with the man overseeing the stampers, as he must himself.

ON WASHING DURING BEATING

One result of the fermentation is that even the whitest rags acquire a slight yellowish color. Therefore, during

beating with the stampers, fresh clean water is continually let into the stamper pits while the exact same amount of dirty water is let out through horsehair net screens set into the wall of the stamper pits. In this manner the fiber is continually washed. Only if this is done will the paper become as white as possible.

HERE WE CAN PAUSE AND CONSIDER that I have urged caution and care in the hiring of skilled workers for all these early steps in the process. We can see that considerable time and attention goes into preparation of the pulp. And yet, up to this point none of the workers have yet made a single sheet of paper. But I implore you to consider that what has been accomplished up until now constitutes the essence of the finished paper. The vatman and his crew will soon form, press, and dry the sheets, and others will size and burnish them, but a majority of the quality and character of the finished paper has already been determined by those responsible for the selection and preparation of the raw materials.

ON SHEET FORMING AND COUCHING

Much is made of the vatman's "shake." This is the characteristic movement each individual craftsperson makes when forming a sheet. It is as essential as the careful stamper treatment I mentioned before. If a skilled worker were to dip his mould into a vat of expertly prepared pulp and simply bring the mould up from the vat and hold it level as the excess water drains away, a layer of pulp would indeed result, but its formation quality would be lumpy and uneven; the sheet—if couched, pressed, dried, and held to the light—would be lumpy, cloudy, and uneven. If the same workman repeats the motions as before, but this time he shakes the mould slightly side to side and front to back while the water still remains in the pulp, then, as if by magic, the pulp acquires a smoothness and appears like a layer of cream on the surface of the mould. Herein lies the importance of the shake. It must be orchestrated in the brief moment when the mould comes up and out of the vat, and still carries all the water held in the pulp in the vat. It is a precious bit of time, and if the shake is not executed expertly, the sheet will lose most of its quality and be an embarrassment to the vatman and the mill. Sheets of common wrapping paper, made from rough quality or colored rags, ropes, sails, and the like can be formed on the mould with little skill. That is entirely acceptable for wrapping paper. But to make fine quality white writing paper, your vatman must have a shake that is as natural to him as breathing.

Sheets well formed on the mould can now be ruined if they are not deftly transferred to the felts by the coucher. Vatman and coucher must work together and not rush their work so much that the fresh sheet arrives in the coucher's hands still laden with such an excess of water that when inverted and pressed against the felt, the sheet crushes or distorts because it has been made to move or flow like water. The two workers are in truth the parents of the fresh sheet, and they must both care for it attentively every moment it is in their hands. The vatman and coucher are in truth the parents of the fresh sheet, and they must both care for it attentively every moment it is in their hands. As I have mentioned before, the vatman, coucher, and layer naturally wish to complete their required posts for the day as soon as possible, but they must not rush the work beyond a certain point if the paper is to be the best it can be.

The vatman and coucher are in truth the parents of the fresh sheet, and they must both care for it attentively every moment it is in their hands.

The vatman must work to keep the sheets of a uniform thickness across the width of the sheet, and a common thickness from one sheet to the next. There is a temptation, however for the vatman to make the paper thinner, as thinner sheets drain faster than thicker sheets made from the same pulp, again allowing the team to finish the work for the day sooner. It is a fact of life in the paper mill that the mill owner must constantly implore the vatman to keep the weight up to the grade expected by the customer.

ON PRESSING AND LAYING

When a post is completed and all hands join in to press the post, every effort should be made to expel as much water as possible. Papermaking is a rhythm of a

kind; it follows a cycle. At the beginning every effort is made to work water into the fiber, and then to dilute the fiber in even more water in order to disperse it evenly. The fiber is like bits of dust in a sea of water. But then, every step that follows is committed to removing the fiber from the water, first in a flat and even layer on the mould, then by squeezing out any remaining water in the press, and finally by drying the sheets free of whatever water is left behind in the loft. So in the end, the cycle is complete and the water is like bits of dust in a sea of fiber.

When the paper is well pressed the post can be moved to the layer. It is his job to remove the still damp sheets from the felts and stack them one upon the next, evenly and without creases or folds. Thus we can see that the pressing must be well executed. If it is not, the paper will retain so much water that it becomes difficult to stack the damp sheets into what we call the pack. This is not a job for idle country folk; it requires real skill. Bear in mind that the layer must supply empty felts to the coucher who, with the vatman, is building up the next post of paper. Thus we can see that the vatman, coucher, and layer work in unison with each other. The pack is then pressed to make it weep and expel excess water, and the sheets are taken to the loft to dry.

ON INCREASING SHEETS MADE PER HOUR

Most teams should be able to produce 2000 sheets of paper in a day.

There are many opinions on the question of how many sheets of high-quality writing paper you should expect your three-person team to make, but most should be able to produce 2000 sheets in a day.

What if the mill owner wishes to speed up the rate of production? Which of these workers needs to be called upon to quicken their actions? The answer, curiously, is none of them. The secret is not to speed the action of the hands, but instead to speed the drainage of the pulp on the mould, for by this path we can see that more paper can be made in an hour or a day. How can this be accomplished?

There are a number of things that can be done. First, as is common in our country, the water in the vat can be heated. The vatman will tell you that hot water is thinner than cold water, which behaves as if it is thicker. To say it another way, any pulp will drain faster if it is first heated. Moreover, the warm water is a great comfort to the vatmen, especially during the colder months of the year. Second, the women in the loft can be implored to select only the most tender and weak rags. These will "fine down" quickly in the stampers to give a pulp that yields good formation quality but still drains quickly, as it has not been beaten for a long period of time. Thirdly, if space is available in the rettery, the rags can be fermented for a longer period of time prior to beating. The fermentation, as it is increased in duration, leaves the fibers more and more readily shortened during beating. This again has the added effect of producing a pulp more willing to part with its watery component for a given beating time. Lastly, one can make thinner paper from which the excess water drains away sooner than it does for a sheet made thicker, but the customer may not abide by thinner sheets.

ON THE IMPORTANCE OF GELATIN SIZING

In order to write on the finished paper with a quill and not have the ink bleed, the paper must be sized, that is to say, dipped into a warm solution of gelatin. Many consider this the sole purpose of the sizing. But there are other important advantages. When paper made of rags, especially well worn and tender rags, is first dried, it may be well-formed when held to the light. But like the rags it was made from, the paper will be tender and lack strength. The gelatin sizing makes the sheet much stronger. As the bookbinders say, it will be more "tough to the needle and thread." Without gelatin in the paper, the sheets will not withstand their handling, especially as bookbinders, like makers of paper, often work quickly under a quota system. The sized paper will be far more resistant to abrasion. It will tend to shed rather than accumulate dirt. Finally, and perhaps most important, if the paper has the correct thickness and even formation quality, with the right amount of gelatin sizing followed by burnishing, the sheet will have a body and feel similar to parchment. In other words, paper can be made to sound, take ink, and endure as if it were parchment. Papermakers are aware of this important fact in my

country, where we have had much success taking away the business of the parchment makers. The parchment makers are not happy about it. We have found, not surprisingly, that parchment clippings can make an ideal gelatin size for papers intended to serve as parchment.

Paper can be made to sound, take ink, and endure as if it were parchment. The parchment makers are not happy about it.

ON DRYING

Once again, this is not a step to be taken lightly. After the damp sized sheets are taken to the loft, the feel of the air in the loft and the condition of the paper already there must be assessed. Is the paper from yesterday still damp or is it fully dried? What are the temperature, wind speed and direction, and the humidity outside? Is a change in weather expected in the next day? If so, does it appear it will it be fair, dry and warm, or cool and damp or rainy? These factors must all be considered. The challenge in the loft is first to ensure that the paper from yesterday is dry, and to adjust the shutters on the windows in the loft so that the damp paper from today is used to help humidify and relax the sheets made yesterday. Only if this is done can yesterday's paper be taken down in twelve hours, relaxed enough to go to the presses and be made flat. Then the still slightly damp paper must be subjected to the exchange, that is, the shuffling of the leaves to put each sheet against a new neighbor, followed by more pressing. These steps will allow the paper to become flat, ready for burnishing, counting into reams, and packing into bales. Note that the initial drying of the paper after pack pressing can be done with somewhat less care, as the sheets will go to sizing next, where they are again thoroughly wet and pressed. After sizing, however, all possible care must be taken in the humidification of the sheets, as this is the last opportunity when moisture in the paper can be used to help keep it malleable for the exchanging, pressing, and flattening work.

ON GRADING AND BURNISHING

The sized sheets are taken to be graded and then burnished by women working with polished stones of agate or flint. This is tedious work, but the customer writing with a quill expects the paper to be at least lightly burnished, if not thoroughly so. Like the workers at the vat, the women who burnish the paper also work on a quota system. When their work is finished they are free to go home. This creates a tendency to work too quickly, and the quality of the paper can suffer. It is not uncommon for the women to secret a piece of soap or mutton fat into the mill under their aprons. They use this to treat the stone, to make it travel easier across the surface of the paper. But the ink does not take to the paper in the right way at that location, and the customers complain, as they should.

The degree of burnishing, and its uniformity can be seen if the sheet is held up flat at the level of the eyes so that light from the distance bounces off the surface of the sheet and into the eye. When burnishing is well done it will have a sort of polish to it, and it will feel similar to the surface of well-made parchment.

ON THE QUALITY OF PAPER MADE AT THE MILL

The mill owner and the mill foreman have many challenges they face. Chief among these, and perhaps the most difficult to manage, is ensuring that the quality of the paper is high. This is made more difficult by the quota system, which as we have seen gives the workers, in their view of things, an incentive to hurry at every opportunity. How can this be problem be addressed? One can make the point to the workers that going too fast often results in poor quality or damaged sheets, and that the paper is then refused and sent back to the mill. But this has little impact on the workers, as they regard it as a problem the owner of the mill needs to negotiate. Some have tried rewarding the workers with an increase in wages if there is an overall increase in quality. But in time there is likely to be a gradual decline in quality, with the workers wanting to retain the higher wages regardless, and arguments about quality and how it is judged ensue.

The only force that can counteract this problem is for the workers to take pride in their work. Thus they must come to see the finished paper as a reflection of themselves. Even though most of them do not read or write, they know of books; they have letters written to

their relatives about important matters. I have worked in mills where the mill owner has taken care to make the papermakers aware of how their paper is used by professors and students in the nearby university, by local officials, and by the clergy in the church. When mill owners show the workers a book that has been copied onto their paper, some may act as if they have no concern about the matter, but most are impressed, and they take note that the mill owner has gone to the trouble to show them how their work is appreciated and used.

Mill workers must come to see the finished paper as a reflection of themselves.

Mill owners often make the mistake of assuming, because of the coarse language the workers use and their lack of education, that they are not intelligent. In my experience, many of them are at least as gifted in the mind as some of the educated and wealthy. I have seen many instances where a worker has acquired a level of skill at an aspect of the craft, such as fermentation or beating, that is to me as if the person has the powers of a master alchemist. To acquire such skill the person must have uncommon intelligence and sensitivities. So, if you wish to make the best paper possible, let your workers know that is the goal of the mill, and that you have faith in their skills and abilities. In many cases they will appreciate the respect you show them, and return it with hard and careful work. Too many who use paper today take it completely for granted. But within the mill, if its importance is acknowledged, all will contribute to making quality paper that will stand for the mill and its workers. They know, better than others, that each finished ream is the work of many. In a successful larger mill in my country, we say that each sheet has been touched by thirty pairs of hands before it is finished. I implore you not to underestimate the intelligence of the workers, and the pride they can feel if paper that comes from the mill is high in quality.

Commentary and suggestions for further reading

While this is a work of fiction, it is based largely on my own experience as a papermaker blended with information from a number of known historical references.

For a detailed analysis of early-modern hand papermaking techniques with citations see http://paper.lib.uiowa.edu/european.php. You can also watch papermaking in action by viewing our video at https://www.youtube.com/watch?v=e-PmfdV_cZU.

Note that the term "post" in the text above refers to the stack of fresh sheets of paper interleaved with woolen felts, prior to pressing to expel the excess water. Most papermaking work assignments in Europe were based on the vat team completing a given number of posts per day. The number required varied according to the size, quality, and thickness of the paper. John Houghton's 1699 "History of Paper," in A Collection for the Improvement of Husbandry and Trade *(vol. 13 nos. 356–362, London, Bodleian Library, Hope Folio 23) cites one mill where, for 17 x 21.5-inch sheets, each post consisted of 150 sheets and the quota for the day was twenty posts. This amounts to 3000 sheets made in a twelve-hour work day, or 250 sheets in an hour. I have not encountered any contemporary references for expected rates of production for fifteenth-century vat teams, but 2000 per day is not unreasonable, with more expected for smaller sizes, less for larger. Thanks to Dr. Elizabeth Yale for this reference.*

Regarding paper quality, Pierre Claude Reynard gives a revealing picture in his "Manufacturing Quality in the Pre-industrial Age: Finding Value in Diversity" (Economic History Review*, LIII, 3 [2000], pp. 493–516) of how eighteenth-century French paper mill owners responded to increased production requirements, and the wider range of quality that resulted, by diversifying the paper grades they offered to their customers. For more on the evolution of labor and management relations during the hand papermaking era see Leonard Rosenband,* Papermaking in Eighteenth-Century France: Management, Labor, and Revolution at the Montgolfier Mill, 1761–1805 *(Baltimore: Johns Hopkins University Press, 2000).*

For an excellent interactive overview of the spread of paper mills, printing establishments, universities and related historical events visit Greg Prickman's Atlas of Early Printing *at http://atlas.lib.uiowa.edu, which identifies Pinerolo, where our fictional author Tomaso lived, as a papermaking town dating to the fourteenth century. For details on water quality and many other aspects of*

500 sheets of Chancery-size paper (12.5 by 18 inches) made by Barrett and student co-workers at the University of Iowa Center for the Book

eighteenth-century French papermaking materials and techniques, see Joseph-Jérome Lefrançois de Lalande, "Art de faire le papier," in Description des Arts et Métiers, *vol. 4 (Paris: Académie royale des sciences, 1761). Translated by Richard MacIntyre Atkinson as* The Art of Papermaking *(Kilmurry, Ireland: Ashling Press, 1976). How many of Lalande's observations would accurately represent early fifteenth-century papermaking is unknown because very little documentation of the earlier procedures has come to light. Lalande makes specific reference to the use of a piece of mutton fat to grease the stone used in burnishing the dried sheets (p.52, Section 115). He describes the use of shutters in drying lofts, saying they give "the means of admitting only the degree and amount of air which is considered necessary for drying the sheets." (p.50, Section 111). He does not, however, describe the use of damp newly made sheets to humidify and soften previously dried sheets. At the University of Iowa Center for the Book we have experimented successfully with humidification to assist in flattening dry paper made from new hemp and cotton fibers. Historically, papers made from old hempen and linen rags may or may not have required a certain amount of moisture in the sheet to facilitate flattening.*

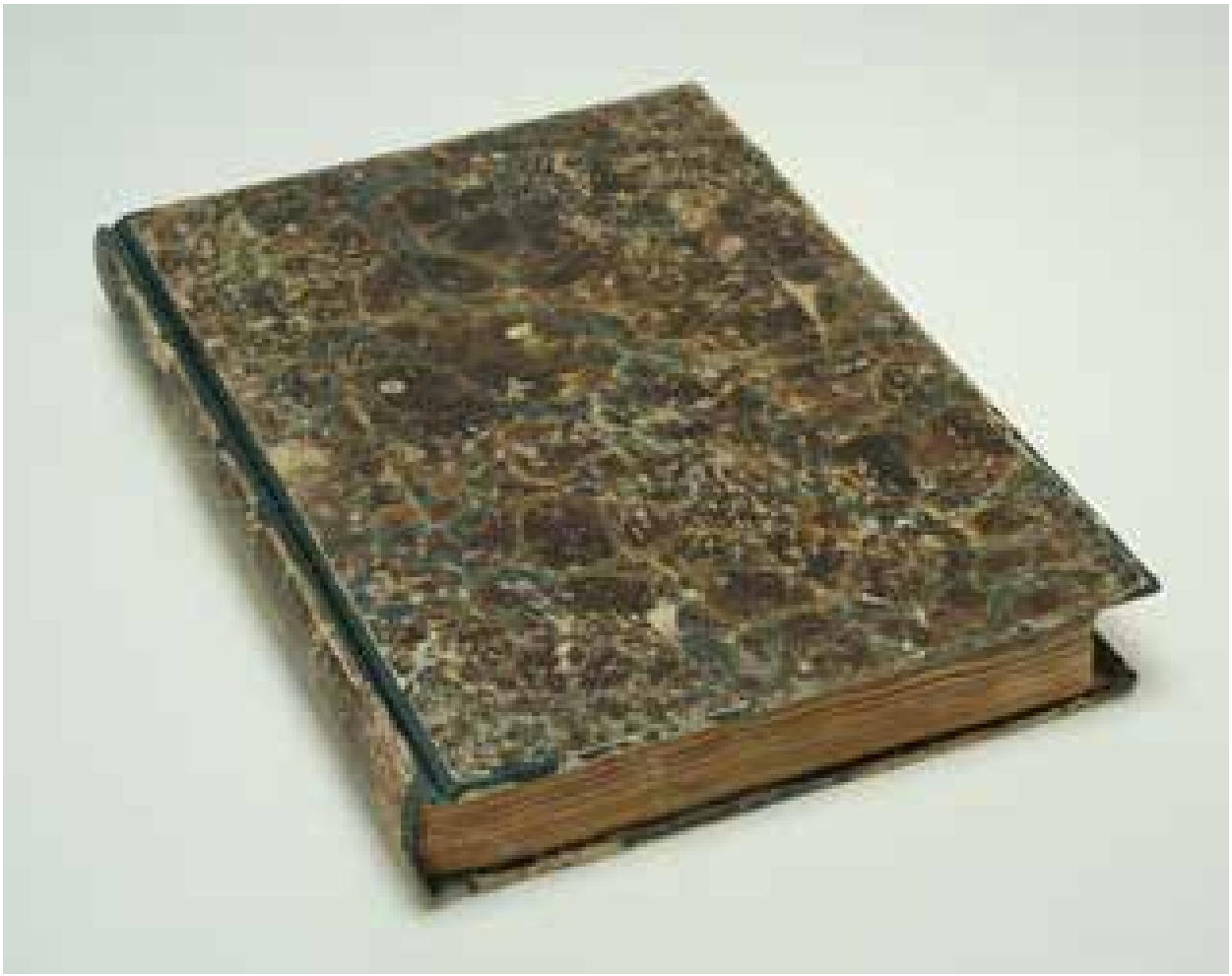
—Tim Barrett

Barrett and student co-workers Katharina Siedler and Mary Sullivan during ongoing work to recreate early production routines.

The book as vessel inspires beautiful metaphor: a craft for traveling, a container, a holder, a receiver, a transporter. Across time and culture, the vessel is at the center of many ceremonies and rites of passage. This full-color exhibition catalog showcases all 50 works from the traveling exhibition, plus binding descriptions and biographical statements by each binder.

VESSEL

https://guildofbookworkers.org/product/vessel



***P. Cornelii Taciti* after conservation. Photograph used with permission.**

An In-Boards paper binding

Katie Smith

Katie Smith is an alumna of Brigham Young University, North Bennet Street School, and West Dean College—with graduate studies in comparative literature studies and book conservation. She is currently a book and paper conservator at the Church History Library in Salt Lake City, Utah. katie.smith@ldschurch.org

MOST NONEPHEMERAL PAPER BINDINGS I HAVE BEEN EXPOSED TO are those discussed in the book world: the German lapped component binding or the Italian one-piece paper case. These are the types of bindings I practiced and played with in school workshops, and the paper binding styles conservators and librarians pointed out to me during various library excursions around the United States and Europe. While paper-covered bindings may not be as ornate as other bindings, I found that those who worked closely with books loved these structures, and I also fell in love with the charm and resiliency these books possessed. However, my contact with permanent, non-ephemeral paper bindings only consisted of these two types of case bindings. Despite Barbara Rhodes' concluding comments to her seminal article stating that there were a "variety of paper binding structures and their permutations" (Rhodes 1995: 62), no one ever seemed to point out any variety recognizably different from the two styles. No physical book, article, blog, or DIY YouTube special ever brought me anything else.[1]

Therefore, when *P. Cornelii Taciti*, from the special collections of Brigham Young University–Idaho, landed on my desk for conservation, I was delighted to find that it was not a lapped or cased-in paper binding but rather an in-boards paper binding; or, a binding where the text block is attached to the cover boards before the final paper covers are added.[2] While in-boards bindings are mentioned in paper-binding books and articles, they are rarely given in-depth treatment, and *Cornelii* seems to possess unique qualities these articles never mention even in terms of in-boards bindings. Due to this, a brief note on the history and nature of the structure itself will deepen the understanding of paper bindings and potentially be of some importance to craftspeople creating a model or artistic rendition of this binding for themselves.

Unfortunately, *Cornelii*'s history has a number of significant losses that may never be recovered. Only one thing is clear: the text block is much older than the cover. Printed in 1527 in one of the printing shops run by Johann Froben—probably the most distinguished early printer in Switzerland—the origin of this text block clearly sets it right in the middle of Europe. It also places the book inside a university-based scholarly group helping Froben print books for the intelligentsia of his world (Hilgert 1971).

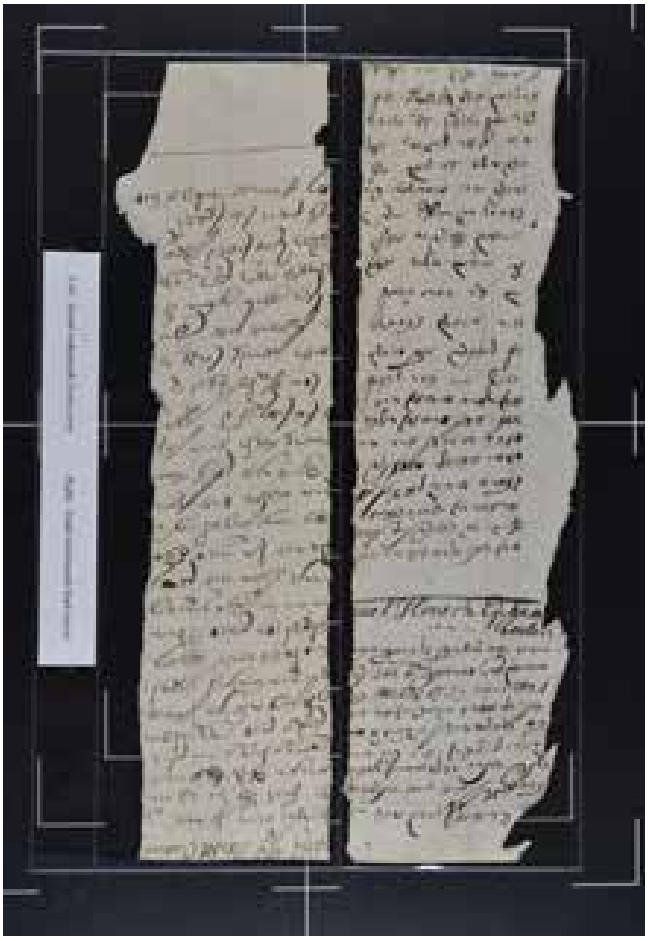
With their help, Froben set new heights in terms of scholastic and utilitarian texts coupled with great artistic design—which included the addition of Hans Holbein as illustrator among others.[3]

Although plain paper wrappers and covers were being created during the sixteenth century, very few of them survive, and additional sewing holes along *Cornelii*'s inner folds suggest that the present binding is a second, much later covering (Cloonan 1991: 5). Pre-seventeenth-century paper bindings are few and far between, but vestiges of paper bindings in later centuries exist in relative abundance (6). In the early seventeenth century, a resurgence of learning and the popularity of newspapers created a demand for the quick and inexpensive production of multiple bindings. The Industrial Revolution's new machinery, coupled with this excitement over informative pamphlets and newspapers, boosted the production of non-ephemeral paper bindings, with paper bindings slowly giving way to textile bindings by the mid-nineteenth century (Frost 1982: 64; The Old Printing Shop 2013; Cloonan: 1991, 12). Because of this, it is likely that *Cornelii* was rebound hundreds of years after the initial printing and binding. It is also likely that the book did not stay within the confines of Switzerland. Therefore, determining exactly where the present binding was created requires focusing on any names or business plates associated with the binding.[4]

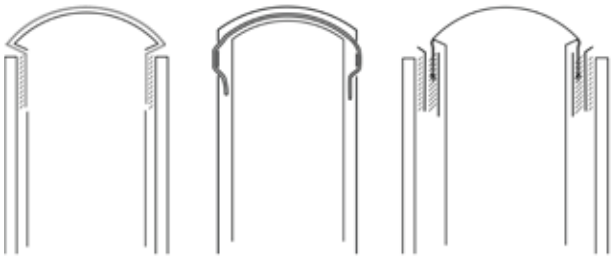
Yet initial inspection of *Cornelii*'s binding revealed no ownership indicators on the text block or pastedowns. With end pages removed, names or name plates have been lost. It was only through the conservation of *Cornelii* that further evidence was found. In lifting pastedowns, a manuscript along the spine edge of the boards was uncovered. With the help of language scholars from Brigham Young University and BYU–Idaho, this manuscript was identified as a cursive Hebrew/Yiddish typical of the nineteenth century[5]. Although difficult to read, a portion of one name—uel Hirsch—was discernible, and aided in narrowing down locations of origin.

Samuel Hirsch (assuming that 'uel Hirsch is Samuel) was a well-known Reform rabbi of the nineteenth century. Born in Prussia, he served as a rabbi in Dessau from 1839 to 1841, then as the chief rabbi of Luxembourg from 1843 to 1866. From there, he immigrated to Philadelphia, where he lived until 1888, eventually moving to Chicago to live with his son, Emil G. Hirsch. He frequently contributed to Jewish journals of the time and was the president of the first Conference of American Reform Rabbis, making it even more plausible that his name would be mentioned in writing (Jewish Virtual Library 2008).

Manuscript found underneath pastedowns



Manuscript uncovered: note the '-uel Hirsch' at bottom right



From left to right: German lapped component binding, an Italian paper case binding, and *Cornelii's* in-boards paper case construction

This implies that the binding was likely produced around the mid-nineteenth century, most likely where Hirsch lived and worked—either around Luxembourg or in the eastern United States.

Initially, I hoped that the book's structure would be a vital piece of evidence in determining where the book was bound, whether in Europe or America. In Italian and German bindings, the text block is made with minimal forwarding, the covers are created and covered with their final decorative paper, and then the text block and covers are attached. However, my initial inspection of *Cornelii* showed something quite different in terms of binding type.

The text block has simple, double folio endsheets (at least as it is discernable from the end of the text block, seeing as there were losses of pages at the front); the sewing stations are sawn-in and sewn around one cord for each sewing station; and the text block is rounded and backed with a simple spine lining of thin brown paper. Typical of rebindings, it is not ploughed or edge-decorated (Cloonan 1991: 43). Indicative of an in-boards binding rather than a case binding, the sewing cords are attached to the cover boards—a few frayed cords on the back cover still hold the text block to the covers—and covered with glued-down manuscript paper. The spine lining is a thin piece of simple brown paper. Finally, a decorative cover paper finishes the binding. There is no endband construction on *Cornelii*, which is also typical for rebindings (Marshall 2000:217, Cloonan 1991:44)

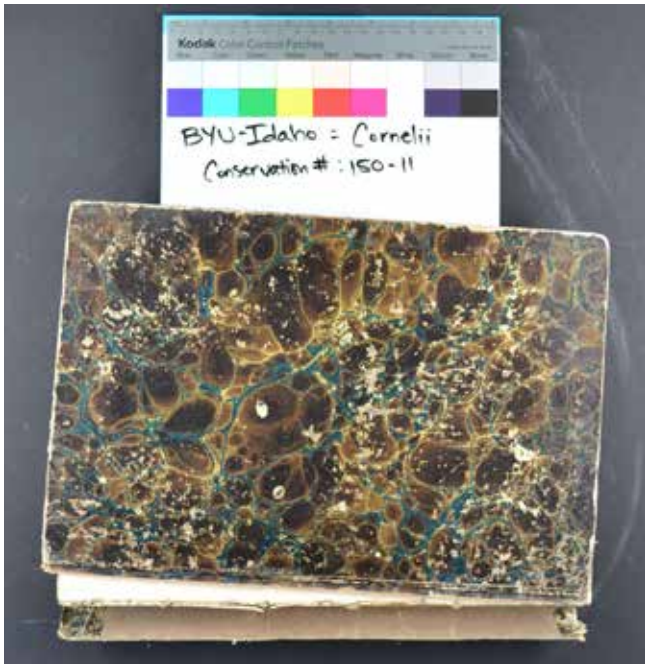
For Rhodes, this type of in-boards binding "is generally associated with England and America" (1995: 54). Generally speaking, *Cornelii* is the most typical type of in-boards binding as described by Rhodes, so its general association and the name Hirsch could easily lead to concluding that this binding is American.[6] Yet Rhodes does concede that while typical of America, this type of binding "is found on the continent of Europe as well" (54). With only this information, and knowing the ubiquitous nature of in-board binding in America as opposed to scant examples on the continent, it would appear that *Cornelii* is an American binding—especially given Hirsch's greater influence in the United States than in Europe. (The covering material for this book is a simple shell marbled paper; therefore, at this point, it is difficult to determine where this paper came from.)

Yet while *Cornelii's* structure is typical of other in-boards structures of the time, two aspects of this particular binding are not identified by other scholars as being either European or American. First, instead of one piece of thick paper wrapping around the spine and onto the inside of the cover boards, *Cornelii* has two pieces of thirty-millimeter-wide thin card: one card adhering to the inside of each cover board underneath the manuscript scrap. These cards do not extend across the spine, but only a few millimeters beyond the spine-side edge of the covers and look as though they originally curved up to fit into the 45° backing of the book. The strips are not the same material as the spine stiffener attached to the cover paper, and the manuscript scrap glued over them is not one piece of paper that extends over the spine either, but two separate pieces glued down on the inside of the cover boards before the decorative cover paper is turned in.

Two aspects of this particular binding are not identified by other scholars as being either European or American.

Unlike the in-boards bindings described by Rhodes as being "tight-to-spine", these thin card strips create a groove along the spine (Rhodes 1995: 53). The card strips seem to have protected the backed portion of the text block, applying pressure to the spine area to prevent future concaving—similar to the way a German lapped binding maintains the shape of its text block with its thick, paper-wrapped spine. In a German lapped binding, "the spine wrapper [stays] tight around the backbone and into the seat of the

joint of the shouldered text block. This molded fit is maintained through time by shelving pressure" (Frost 1982: 66). Essentially, the heavy spine-molded paper in a lapped construction maintains more pressure along the spine than the rest of the text block while shelved, which in turn keeps the spine in its original, rounded shape.[7] Although not proven, it is interesting to surmise that bookbinders understood how important it was to maintain shape and simply utilized this wrapping idea, evolving it to this small strip of card along the spine. It did not, however, prevent the cover boards from tearing away from the text block, as the only connections between the two are thin marbled paper and small cords.



***Cornelli* before conservation. Notice the covers have pulled away from the spine piece. Photograph used with permission.**

The second interesting aspect of this binding is the covering material, which consists of three parts: a piece of paper for the spine and separate pieces of paper for the front and back covers respectively. This three-part cover distinguishes itself from the lapped component and the Italian paper cover. Although the lapped binding's case is in three parts, the decorative paper on the outside is often all in one piece or three pieces with the spine paper different from the cover board paper. *Cornelii*'s decorative cover is separated, but the marbled paper is the same pattern, so it appears to be one whole piece of paper that is covering the boards [8]. This is most likely due to the covering process itself. Trying to cover an in-boards structure with just one piece of thin marbled paper would be difficult without tearing, especially with a fairly large book (*Cornelii* measures 12 x 9 ¼ inches closed).

Stylistically, a construction of three separate covering papers also lends itself to some rather artistic and beautiful possibilities while keeping to an in-boards binding technique. As a modern book-binder, I find the potential of these covers quite compelling. For this reason, I will conclude by listing the steps required to produce your own model or artistic rendition. Although this particular binding cannot be given an exact location/bindery or precise date of origin, it does offer a look at a different type of paper binding that adds depth, value, and history to the paper binding craft existing during the mid-nineteenth century.

STEP-BY-STEP GUIDELINE FOR CREATING A THREE-PART IN-BOARD PAPER BINDING

1. Cut pages large and fold into three folio gatherings. Endsheets are two folio sections, also cut large. Press overnight.
2. Once pressed, use a board shear to cut them to the desired size. *(Cornelii* was not ploughed.)
3. Sewing station holes
    a. Cut a piece of paper the same height as text block.
    b. Mark the kettle stitch about 7 millimeters in from the head and tail.
    c. Divide the rest of the spine area evenly between the kettle stitches. (*Cornelii* has five sewing stations.)
    d. Cut two pieces of binder's board to exactly the same size as the text block, sandwich the text block between the boards, and then use masking tape to keep all the folios together in line with each other.
    e. Fit the text block into a job backer or press.

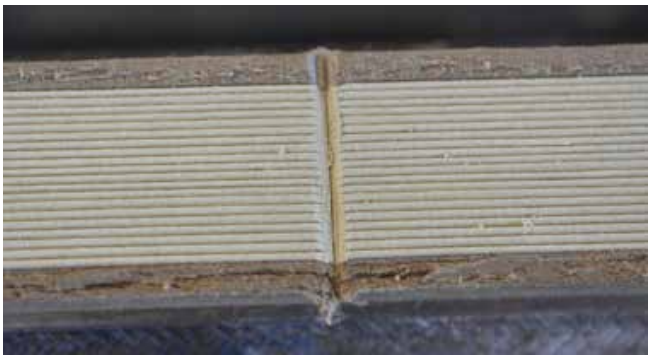
f. With a pencil, transfer the sewing station marks to the spine using a square.

g. Take a piece of the cord that will be used to reinforce the sewing (this cord is not thick, but actually quite small, only 2 to 4 millimeters in diameter) and with it mark the width the sewing station needs to be to accommodate the cord. Make this second set of marks towards the head side of your original marks.

Marking the sewing stations using the cord that will be sewn around

h. With a small saw (I prefer using a sharp scalpel), cut down into the text block at an angle on both sides of your sewing stations to create a triangular notch into the folds. You need to cut deep enough that all the folios within a section/gathering will have a hole and the cord will fit snuggly inside, while making sure that the spine will not have any bumps or grooves once lined. Head and tail kettle stitches do not require large, angled cuts, so the kettle stations can just be simply slit straight through to the inner folios.

Using a scalpel to cut into the textblock at an angle

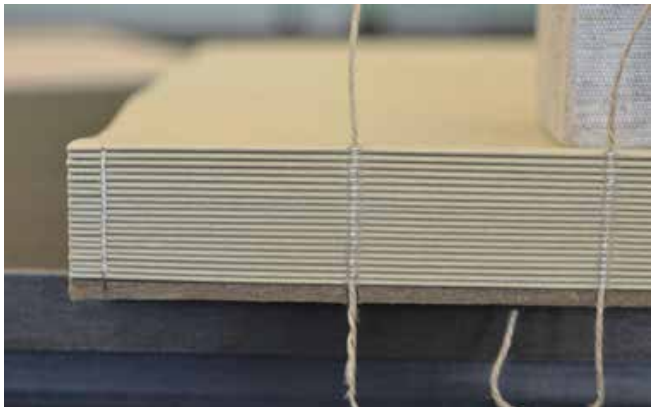


Finished look of the triangular notched sewing stations

4. Sewing

   a. Set up a sewing frame with cords.

   b. This sewing is simply out and over the cords and back in, with the usual kettle stitch at the head and tail. Round and back the text block to a 45° angle.



Sewing the textblock

5. As there are no endbands, simply line the text block with a piece of strong paper and wheat starch paste or gelatin.

6. Prepare boards

   a. Cut binder's board extra wide and to exact height desired (allowing for small squares) and then cut two thinner cards (Bristol or 10-point board) to the same height.

   b. Trim the thin cards to about 30 millimeters wide (*Cornelii's* cards were roughly this wide) and glue this to the inside of the cover boards—extending beyond the spine edge to cover the backed portion of the text block. My card extended approximately 4 millimeters. Press and let dry.

Thin 10-point card adhered to the inside cover boards near the spine

c. When dry, crease the thin board up to match the 45° angle of the backed signatures so that it is flush with the spine and backing. At this point, I like to pare and sand down the side of the thin card glued to the cover boards so that the spine area is not quite so bulky nor will the card cause deep creases, which can mar the text block pages in a noticeable manner. *Cornelii* was not pared or sanded, however, and you may choose to skip this step.

Thin card is folded up to fit the backing

7. Attach boards and text block

   a. Cords are frayed out so they lie flat.

   b. With a piece of waxed paper under the cords to protect the text block, fray out and glue the cords to the inside of the cover boards, over the thin card. The tip of the thin card and the tip of the backed text block should be flush. Weight and dry.

Cords are glued to the inside of the board

   c. Take two pieces of strong paper (I use handmade) with one side cut straight. Glue this paper to the inside of the cover boards, with the cut side along the spine, using PVA over the cords and thin card. Glue the board for this, not the handmade paper as this paper should be flush with the spine edge of the cover boards, but not glued on the other edge of the paper in a straight line. Once dry, you want to tear the non-adhered paper excess and sand smooth. At this point, trim the excess width of the board to the exact measurement you want for your fore edge square.

Handmade paper glued over the thin board and torn

8. Spine piece

   a. Cut a piece of thin 20-point card to exactly the width of the spine and the height of the boards. This is not the same thickness as the thin card strips, but thicker.

   b. Glue a small piece of thread on the head and tail of this spine piece to help mold the endcaps.

This is not original to *Cornelii—Cornelii's* endcaps were formed during the turn-in process by simply folding the excess turn-in paper over the text block— but endcaps are very difficult to form with paper, and this will make the turn-ins less likely to tear.

9. Cover pieces

   a. For the spine piece: cut decorative paper tall enough to allow for the length of the book plus turn-ins, and trim the width so the paper extends about 40 millimeters to each side of the spine.

   b. For the covers: cut decorative paper for the cover boards large enough to allow for turn-ins at the head, tail, and fore edge.

10. Attach the cover material

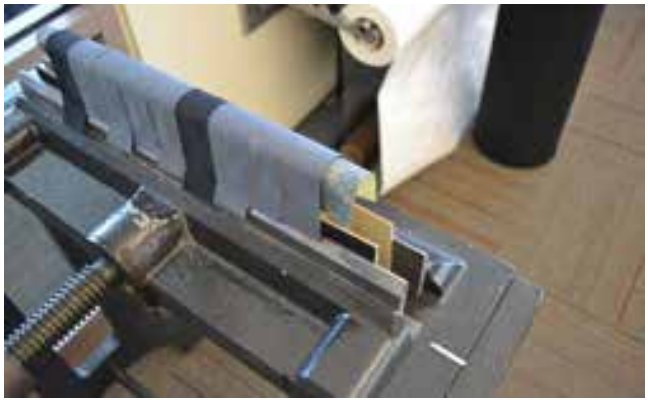
   a. Prepare the spine piece and attaching the spine to the binding

      i. Dampen the marbled paper and, with PVA, glue the thin-board spine piece/stiffener to the middle of the marbled paper. While damp, slightly round the spine to match the round on your text block. You want this round to be exact, as it is too difficult to pull the spine piece tightly onto the book when affixing the decorative paper cover if the spine piece is not precisely rounded. To shape the spine, place the spine piece onto the spine of the text block while still damp, wrap them tightly together with banding, and let dry. Velcro strips on a job backer work well to wrap and hold the spine piece to the text block.
      At this point, the spine piece is not adhered to the spine but will dry into the exact spine shape. Wrapping medical bandages is also an option during the drying process.

      ii. When dry, take the spine piece and glue out the paper up to but not onto the edges of the spine stiffener. Adhere it carefully to the grooves and covers of the book, and fold the turn-ins over the spine and onto the cover boards. I used a mix of wheat starch paste and PVA as I needed something with a little give and a little tack, but you can also use gelatin. Be careful not to tear the paper while working the endcaps. *Cornelii's* endcaps are not pretty, but a slight shaping does add quite a bit to the overall aesthetics of the binding,

      iii. Once everything is in place, use metal-edge boards to press and let dry. You want the groove to be very well defined, so if you don't have metal edges, you can either use knitting needles or cut some linen or cord, twist tight, lay it in the groove, and then press with boards. You can also use felt or thick padding to make sure the grooves are tightly in place.

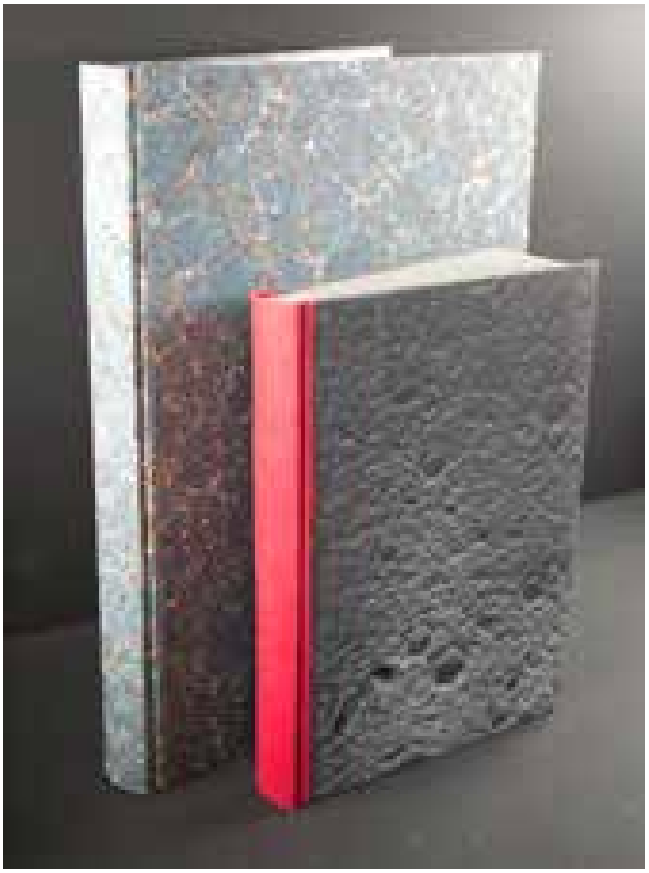
   b. Cover boards: Glue out the paper for the front and back boards with PVA. The cover paper is adhered to the boards only about two millimeters from the groove along the spine. Turn-in the heads and tails of each cover board before the fore edges.



Spine moldedusing Velco strips in a backing press

Molded spine piece and cover paper applied to cover

Once dry, the turn-ins are trimmed even across the head, tail, and fore edge on the inside of the covers and the pastedowns are finally glued down with the covers closed. Put the book in a press and let dry.



Finished bindings: marbled paper is Payhembury, red spine is Cave Paper, and moon paper is from Hook Pottery Paper

ACKNOWLEDGMENTS

Thanks to Laurie Francis, Special Collection, David O. McKay Library BYU–Idaho for her help and support. Thanks also to Christopher McAfee, Head of Conservation, Church History Library Salt Lake City, Utah, who designed the diagrams used in this article.

NOTES

1. The popularity of these two styles is most likely due to a 1982 article by Gary Frost that describes not only the historic import and structure of these two paper binding styles, but also points out clear reasons why they could be used as conservation bindings on books of roughly the same time period (Frost 1982: 64–67). Good, comparative explanations of the different types of paper bindings are given by both Barbara Rhodes (1995) and Michèle Valerie Cloonan (1991). Any interested readers can learn more about various paper bindings by turning to their work (see bibliography).

2. The full title of this volume is *P. Cornelii Taciti eq. Ro. Historia Augusta actionum diurnalium: additis quinque libris nouiter inuentis. / Andreae Alciati Mediolanensis in eundem annotationes. De situ, moribus et populis Germaniæ libellus, eodem Cor. Tacito auctore. Eiusdem dialogus: an sui seculi oratores antiquioribus, & quare concedant. Cn. Iulli Agricolæ uita, per eundem.* This particular book will be known as simply *Cornelii* for the rest of the article.

3. It is unknown if Hans Holbein did the illustration for this particular book or not. That being said, the woodcut borders and initials are quite good, and Froben understood the importance of finding skilled illustrators as a selling point for his print shops. Unfortunately, the first few pages of this text block were torn out (probably the best of the woodcuts, and most likely the images that would have been stylistically identifiable as being, or not being, Holbein's). There is, however, a printer's mark at the end of the text block that proves it is a Froben and was printed in Basel. For more information on Froben and the scholars and professionals that worked for him, see Earle Hilgert's article (Hilgert 1971: 141–69).

4. Referring to one type of paper binding, Rhodes states: "Of course, a text need not be bound in the country in which it was published. Other lapped component bindings in the survey were definitely French, Swiss, Italian, or Eastern European, so we can presume that there was at least some overlapping of national binding styles" (Rhodes 1995: 52). This being the case, it is just as likely that the original binding of this text block did not occur in Switzerland either.

5. Holly Green and Ron Anderson from BYU–Idaho and Donald Parry and his associates at BYU identified the writing as modern Hebrew/Yiddish. It is not suggested by the author that anyone should disassemble a book in search of information or evidence such as manuscript scrap. The manuscript was

found only because necessary conservation processes required the lifting of pastedowns. Per the request of the library, these manuscript items were then removed for photographing and further study.

6. Rhodes (1995: 54) uses percentages to determine the most common features in the collection she was working with. Most of the characteristics found on *Cornelii*'s binding were among the highest percentage of their type, so this was a typical book and similar to many in Rhodes's collection—if you don't factor in the unique spine strips and three-part cover.

7. If this unique feature can be proven to be an evolution from a lapped-component structure then it could lean more toward identifying this binding as having been created in Europe, close to Germany, against my above assumption that it is American. That said, I have observed more of a mixing of styles while conserving American bindings than European bindings, so a melding of in-boards and lapped component bindings would not be out of place in the United States. All of this would need further study to determine exactly how and where this unique feature came to be constructed.

8. In fact, two conservators I work with initially perceived it as a full piece of marbled paper, as I did myself. The three pieces were so carefully matched to look like one full piece that it succeeded in tricking the eye. Only when I started to look closely at the turn-ins to see if it was cased-in or in-boards did I suddenly feel that the cover board papers were overlapping the spine covering. I thought this odd and looked up Cloonan's information on decorative covers. She notes that many in-boards bindings did have one to three pieces of paper as the outside decoration, although the three-piece construction involved one color on the spine and another color on the cover boards, most likely with thicker paper along the spine to help prevent wear (Cloonan 1991: 10). Given how thin this marbled paper was, it was surprising to see it used on the spine where movement along the groove would quickly wear it away.

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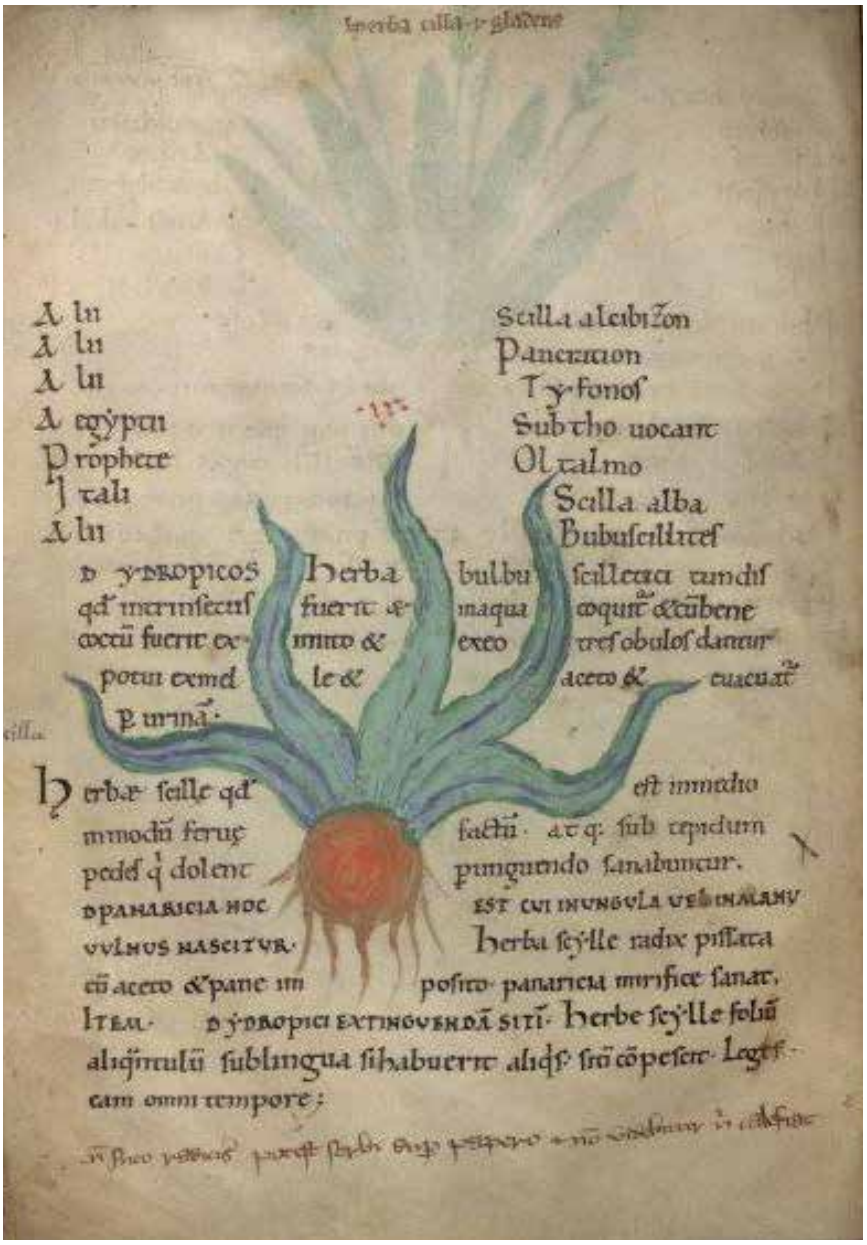


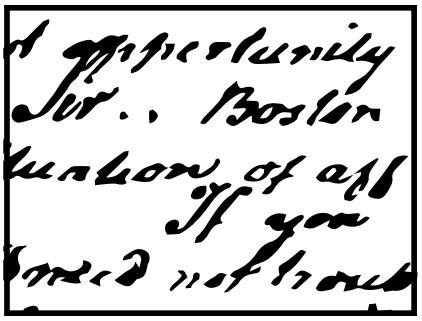
An illustration of a squill, the juice of which can be used as a heat-developed invisible ink. By permission of the Bodleian Library, Oxford.

Reading Between the Lines

The Colorful History of Invisible Ink

Barbara J. Rhodes

"reading between the lines" is an expression in common use, generally referring to the discernment of a hidden meaning, but few people today realize that the phrase actually stems from the practice of writing between the lines of an otherwise innocuous document with invisible ink. The popularity of the expression implies that the practice had to be pretty well known; certainly there were plenty of published recipes for invisible inks available. During my research some years ago on early document copying, it seemed that almost every collection of ink recipes I found included one or more for invisible ink, which was most often described as "sympathetic ink." This raised some questions, such as who was using these recipes and for what purpose? Was there that much secret correspondence going on?



Barbara Rhodes has served the American Museum of Natural History Library as conservator since June of 1987. Previously, she was Assistant Reference Librarian for Special Collections and Maps at Oklahoma State University's Edmon Low Library (1981–1984). Ms. Rhodes is a member of the American Institute for Conservation of Historic and Artistic Works. brhodes@amnh.org

Invisible inks are actually a part of a much larger picture. They have been an influence on, and been influenced by, important developments in chemistry from very early in its history, and even contributed to the invention of photography. They are also still very much in use in the commercial world, in the form of safety and reprintable papers, invisible product barcodes, and many other incarnations.

The term "sympathetic ink" refers to the old idea of chemical sympathies, in which compounds have an "affinity" for each other and can act on each other from a distance, without the connection necessarily being visible. This designation was first used in 1669[1] to describe an ink of lead acetate, which was revealed by exposing the written letters to sulfur fumes. The fumes were evolved by heating the pigment orpiment (arsenic sulfide) and quicklime (calcium oxide) in aqueous solution.[2] Once the name "sympathetic ink" was adopted, it was understood to refer to invisible ink until well into the twentieth century.

Of the hundreds of substances which have been used as invisible inks, there are six general types, categorized by their method of development (see Table I): reagent-developed inks, which react with other chemicals to form colored compounds; heat-developed inks, which include organic materials, acids, alkali, and numerous metal compounds; inks which develop color through exposure to light or air; inks which become visible when the paper is dipped in water; inks which sit on the surface of the paper and attract and hold particles of a colored substance, such as ash

Invisible Inks by Type (List is not exhaustive)						
SUBSTANCES USED	REAGENT-DEVELOPED	HEAT-DEVELOPED	LIGHT OR EXPOSURE-DEVELOPED	REVEALED BY WETTING THE PAPER	REVEALED BY POWDERING THE SURFACE	FLUORESCENT OR LUMINESCENT
ACIDS	citric, gallic, sulfuric, tannic	citric, gallic, hydrochloric, nitric, sulfuric, tannic		hydrochloric, nitric, and sulfuric		
ALKALI	potassium carbonate, sodium carbonate	potassium hydroxide, sodium hydroxide				
BODILY FLUIDS		blood serum, milk, urine		urine	milk, urine	bile, blood, saliva, urine
FRUIT AND VEGETABLE JUICES		apple, artichoke, cabbage, cherry, grape, leek, lemon, lime, onion, orange, pear, pomegranate, turnip, vinegar		lemon juice, vinegar	fig, flax stem, quince, spurge	
METAL SALTS	Salts of: antimony; arsenic; bismuth; cobalt; copper; gold; iron; iridium; lead; manganese; mercury; nickel; palladium; platinum; potassium; silver; tin; titanium; zinc	Salts of: arsenic; bismuth; cobalt; copper; iron; lead; mercury; nickel; potassium; sodium	copper nitrate, ferric chloride and nitrate, ferrous sulfate, gold chloride, iron acetate, mercury nitrate, oxal-molybdic acid, potassium iodide, silver nitrate, tin chloride and nitrate	alum, bismuth nitrate, cobalt chloride, ferrous sulfate, lead acetate	sodium chloride	barium sulfhydrate, calcium sulfide, uranium nitrate, zinc sulfide
OTHER COMPOUNDS		ammonium chloride		camphor in alcohol, linseed oil mixed with ammonia, paraffin in benzol	fat, grease, or tallow; gums, sugar	anthracene, esculin, phosphorus, pyramidon, quinine sulfate, salicylic acid
PH INDICATORS	anthocyanins, phenolphthalein					

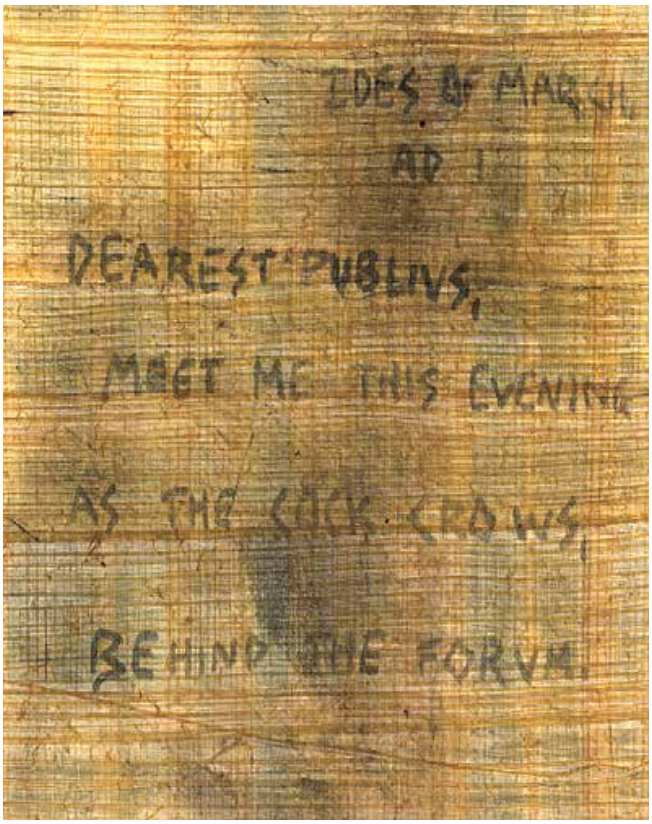
or dust; and finally, fluorescent and luminescent inks, which are revealed by exposure to light energy of various wavelengths. One further category might be added, that of radioactive inks (see, for example, Charles Pecher's patent for a "Means and Method for Transmitting Secret Intelligence," US Patent 2,407,381, issued in 1946). These emerged after the turn of the twentieth century, but as they were not available for other than military and espionage use, they will not be considered here. Their chief use today appears to be in the field of biochemistry (as described in lab manuals such as Holtzhauer 2006, 80).

INVISIBLE INKS HAVE BEEN IN USE for about as long as visible inks. The earliest known reference to invisible inks appears in the work of Philo of Byzantium, in the third century BC (Mackrackis 2009, 26).[3] His method involved writing on a new hat or on human skin with crushed gall nuts infused in water. The message could then be revealed with vitriol (iron or copper sulfate). In AD 1, the poet Ovid famously recommended the use of milk or flax juice to young women who wished to send a message to a lover (Naso 1877, 457). This passage appears in the *Art of Love*, Book 3, lines 627–631:

> *Tuta quoque est fallitque oculos e lacte recenti littera (carbonis puluere tange, leges), fallet et umiduli quae fiet acumine lini,ut ferat occultas pura tabella notas.*

This translates as "Letters, too, written in new milk, are safe and escape the eye; touch them with powdered coals, and you will read them. The writing, too, which is made with the stalk of wetted flax, will deceive, and the clean surface will bear the secret marks."

Pliny the Elder's *Natural History*, written in 77 AD, describes the use of tithymalus characias, a species of euphorbia, to be developed by the same method, though he also specifies that it be used on human skin (Pliny 1856, 177). The bearer of the message must have found it rather uncomfortable, as the juice of this plant is an irritant. The poet Ausonius, in a letter dated about the year 400, also recommends milk, but specifies that the recipient should bring out the writing by holding the papyrus to hot cinders (Ausonius 1919, 110): "Trace letters with milk: the papyrus as it dries



A message written in milk on modern papyrus, developed by dusting with ivory black pigment on a soft brush, shows what a letter written on papyrus in milk and brought out by carbon powder might look like.

will keep them ever invisible; yet with glowing embers the writing is brought to light." This is the earliest reference I could find to a heat-developed invisible ink.

In the tenth century, the Arabic poet and traveler Abu Dulaf described two forms of invisible writing used by marketplace tricksters (Bosworth 1976, 199). One is ammonium chloride (better known by the name "sal ammoniac"), developed by heat. This ink appears very easily with little heat, but if made too strong, it will quickly corrode the paper.

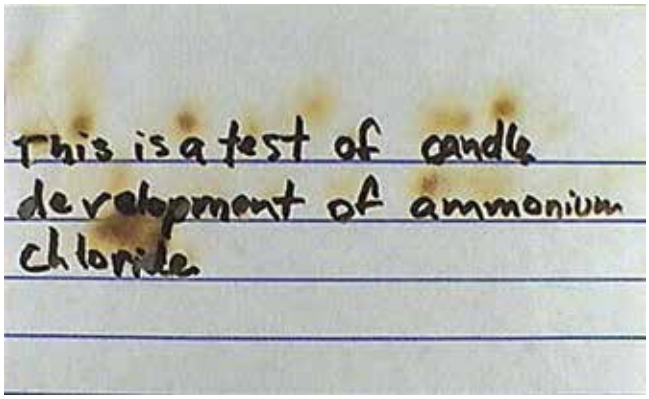
The second ink is a gall nut ink, developed with copper sulfate. There are also accounts of the use of alum as an invisible ink in China in the eleventh century (Needham 1985, 315). At the same time, organic materials such as plant juices were also known as invisible inks, as can be seen in an annotation to an eleventh century English manuscript owned by the Bodleian Library (see the frontispiece accompanying this article). This page of a book on herbal medicine

Invisible inks described in Giambattista della Porta's (1558) *Natural Magic*

SUBSTANCE	REVEALED BY
Alum or ferrous sulfate	Dipping in water
Ammonium chloride	Heat
Egg, obscured by black pigment	Scraping off the black to reveal the letters
Fat, milk, or fig juice	Powdering with coal dust or ash
Ferrous sulfate	Gallnut infusion
Glow-worm juice	Reading in the dark
Lead white and gum	Holding the paper to the light
Lemon juice	Lead acetate
Lemon or other fruit juice	Heat
Mercury with egg white and vinegar	Burning the paper
Vinegar or urine	Powdering with mill dust
Willow juice, putrefied	Reading in the dark

shows a red squill, with a brief annotation below, stating that it can be used as an invisible ink, to be brought out by heat (Dioscorides, Ms. Bodl. 130, fol. 5v.).

Early invisible inks in the West formed a category of "natural magic," which assumed that certain things had hidden powers to affect other things, and thus to produce various inexplicable phenomena. The concept was widespread until late in the sixteenth century, gradually giving way to "natural philosophy," as early scientists worked to explain everyday phenomena through observation and experimentation. Some of the early methods of invisible writing bordered on the fantastic; Francois Rabelais had some fun with this in Chapter 24 of his 1532 book *Pantagruel* (1890, 277–279), in which his hero must try many different methods of revealing the hidden words he believes he will find on the paper wrapping a diamond ring sent to him by a lady. He begins by testing the paper for some conventional invisible inks—ammonium chloride, tithymalus, and white onions.



Ammonium chloride ink, developed with the heat of a candle, showing lacing

> Then he rubbed one part of it with the oil of nuts, to see if it were written with the lee of a fig tree, and another part of it with the milk of a woman giving suck to her eldest daughter, to see if it was written with the blood of red toads, or green earth frogs. Afterwards he rubbed one corner with the ashes of a swallow's nest, to see if it were not written with the dew that is found within the herb alcakengy, called the winter cherry. He rubbed, after that, one end with ear-wax, to see if it were not written with the gall of a raven. Then did he dip it in vinegar, to try if it was not written with the juice of the garden spurge. After that he greased it with the fat of a bat or flittermouse, to see if it was not written with the sperm of a whale, which some call ambergris. Then put it fairly into a basin full of fresh water, and forthwith took it out, to see whether it was written with stone-alum (1890, 277–279).

The last item on the list, alum, was actually used by Mary Stewart to send secret messages from her captivity under Elizabeth I. But after all this effort on Pantagruel's part, it turns out that the message had been engraved on the ring itself.

BY THE LATE FIFTEENTH CENTURY, major works on "steganography," or "covered writing," began to appear. These books were primarily concerned with

cryptography, or codes, but usually included a few methods of hiding writing by means of invisible inks. The texts most often cited by later authors include Johannes Trithemius' *Polygraphiae*, published in Basel in 1518;[4] Jerome Cardan's *De Rerum Varietate*, 1557; and Gaspar Schott's *Schola Steganographica*, published in 1665. Of the early printed sources of invisible ink recipes, one of the most bountiful, as well as influential, is a book entitled *Magiae Naturalis,* published in 1558 by Giambattista della Porta, an entire chapter of which is devoted to secret means of communication. The invisible inks most commonly known in the sixteenth century constitute a selection of natural materials plus a few more sophisticated chemical substances. Porta's recommended inks are listed in Table 11. He also suggested the use of silver nitrate for secret communication, the message being written on the skin of the bearer.[5] *Natural Magick* was very widely read, and was quoted by a large number of other authors offering means of secret writing.

Around the same time we also start to see "books of secrets" published, which included both arcane and useful information. These books were intended sometimes for particular trades, and sometimes for a more general audience. Many of these compendia included invisible ink recipes. For example, in 1582, John Wecker published his *Eighteen Books of the Secrets of Art & Nature*, which went through more than sixty editions in four languages. Wecker gives the recipes for numerous invisible inks, which he attributes to famous authors such as Jerome Cardan, Antonio Mizaldo, and Albertus Magnus (Wecker 1661, 268–275).The latter was more associated with magic than with cryptography, giving, for example, the following recipes (Anon. 1560, 138): "To wryte letters or bylles, whiche be not readde but in the nyght. Take the gall of a snaile or milke of a sow, and put it to the fire or with water of a worm shining late." This is apparently the sort of recipe that inspired the satire of Rabelais.

As empirical methods of experimentation began to replace alchemy in the seventeenth century, many scientists, including Robert Boyle, still had an interest in invisible inks. Boyle's notes contain recipes for writing with orange juice or urine; his published works also describe experiments done with blood serum, with ferrous sulfate and galls, and with lead acetate and the sulfur fumes derived from the reaction of orpiment and quicklime (Shaw 1725: 38, 468). Invisible inks, which largely consisted of the same substances used in the previous century, were also to become an integral part of formal instruction in chemistry, as examples of particular types of chemical reactions. For example, the "book of fate" experiment, in which a secret message written in lead acetate ink is developed by sulfur fumes penetrating through the pages of a closed book to turn the letters a dark brown, was first published in the late seventeenth century. By the middle of the eighteenth century, this phenomenon had gone from being described as a "magnetic water acting at a distance" (Beckmann 1797, 175–176, see endnote 2) to an example of the penetration of vapor through a porous material. Mr. l'Abbe Nollet, a member of both the French and English Royal Societies, describes the experiment in his *Lectures on Experimental Philosophy*, following it with this comment (Nollet 1748, 74–75):

> Since all occult qualities, are banished out of natural philosophy, by which an answer could be given to every thing, but which in reality gave a reason for nothing, to any one that desired clear and distinct ideas; we must no longer admit *Sympathy* and *Antipathy* as causes of any phaenomenon, unless we take these words by way of abbreviation, for the mechanical action of one body upon another.

Books of secrets remained popular, though the focus began to shift from merely useful information to instructive recreations. A fairly typical book of this kind is William Leybourne's *Pleasure with Profit: Consisting of Recreations of Divers Kinds* (1694, 13), which includes recipes for three types of invisible inks: ammonium chloride or lemon juice (heat-developed), alum (dipping the paper in water), and urine or milk (brought out with ashes or dust). John White's *A Rich Cabinet, with a Variety of Inventions*, first printed in 1651, and reprinted eight times during the seventeenth century, gives this advice to those who would write secret love letters (White 1668, 32):

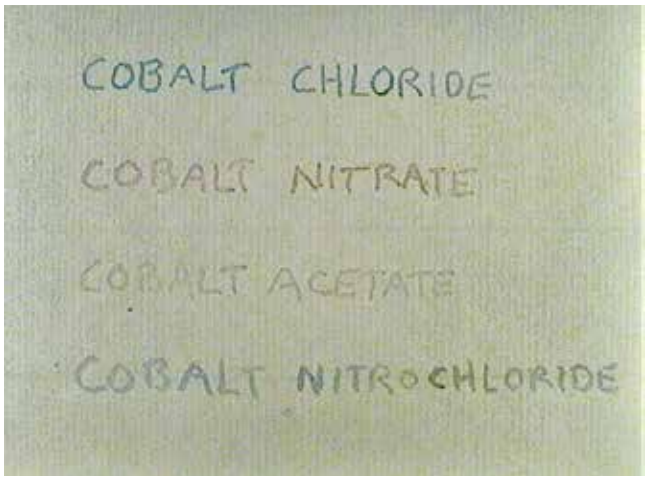
> Write a letter (what you please) on one side of paper with common ink, then turn your paper, and write on the other side with milk, (that

> which you would have secret) and let it dry; (but this must be done with a clean pen:) Now when you would read it, hold that side which is written with ink to the fire, and the likely letters will then shew blewish on the other side, which may be perfectly discerned."

Another popular method for writing secretly, first published in Schott's *Schola Steganographica* but now presented to the general public, was to write with very diluted common ink on clean paper, and when the writing was dry, write an innocent text over the invisible one using gunpowder mixed with water. To read the secret message, one had to wash off the gunpowder ink with a gallnut solution, which would simultaneously darken the secret message (Snow 1703, 228).

The culture of letter writing was another factor in seventeenth-century (and later) invisible ink use. Aside from the issue of postal censorship (correspondence was not safe from official eyes looking for evidence of sedition), it was considered polite to be discreet when communicating sensitive matters to one's friends. Several manuals for letter writers from this period state flatly that secrecy is a characteristic of good breeding, and of great importance to society. For this purpose, some of them included instructions for invisible writing, generally with simple organic inks (Bannet 2005, 264–265).

IN THE EIGHTEENTH CENTURY, the trend toward useful instruction was channeled into what became known as "rational" or "philosophical" recreations. Books of experiments for the educated amateur became very common. In 1747, Jean-Jacques Rousseau, inspired by a book of this sort, decided to try making the lead acetate ink mentioned previously. Unfortunately, the developing solution blew up in his face, and he was not only sickened by the arsenic sulfide but temporarily blinded as well (Rousseau 1953, 209).[6] I would like to take this opportunity to remind the reader that some of the chemicals, particularly some of the metal salts, used in making invisible inks are quite poisonous, if not all potentially explosive. So, please, proceed with caution, and don't try this one at home. Lead acetate ink (itself very poisonous) can be developed with a solution of either potassium or ammonium sulfate, which stink mightily, but are not nearly so dangerous as the orpiment and quicklime method.



The four most commonly used cobalt inks—cobalt acetate, chloride, nitrate, and nitrochloride—showing their characteristic colors of purple, blue-green, pink, and blue, when developed by heat.

A new type of sympathetic ink which became extremely popular as a chemical plaything was cobalt chloride ink, first described in 1737 by Jean Hellot, a chemist and dyer (Hellot 1737, 104).[7] This ink, which is made from a water-soluble deliquescent salt, is able to appear and disappear simply by being heated or cooled. When the salt is in its humid state, it is red, and when the moisture has been driven off by heat, it is blue. This makes it possible to return a message to its invisible state simply by breathing on it. Cobalt chloride ink is actually a faint pink; authors recommending its use often specified that a pinkish, or at least not-too-white paper be used for the message.

By the end of the century, cobalt acetate ink had been introduced, followed shortly by cobalt nitrate ink. It is their color-shifting property which later made cobalt salts useful for humidity indicators, including the salt cards used today. Cobalt inks can also be modified to produce different tints (using sodium chloride or potassium nitrate, for example), which allowed them to be used for painting the popular "chemical landscapes." Landscape scenes would be drawn in black ink, and then painted with cobalt inks; when exposed to a heat source, the scene would change from winter to spring. Erasmus Darwin (grandfather of Charles) was so taken with this transformation that he featured it in his poem, *The Botanic Garden* in 1791 (Darwin 1791, 56):

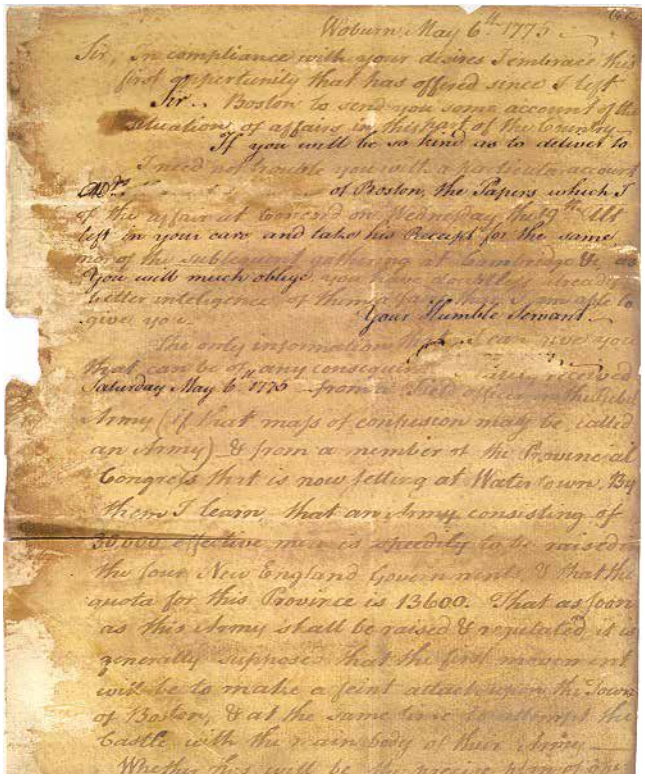
Thus with hermetic art the adept combines
The royal acid with cobaltic mines;
Marks with quick pen, in lines unseen portrayed,
The blushing mead, green dell, and dusky glade;
Shades with pellucid clouds the tintless field,
And all the future group exists conceal'd;
Till waked by fire the dawning tablet glows,
Green springs the herb, the purple floret blows,
Hills, vales, and woods, in bright succession rise,
And all the living landscape charms the eyes.

The "royal acid" mentioned above is "aqua regia," a mixture of hydrochloric and nitric acids.

One other invisible ink displays the property of appearing and disappearing when heated and cooled: copper chloride, introduced in the nineteenth century (see Gillet-Laumont 1802), was often used in conjunction with cobalt inks for magic pictures, as it produces a rather nice yellow color. It can be made easily with equal portions of copper sulfate and ammonium chloride.

Perhaps the most comprehensive eighteenth-century experiments on sympathetic inks were conducted by Dr. Luigi Brugnatelli, an Italian chemist. In an extensive article that appeared in *The Italian Mercury* (1789), he detailed his work with various metallic salts, including those of bismuth, mercury, lead, gold, silver, and copper. A discovery of Brugnatelli's, which was to become important to the development of safety papers (which reveal any attempts at alteration of the inks used for writing on them; see below), was the reaction of potassium ferrocyanide with chlorine to produce a greenish blue color (1789, 66–67). Impregnation of a paper with potassium ferrocyanide will alter the color of iron-gall inks to a blue-black, as well as indicate any attempts to eradicate or alter the writing with bleach.

Tin chloride ink, on an alkaline paper, developed by spraying with a solution of cochineal.



A Revolutionary War letter, written by Benjamin Thompson in 1775, from the collection of the Clements Library; it was written in a gallnut solution and developed by washing over with ferrous sulfate. By permission of the William L. Clements Library, University of Michigan.

As the science of chemistry progressed, many chemists were interested in finding commercially important compounds such as dye mordants, accurate reagents for testing, and pH indicators. Experiments along these lines often produced colored reaction products, so occasionally a new invisible ink was born. One of the best examples of this crossover is tin chloride, used as a mordant for dyeing textiles, which appears in a number of sources as an ink to be revealed by dyewoods or cochineal (for example, in the entry on inks in volume 11 of the *Encyclopaedia Londinensis* [1812, 66]). It was also used as a developer for gold chloride ink, forming the dye known as Purple of Cassius. Gold chloride will appear of its own accord on exposure to light, but is instantly brought out by the tin compound.

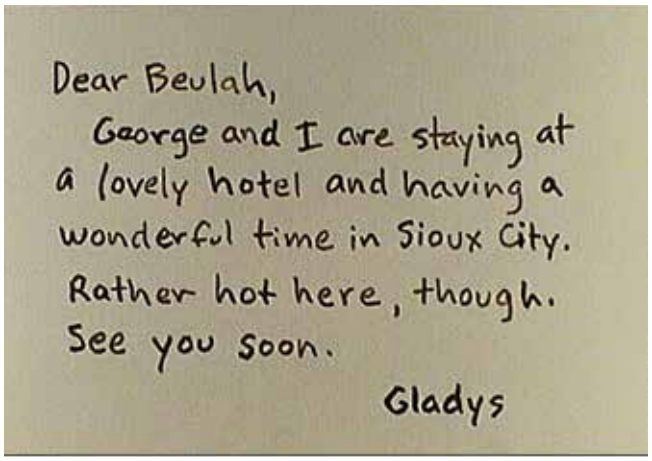
Some of the best-known eighteenth-century American uses of invisible ink took place during the

Revolutionary War. A letter written by Benjamin Thompson in 1775 shows writing between its lines in what has been determined to be a gallnut solution, developed by ferrous sulfate (Brown and Stein 1950, 631). The small amount of writing in the darker-looking letters is actually the cover message; the invisible message constitutes the bulk of the text. The sheet is discolored overall, partly because the ferrous sulfate has darkened over time.

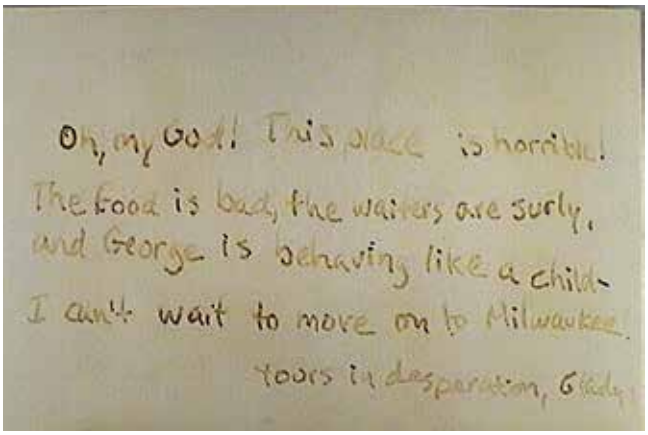
The other side used invisible inks as well, of course. Edward Bancroft, private secretary to Benjamin Franklin, acted as a double agent for the British, submitting reports written in what he called "white ink," which he rolled up and hid in the hollow of a tree to be picked up by his contacts (Rae 2011). This is the same Edward Bancroft who wrote *Experimental Researches Concerning the Philosophy of Permanent Colors* (Bancroft 1814). John Andre, also a spy for the British, would write the letter "A" or "F" in an upper corner of his letters which contained invisible ink, signifying either "Acid" or "Fire," *i.e.* reagent or heat development (Spy letters, 1999).

INVISIBLE INKS BECOME increasingly technical during the nineteenth century, but they were no less popular. General interest and scientific magazines, pharmacists' and other trade journals, domestic encyclopedias, and general encyclopedias routinely included sympathetic ink recipes. Books of "chemical recreations" also continued the legacy of the previous century. One of the most widely known and most influential of these was Fredrick Accum's *Chemical Amusement*, published in 1817. It describes in the preface (iv) how to perform tricks with a number of the popular invisible inks of the day, and then explains the chemical mechanisms of each one, "that the experiments may be of greater value than merely to afford amusement for a leisure hour." Numerous chemistry instruction books, such as John's *Elements of Chemistry*, included descriptions of various invisible inks, such as ferrous sulfate, potassium ferrocyanide, cobalt chloride, lead acetate, and bismuth acetate, in a chapter on metals (Webster 1811, 176–190).

In a more popular scientific vein, the first volume of *Scientific American* (1845) featured an article on "Sympathetic inks for secret correspondence," in a column entitled "Interesting Experiments." It



A postcard with an innocent-looking message, written in an ink made from starch and iodine. This formula was often used for disappearing inks as well, as the iodine will sublimate off over time, and the ink lose its color. This process is hastened by heat, which develops the underlying message.



The same postcard with the hidden message, written in sulfuric acid, developed by heat.

described seven inks: ammonium chloride, developed by heat; ferrous sulfate, developed by an infusion of nut-galls; a solution of galls, developed by ferrous sulfate; potassium subcarbonate,[8] developed with iron sulfate; copper sulfate, developed by potassium ferrocyanide; sodium bicarbonate, developed with copper sulfate; and silver nitrate, written with in the dark, and exposed to light to bring out the letters (1845, 2).

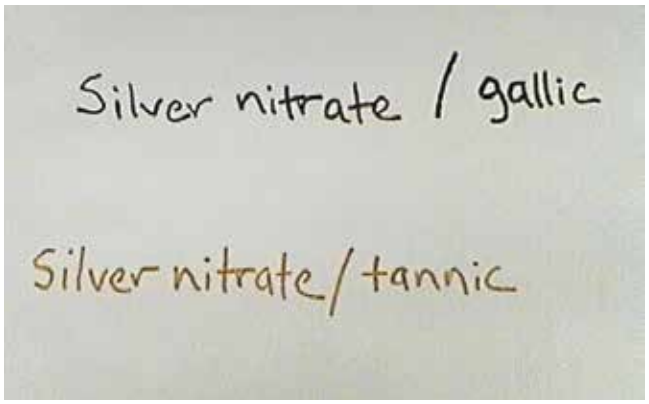
There were more practical uses of invisible inks for the general public, however. Thrifty letter writers, including Thomas Carlyle and his family, often wrote short messages with these inks in the margins or on the wrappers of newspapers and sent them in lieu of an actual letter, as letters had a higher postage rate. In September of 1834, Carlyle wrote to his mother, "The Newspaper comes regularly on Friday about noon;

and on Saturday I as regularly forward it to Alick, who will thus find it waiting for him on Monday. Tell Jean, she must not again write on it *with so coarse a pen*, lest they detect us, and come out with their fine of fifty pounds!"[9] Post offices in Europe and America were aware of this practice, however, and were on the lookout for suspicious papers, as may be seen in this small notice from an 1837 magazine: "Several prosecutions are now in progress for writing on newspapers. A person in Ireland has lately been fined 2l. 18s. 2d. for writing to his brother in England on the corner of a newspaper, with invisible ink" (Several Prosecutions 1837, 378).

Postcards, introduced in the late 1860s, made some writers nervous about who might be reading their correspondence, and provided the impetus for some new permutations of invisible communication. As it would appear strange to send a postcard with no message on it, by the 1880s, correspondents could write an invisible message with sulfuric acid, then write an innocuous message over it with an ink made of iodine and starch, which forms a blue compound. When heated, the iodine writing would disappear, and the sulfuric acid writing develop. Unfortunately, it would probably now be difficult to read an old postcard written in this manner, as the acid would eat into the substrate, and the iodine compound would eventually sublimate out of the letters in the open writing.[10]

The science of photography owes a lot to sympathetic inks, specifically as regards the concept of the development of a latent image, but also as to the selection of chemicals for experimentation. In 1737 (104), Hellot had suggested that silver nitrate could be used as an invisible ink, and as R. D. Wood points out in his paper, "The Daguerreotype and the Development of the Latent Image," the concept of invisible writing would have been very familiar to the scientists who did the first experimental photographic work, particularly with silver nitrate and gallic acid (1996, 165–167).

Mercury compounds would also have been familiar as invisible inks at the time of the birth of photography, having been mentioned by Hellot in the same article (1737, 105), and also having enjoyed a bit of a vogue in the early nineteenth century. Iodine, discovered in 1811, was in use as a developer for invisible ink made of starch by the late 1820s (Sympathetic Ink 1827, 401).[11] As the art progressed, photographic chemicals became the inspiration for a number of invisible inks. The list of chemicals associated with both photography and invisible writing is rather extensive, and includes but is not limited to ferric chloride and other iron salts; gallic acid; gold chloride; mercuric chloride; potassium bromide, ferrocyanide, iodide, and thiocyanate; pyrogallol; silver nitrate; sodium chloride and thiosulfate; and tannic acid.



Some typical reaction products of silver nitrate ink developed by gallic and tannic acids. The gallic acid produces a blacker reaction product, which made it more useful for photographic purposes.

There is a largely forgotten photographic trick, which was widely published from the 1860s until well into the twentieth century, which also owes something to invisible writing—i.e., "magic photographs" (see Harrison 1888, 93, for a brief description). These were made by producing a photographic print in the normal way and then bleaching the image with a solution of bichloride of mercury. The image was still present but now consisted of a colorless salt of mercury and silver. The picture could be made to reappear by the application of "hypo" (sodium hyposulfite). A version of this method was used for transporting forbidden photographic and cinematographic images in the early twentieth century, as reported by H. O. Nolan of Riverbank Laboratories (which was established in 1918 for the purpose of decrypting enemy codes). In that same year, Nolan published a similar method for hiding written messages.

> For writing. – Paper of good quality is soaked in 5 per cent aqueous solution of potassium bromide, dabbed off with blotting paper, and dried. On this message is written with a 2 per cent solution of silver nitrate, using a gold or

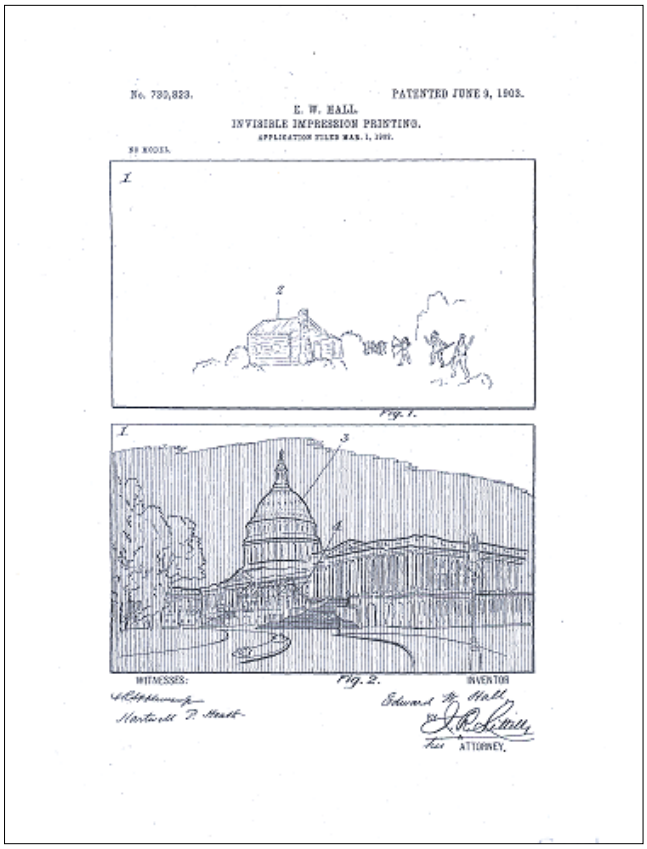
> glass pen and working in a dim light. When dry, the writing is exposed for a short time to a bright light. It is better to give it a rinse in distilled water before this operation. Fix in a weak hypo for five minutes, and rinse thoroughly. On drying, there must be no sign of the writing visible. Develop with the physical developer given above. (Nolan 1918, 15).

The "physical developer" consists of a mixture of mercuric bromide, sodium sulfite, and Amidol.

EARLY IN THE FIRST WORLD WAR, agents on both sides were still using lemon juice, potassium ferrocyanide and other invisible inks that had been known for centuries, and, not surprisingly, they were getting caught. One common ink detection method used on suspect letters was called "striping," with brushes dipped in various developing chemicals (The Codebreakers 1968, 122). If a stripe drawn across the surface of a document revealed a line of invisible writing, then the rest could be developed and read.

As detection methods became known, new inks were formulated to thwart them. By the end of the war, new categories of invisible inks had been added to the list, such as inks readable by non-visible light spectra and pH-sensitive reagent inks. Two of the best known are quinine sulfate, which fluoresces in ultraviolet light, and phenolphthalein, which is clear but becomes a bright dark pink when treated with alkali. The latter had been known since around 1900, though mostly through pharmaceutical journals (it's a laxative) until the war. World War I documents containing information about invisible inks were until very recently still considered "classified" by the CIA. Several of these documents are now available at the National Archives website. It is difficult to see what all the fuss was about, as the same information is available in Nolan's 1918 booklet and any number of other published sources.

During World War I, iodine fuming became the first "universal developer" of invisible writing.[11] This method consists of suspending a document over iodine crystals in a sealed chamber, then gently heating the iodine until it sublimates and deposits on the surface of the paper. The iodine tends to settle mostly on areas where the fibers have been disturbed by writing, and it reacts with the starch in the paper


No. 730,823. PATENTED JUNE 9, 1903.

E. W. HALL.

INVISIBLE IMPRESSION PRINTING.

APPLICATION FILED MAR. 1, 1901.

NO MODEL.

Fig. 1.

Fig. 2.

WITNESSES: INVENTOR

ATTORNEY.

E. W. Hall's 1903 patent for printing postcards with invisible ink images.

to bring out the letters. Iodine and potassium iodide are still the chemicals of choice for quick identification of counterfeit money, and are available in several brands of "counterfeit detector pens," which can be purchased at stationery stores. If a mark made with the pen turns dark, the bill can be presumed to be a counterfeit, as most world currencies are not printed on paper containing starch. Silver nitrate, which reacts with many of the chemicals used in invisible writing, also came into use as a developer around the same time.

World War II saw the use of a wide variety of secret inks. The British Special Operations Executive, charged with espionage, sabotage, and reconnaissance, taught its operatives to use 159 different invisible inks (a total of 70 substances were used, with multiple means of development for many of them). Sixty-eight of the invisible inks recommended could be detected by the use of ultraviolet light. I have not tested all of the materials in this category, but it includes inks made with egg white, eosine, onion juice, mucilage, petroleum jelly, pyrogallol, lactic acid, gum arabic,

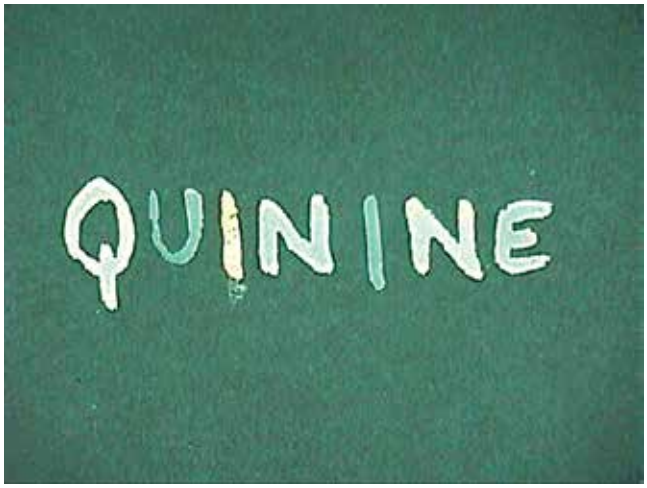
fuchsin, potassium hydroxide, oxalic acid, and salts of cobalt, copper, gold, iron, lead, manganese, mercury, nickel, and zinc (*How to Be a Spy* 2001, 2004).

By the time of the Cold War, complex methods of invisible writing such as ink-impregnated transfer papers, photographic methods, and inks visible only by x-ray were favored except in cases of emergency. An article by Kristie Macrakis (2009b) in *Chemical Heritage* magazine describes the use by the East German secret police of cerium oxalate, which required a three-part developer system.

Meanwhile, back in everyday life, invisible inks were being used to print invisible picture postcards, games, teaching devices, and eventually electoral ballot verification systems. The behaviorist B. F. Skinner, who had several inventions to his name, held patents (granted between 1968 and 1972) for five teaching devices that used invisible ink as a method of instant reinforcement.[12] These days, one can buy invisible ink from a large number of sources; the vast majority of this ink is of the fluorescent variety. Invisible ink computer printer cartridges are available on the internet, as are instructions for filling cartridges with lemon juice. Those who are interested in making their own fluorescent inks might like to try tonic water (which contains quinine), detergents with optical brighteners, or vitamin A. The last is oil-soluble rather than water-soluble, so one needs to modify the late nineteenth-century linseed oil and ammonia formula[13] as follows: mix together one drop of oil from a vitamin A capsule, 20 drops of ammonia, and 100 drops of distilled water. This will tend to separate, so the mixture must be shaken before every dip of the pen; it produces writing that fluoresces bright yellow.

ONE OF THE MODERN INCARNATIONS of invisible media consists of inks deposited on the paper in the form of dye-filled microcapsules that are colorless until heated to a certain temperature. Most will return to a colorless state when cooled. Some forms of copying and printing papers now make use of thermochromic inks known as leuco dyes, which were first introduced in the 1970s. One use of leuco dyes which might be familiar is in mood rings, but they are also more usefully employed in flat thermometer strips.

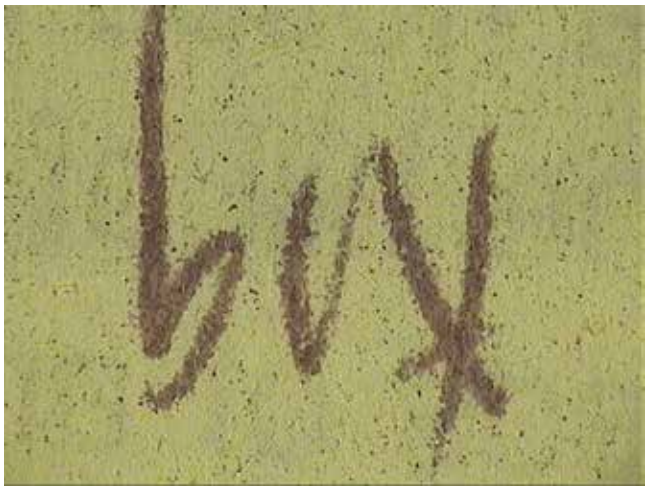
Papers treated with thermochromic chemicals, which are used for thermal printers, have also been on the market for some time. One example of this type of paper is impregnated with a solid mixture of a fluoran dye with a heat-sensitive acid. When the printer selectively heats the paper surface, the acid is melted, the dye undergoes a chemical reaction in the liquid phase, and assumes its colored form in the shape of the printed characters. The most familiar uses of this type of paper are in thermal fax machines and cash register receipts.



Letters written with quinine sulfate under shortwave UV light (312 nm.)

Unfortunately, exposure to ultraviolet light, solvents, and high temperatures can reduce the lifespan of leuco dyes. Records on thermochromic papers slowly fade out over time, but, far from considering this a disadvantage, some manufacturers are actually making use of this characteristic and enhancing it. An inkless printer called the PrePeat uses a rewritable sheet made of PET film and coated with leuco dyes. This product is intended for printing information that will only be temporarily useful, as the dyes return to their colorless state after 24 hours.[14]

A close relative of the thermochromic papers, in that it incorporates dye components deposited on its surface in microencapsulated form, is carbonless copy paper, also known as "NCR," or "no carbon required" paper. These papers, which appeared in the late 1960s,[15] mostly work as a two-part system, with the top sheet of the copy form being coated on the verso with dye capsules, and the copy sheet being coated on the recto with either the dye capsule or a reactive clay substance. When the user writes on the top sheet, the pressure of the pen bursts the microcapsules, and the

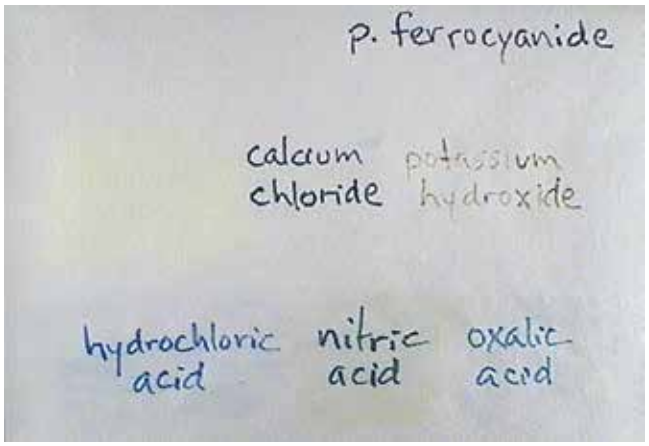


The word "box" as it appears on the copy sheet of a carbonless copy form. Note that the microcapsules of ink are broken easily enough to create random dots on the surface.

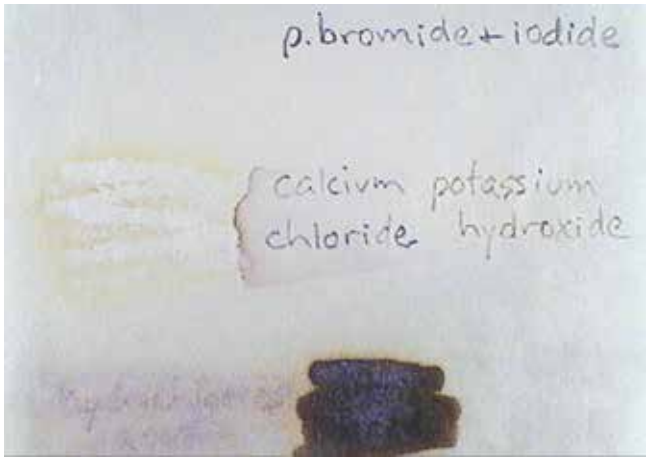
dye components react with each other to form colored compounds. Typical carbonless copies are made up of many dots of color, formed from invisible ink components as the user writes.

Methods for removing writings in iron gall ink have, over the centuries, involved acids, alkali, and bleach; for restoring the legibility of faded writings, the chemicals of choice have been gallnut solutions and potassium ferrocyanide. These are directly related to invisible inks. Some recipes for secret communication suggest erasing iron gall ink writing with either an acid or an alkali, then bringing it back with an alkali or an acid.[16] Either combination results in a rusty red appearance to the writing.

Early safety papers took advantage of these known chemical reactions in order to foil attempts to alter writing on legal and business documents. One of the first patents for a safety writing paper was granted in 1817 (Tigere 1858, 22–23);[17] the treatment consisted of adding potassium ferrocyanide to the paper before sizing, as it reacts with acids and bleach to form colored products. This paper apparently saw commercial production; it is described by Robert Barclay (1860) as being used by some London banks. Barclay based his own process for patent safety paper partly on Tigere's work, using both potassium ferrocyanide and manganese ferrocyanide, mordanting the potassium compound with aluminum acetate to prevent formation of Prussian blue during treatment of the paper pulp (1860, 313).[18] By the 1850s, the reactive



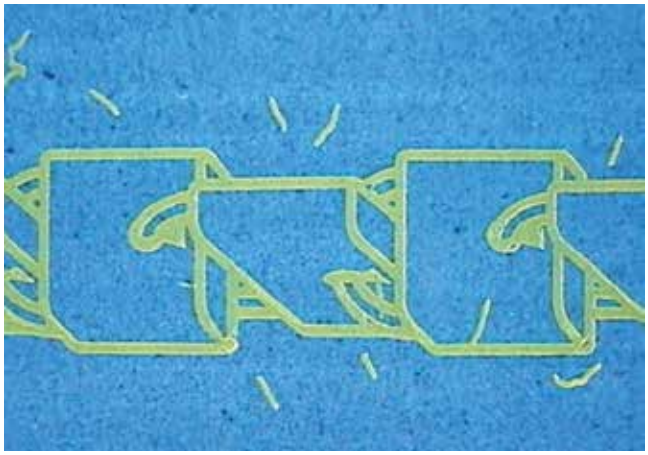
Ruscomb Mill Queen Anne paper, surface-treated with potassium ferrocyanide, showing attempts to remove fresh iron gall ink with acids, bleach, potassium hydroxide and calcium chloride, a common cleaning solution often suggested for removal of ink stains.



Ruscomb Mill Queen Anne paper, surface-treated with a mixture of potassium bromide and iodide, showing the results of the same ink removal attempts as above.

chemicals used had begun to include alkaline iodides and bromides; these chemicals, as well as potassium ferrocyanide, are still used in the manufacture of safety papers. Shortly after the Civil War, John M. Sturgeon (1868) patented an "improvement in postage stamps," which featured printing in invisible ink, and was intended to prevent removal of the stamps with water for fraudulent reuse. This printing could be done on the face of the stamp in an ink containing tannic and gallic acids and ferrous sulfate, which, when wet, would show the word "cancelled."

Many modern safety papers used for checks and other documents are still chemically treated to resist alteration of any writing done on them. One security paper patent from the year 2000 specifies,



A modern safety paper printed with inks visible only under shortwave ultraviolet light. UV-reflective fibers in the paper are also visible.

as a chemical protective measure, the combination of a metallic mordant with dyes in the paper pulp (Rittenhouse, 2000). When the materials in the pulp that isolate the mordant from the dye are dissolved by an attempted erasure, a colored reaction product forms. This patent lists ferric chloride and tannic acid as one of its preferred dye and mordant combinations (Rittenhouse 2000, 4).

Chemical treatment is just one of many layers of protection, from inks responsive to specific wavelengths of light, to microprinting, to color-shifting inks, thermochromic inks, coin-rub inks, and so on. These measures can be found not only on legal and financial instruments but also on doctors' prescription

Invisible Inks Tested and Their Approximate pH Values

Alum	3.5	Nickel nitrate	5
Ammonium chloride	5.5	Nitric acid	0
Bismuth nitrate	1	Onion juice	5
Camphor in alcohol	5	Phenolphthalein	5.5
Cobalt acetate	7	Potassium carbonate	11
Cobalt chloride	5	Potassium chromate	8.5
Cobalt nitrate	5	Potassium dichromate	4
Copper bromide	4	Potassium ferrocyanide	7
Copper chloride	4.4	Potassium hydroxide	14
Copper nitrate	4.2	Potassium iodide	5.5
Copper sulfate	4.4	Potassium nitrate	5.3
Ferric chloride	2	Potassium thiocyanate	5.3
Ferrous sulfate	3	Saliva	7
Fluorescein	6	Silver nitrate	4.5
Gallic acid	2	Sodium chloride	11
Gold chloride	3	Sodium hydroxide	14
Hydrochloric acid	0	Sodium thiosulphate	6
Lead acetate	5.5	Starch	5.5
Lead nitrate	4.5	Sulfuric acid	0
Lemon juice	3	Tannic acid	3
Linseed oil/ammonia	11	Tin chloride	2
Milk	7	Urine	7
Nickel chloride	5	Vinegar	2

papers, certificates and diplomas, and business documents that require authentication.

MANY PUBLISHED INK RECIPES, regardless of type, do not contain very specific instructions. There is also an inherent variability in the strength of early inks, which were not made from refined chemicals. As it was not possible to account for every conceivable variation, in my own experiments I tried to use solutions of consistent strength, with reagent grade chemicals. Each ink was tested to determine its pH (see Table III), as this can be a very important factor in how an ink will interact with the paper substrate, especially over time. Most of them fell into the mildly acidic range, though there were some which were strongly acidic, and some which were alkaline.

Paper itself is significant in the performance of any writing ink, and invisible inks are no exception. Papers used for writing with invisible ink must have the following characteristics: they must not have a surface coating which will show the use of liquids; they must not allow the ink to spread; and they must not have fillers or other components which will interact chemically with the ink chosen. For instance, one should not write an invisible message on an alkaline paper using gallic acid, as it will soon become visible.

Writing with invisible inks also requires some specific characteristics from the implement chosen. It must be smooth and somewhat blunt, so as not to scratch the paper; it must not impart any color to the ink (as can happen with a steel pen); and it should be something which would have an innocent explanation if found among one's possessions. Historic invisible ink instructions generally specify a quill, or a gold or glass pen. For the modern experimenter, round wooden toothpicks work reasonably well, and give a consistent result with water-based inks.

THE MOST DETAILED AND PRACTICAL set of instructions for detection of invisible messages are provided by H. O. Nolan (1918, 6–11, 15). The list includes examining the quality, weight, and surface characteristics of the paper to determine if it has been resized or otherwise altered overall; use of raking and transmitted light; taking photographs (including contact prints) and x-rays of suspect documents; and finally, using heat or chemicals to make the writing appear.[19]

Ultraviolet light has been used for the detection of invisible writing since the first decade of the twentieth century, and it is a very effective method. Most of the inks I tested were indeed detectable by UV (some only by the short wavelength of 254 nm) or other light source; though it didn't work as well for alum, ammonium chloride, and some of the organic inks. Inks with a metallic component all showed up well using this method. The chemicals used in forensic examination, iodine (applied by fuming) and silver nitrate (applied in solution), also worked well for the most part, but are not really nondestructive. Though iodine will sublimate off, and can be decolorized by various chemicals such as sodium thiosulfate and weak vegetable acids, this is still on the harsh and invasive side. Solutions containing sulfur, or just sulfur fumes, will also develop most of the metallic inks.

There are a number of other nondestructive technologies that might be of use in detecting invisible inks, including Raman spectroscopy, confocal microscopy, and FTIR (Fourier transform infrared spectroscopy). These are already in use in modern forensic laboratories for the examination of questioned documents. I have not had the opportunity to try these methods, but they should produce some interesting results.

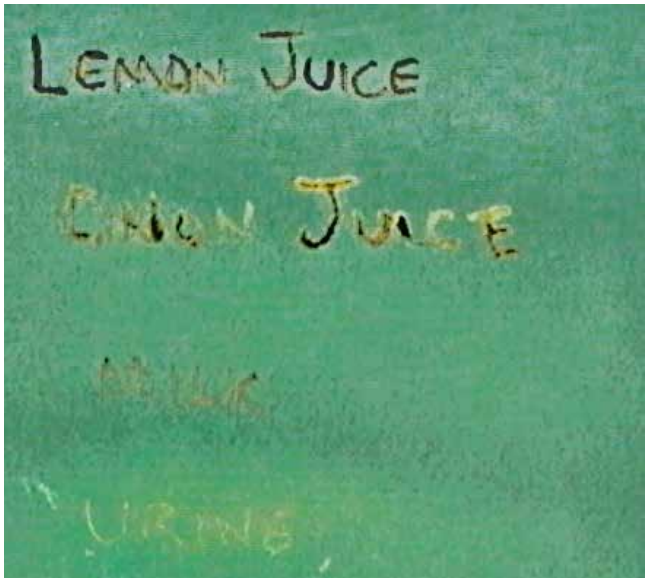
So, what should one look for, and where, to detect developed and undeveloped invisible inks on a given document? One of the most common places is between the lines of the visible text, though some secret agents were taught to write crossways to the covering letter; the margins of a letter or printed sheet; the verso of a letter; blank pages of books

Potassium iodide after exposure to ultraviolet and ambient light for 24 hours.

or pamphlets; and sometimes, in dots beneath the printed letters on a page. There may also be writing on envelopes or wrappers associated with suspected documents.

Certain invisible inks will become colored on their own, such as iron salts, gold chloride, silver nitrate, potassium ferrocyanide, and potassium iodide. Some acids and alkali will also give themselves away, generally by interacting with the paper on which they are written. Acids may eat through the paper entirely; strong alkali will affect the paper color, and can be corrosive as well. Several of the commercial fluorescent invisible inks I tried also developed color over time, though some did not.

If one is trying to determine whether a given ink on a document is an invisible ink which has been developed, there are a few typical characteristics which might be of use. If heat has been used, this may affect the appearance of the paper; some inks required a fairly high temperature in order to become visible. Paper bearing inks such as cobalt chloride, which require very little heat, may not be discernibly affected. The effects of heat will also show up under UV examination, as will the places on which a reagent has been applied.



Heat leaves its mark on paper when it is used to develop an invisible text. Depending upon the amount of heat required for development, scorching may be visible in normal and UV light, as shown here.

In conclusion, I'd like to say that invisible inks have played a larger role in the world of document and image production than most people know. Knowledge of invisible inks has played a part in the development of photographic science, document copying, and information security. Right now, invisible inks are being used for some very creative purposes, which keep changing as international relations, business, and society also change.

This research is an ongoing project, and has turned up such a large amount of information that it was impossible to include everything in one paper. I intend, therefore, to give it a book-length exposition.

NOTES

1. The designation was given in 1669 by Jacob LeMort, in the *Collectanea Chymica Leydensia* (LeMort, 1684: 97). The ink itself had been described in 1653 by Pierre Borel, who termed it a "magnetic water which acts at a distance." I could not find the text of the first edition, but the passage is repeated a few years later in Pierre Borel, *Historiarum, et Observationum Medico-Physicarum, Centuriae IV* (Paris: Ioannem Billaine, 1656), 110–111.

2. Borel's description of the "magnetic water" was translated by Johann Beckman in his *Histories of Inventions and Discoveries* (1797: 175–176) as follows:

> Magnetic waters which act at a distance. An astonishing effect, indeed, is produced by the contest of the following waters, which are thus made. Let quick-lime be quenched in common water, and while quenching, let some orpiment be added to it (this, however, ought to be done by placing warm ashes under it for a whole day), and let the liquor be filtered, and preserved in a glass bottle well corked. Then boil litharge of gold [lead oxide] well pounded, for half an hour with vinegar, in a brass vessel, and filter the whole through paper, and preserve it also in a bottle closely corked. If you write any thing with this last water, with a clean pen, the writing will be invisible when dry; but if it be washed over with the first water it will become instantly black. In this, however, there is nothing astonishing; but this is wonderful, that though sheets of paper without number, and even a board

> be placed between the invisible writing and the second liquid, it will have the same effect, and turn the writing black, penetrating the wood and paper without leaving any traces of its action, which is certainly surprising; but a fetid smell, occasioned by the mutual action of the liquids, deters many from making the experiment. I am, however, of opinion, that I could improve this secret by a more refined chemical preparation, so as that it should perform its effect through a wall. This secret I received, in exchange for others, from J. Brosson, a learned and ingenious apothecary of Montpelier.

The effect of the sulfur fumes on the ink through a stack of paper later became the basis of a popular parlor trick known as "the book of fate," in which an invisible message written in either lead acetate or bismuth nitrate would be placed in the front of a thick book, and a paper impregnated with the developing fluid at the back; the fumes would permeate the paper and develop the writing.

3. Quoted in Macrakis 2009a. Her source is cited as: Philonis. In: Thévenot, Melchisedech. (Ed.) *Veterum Mathematicorum Opera* (Paris: Ex Typographia Regia, 1693).

4. Trithemius' real name was Johann Heidenberg, but he was better known by the name of his native town, which was Trittenberg. His first major work on secret writing was *Steganographia*, written ca. 1499–1500; it was not published until early in the seventeenth century but was widely circulated in manuscript form.

5. Porta, 349. The author states that if you "make letters" on skin "with aqua-fortis, which hath eaten silver or brass, they will appear many days." Aqua-fortis (nitric acid) reacts with silver to form silver nitrate.

6. The book in question was Jacques Ozanam's 1694 *Recreations Mathematique et Physiques*, which went through at least ten editions.

7. Hellot may have gotten his information about cobalt ink from a German alchemist, Dorothea Walchin (1705); see Macrakis 2012.

8. A subcarbonate is a compound containing an excess of the basic constituent; potassium subcarbonate could have been a mixture of potassium and potassium carbonate.

9. Thomas Carlyle to Margaret A. Carlyle, 1 September 1834, *The Carlyle Letters Online*. http://carlyletetters.org.

10. "Sympathetic Ink," *The Quarterly Journal of Science, Literature and the Arts* 22 (1827): 401.

11. Its use for bringing out invisible or erased writing was actually known much earlier, as evidenced by this description of iodine fuming from 1860: "If any liquid—water, alcohol, salt water, vinegar, saliva, tears, urine, acids, or alkalies—has been applied to the surface of the paper before its exposure to the vapor of iodine, the places to which such application has been made are indicated by the varying tints of color imparted by the iodine" ("Forgery" 1860, 311).

12. Burrhus F. Skinner, U. S. Patents 3,363,336 (1968a); 3,363,337 (1968b); 3,363,338 (1968c); 3,516,177 (1970); and 3,560,046 (1972). For titles, see bibliography.

13. This recipe was published numerous times; the following notice of it should suffice: "Process for Producing Pictures etc. on Paper, Which Become Visible When the Paper is Wetted, and Disappear When it is Dried. C. Schmidt and E. Vehl. Gerlin Ger. Pat 19219 Jan. 1882. The ink used for drawing is a mixture of 1 part linseed oil 20 parts ammonia liquor and 100 parts water." *Journal of the Society for Chemical Industry* 1 (1882): 403.

14. There are numerous references to this product on the internet. The Green Technology website featured a short article on it ("Prepeat—Inkless Rewriteable Printer") on January 28, 2012.

15. The first patent I could find for this product is Howard C. Hass' "Pressure Responsive Record Material," U.S. Patent 3,287,154, filed 13 December 1965, and issued 22 November, 1966.

16. Take, for example, this recipe from *Valuable Secrets Concerning Arts and Trades: or, Approved Directions, from the Best Artists, for the Various Methods…* (1775, 206):

> To make an ink which appears, and disappears, alternately.

> Write with an infusion of gall-nuts filtered through brown paper, and the writing will not be visible. When you want to make it appear, steep a little sponge, or bit of cotton, into an infusion of vitriol, and pass it over the written place of the paper; the writing will immediately appear. To rub it off, and make the paper look all white again, do the same with spirit of vitriol, and all the writing will be gone. To make it visible again, rub over the paper with oil of tartar; and thus continue forever.

17. Gabreil Tigere, British Patent AD 1817 June 3, No. 4131. Summarized in *Abridgements of the Specifications Relating to the Manufacture of Paper, Pasteboard, and Papier Mache* (London: Printed by George E. Eyre and William Spottiswoode, 1858), 22–23.

18. It should be noted that in the discussion section of this article, pp. 318–319, William Herapath, himself the holder of a safety paper patent, accuses Barclay of having claimed as his own the method described in a lapsed patent by David Stevenson (No. 7,313, dated 1837).

19. Nolan, *Production and Detection*, 6–11.

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Life Savers: A Sweet Story in 12 Parts. Volume 1. **Candy box, interior view. Life Savers Candy Company. Multiple, number unknown. American. nc. 1941–1948. 14 x 9.5 x 4.5 cm (5.5 x 3.7 x 1.8 in).**

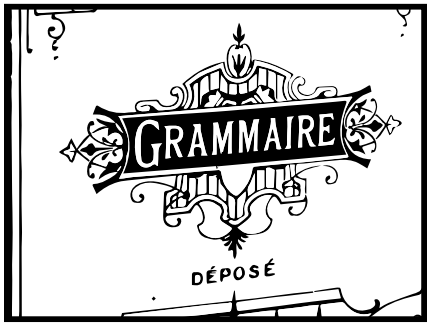
Blooks
(things that look like books, but aren't)

Mindell Dubansky

The transformation of the book is an inescapable theme of contemporary life. As a result of the advancement of computer technology, the book as we have known it is experiencing a major cultural shift, and many question the future of the physical book. Simultaneously, we know that there are many kinds of books for which there is no better format than the codex. More than ever, artists, designers, collectors, and librarians are attracted to books as objects and admire them for their physical beauty, historical significance, structural properties, and emotional currency. Interest in rare books, the book arts, the use of the book in works of art, and book repurposing is flourishing.

All over the world, people have been making, collecting, and presenting booklike objects that reflect their devotion and respect for books and for each other. The earliest such "blook" I have identified is a fifteenth-century practical joke. It no longer exists, but has been described as a block of wood painted to look like a book, bound in white velvet, with two silver-gilded clasps and enameled arms of the duc de Berry. The Limbourg Brothers, makers of the famous Book of Hours, presented the object to the duc de Berry as a Christmas gift (Husband 2008, 35). There are countless examples of blooks, as the book, or codex, is a universal format that provides a perfect container and disguise for many kinds of objects.

The diversity and abundance of objects made in book form would astonish even seasoned book professionals if they had the opportunity to see them presented together. Examples include travelling bars, smoking paraphernalia, cameras, radios, banks, toys, memorials, food tins, desk accessories, book safes, musical instruments and boxes, magic tricks, stage props, furniture, jewelry, and various thematic kits. Blooks embody many of the same characteristics as real books and often closely imitate specific book titles and formats. Their forms represent knowledge, education, taste, power, wealth, and personal attachments. They serve as reminders of visits to important places, as receptacles to hold valuable and practical objects, and are sources of great amusement. Many have been treasured and passed down through the generations, and these reside in private homes, public



Mindell Dubansky is head of the Sherman Fairchild Center for Book Conservation at the Thomas J. Watson Library, The Metropolitan Museum of Art. A book conservator, artist, author and book collector, she has built unique collections in order to develop new areas in the field of book history, most notably a collection of publisher's bindings designed by Alice C. Morse (1863–1961), which resulted in the Grolier Club publication* The Proper Decoration of Book Covers: The Life and Work of Alice C. Morse*, in 2008. Mindell.dubansky@metmuseum.org.

and private businesses, and museums and libraries around the world.

The objects represented in this selection are but a few of the amusing and inspiring objects in my growing collection of over 600 blooks made from the late 18th century through the present time. My motivations for collecting blooks are many. Primarily (and I know that my fellow bookworkers will know what I mean), I have always been amazed at the strength of the human attraction to books. For bookbinders, conservators, librarians, and book artists, the attraction becomes a compulsion. It's not enough to live with books; we crave an intimate engagement with the object, and this becomes a way of life. After thirty years as a bookbinder, I am still in awe of the way in which my life has become entwined with the book.

I collect blooks as a way of examining and celebrating the diversity of and human interest in books, through the observation of objects that emulate and interpret the book in a great variety of ways. My collection is a subjective accumulation based on my personal interests and a limited budget. I have collected across wide subject areas, choosing to illustrate the subject as a whole rather than specializing in any one area. It was only when I completed a collection catalog that the true scale of my collection and its themes emerged. The process of cataloging the collection allowed me to visualize the general history of blooks quite clearly. Since then, research and discovery of objects in other collections have enabled me to build a conceptual blooks timeline. My work has revealed fascinating objects of great age, sumptuousness, historic significance and rarity.[1]

The ten chronologically arranged blooks in this article[2] have been selected for their close resemblance to actual bound books and for their charm, structural diversity, and potential ability to inspire bookbinders, book artists and conservators to design original book objects and protective enclosures.[3]

NOTES

1. Highlights of my collection will be exhibited in "Blooks: The Art of Books that Aren't" at the Grolier Club in New York City, January 28–March 12, 2016. The exhibition is accompanied by a full-color catalog. For more information about blooks, please visit my blog, aboutblooks.blogspot.com.

2. Although people inevitably will reuse books for other purposes as they have for centuries, it is unfortunate that the publishing industry and educators are currently encouraging the repurposing of books and the making of altered books. These practices are responsible for the loss of countless valuable books and the historic evidence they carry. I suggest that instead of adapting books for book objects, people should make them from scratch.

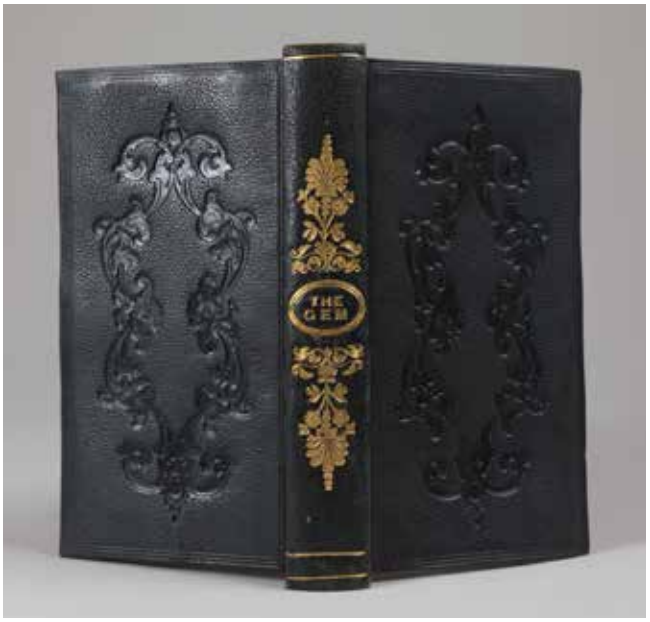
3. All photographs in the gallery that follows are taken by Scott Geffert and are copyright the collection of Mindell Dubansky.

A BLOOKS GALLERY

Embroidery kit: *The Gem*

The Gem embroidery kit has its aesthetic roots in the luxurious and popular annual gift books produced in England and America from the 1820s to the 1860s. Its stamped leather binding is characteristic of publishers' bindings from the 1840s. The maker of *The Gem* is unknown, and it certainly could have been made by a bookbinder, but also by any of a number of manufacturers who made fancy goods and souvenir wares.

The format for this portable kit is a portfolio with two flaps. It is bound in full black leather, thinly pared. Both covers are blind-stamped with a central ornamental cartouche in a floral motif. The rounded spine is gold-stamped with the title in a central oval cartouche and floral sprays above and below. *The Gem* is lined in pink silk moiré. On the right side of the interior are four pockets to hold sewing needle packets; on the left side are two fold-out flaps, at top and bottom, sewn with three vertical slots for holding skeins of sewing silk. A band of silk loops is attached for holding sewing implements. At the spine, a red ribbon loops around a folio of wool fabric meant to hold needles and pins. *The Gem* was originally protected by a slipcase, although in this copy the slipcase is missing. I have seen photographs of three slipcase variants for *The Gem*, one in leather with the same cover design stamped in gold, another in Tartanware, and a third in mother-of-pearl.

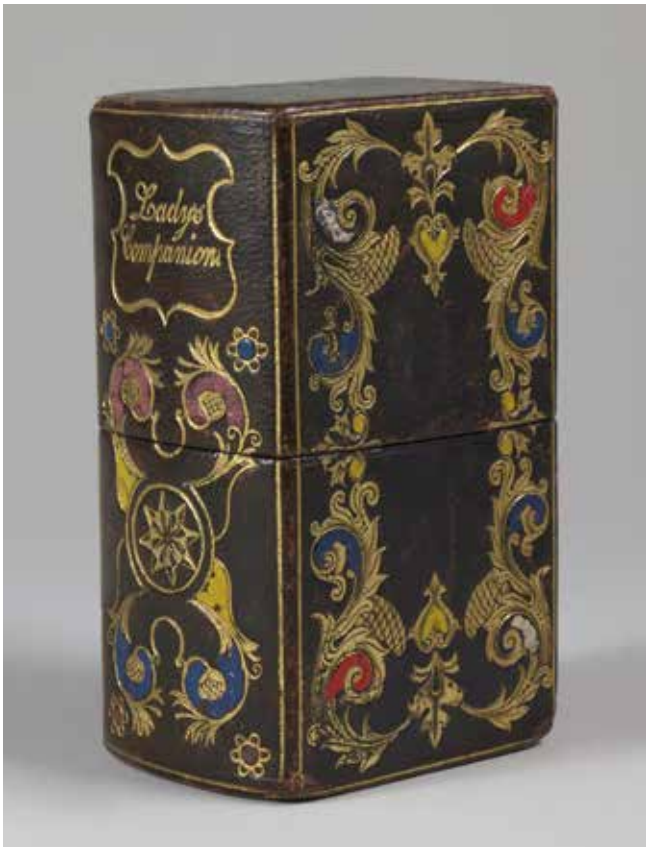


***The Gem*. Embroidery kit, exterior and interior. Maker unknown. Multiple, number unknown. English or Scottish. c. 1840–1850. Paper, leather, silk moiré. 11.6 x 6.6 x 2 cm (4.6 x 2.6 x .8 in).**

Etui: *Ladys' Companion*

THIS IS ONE OF MANY DECORATED leather etuis, or ornamental cases, entitled *The Lady's Companion*. While some are straightforward boxes, many are book-shaped. These were made in many colors and styles, from simple to fancy, and were designed for ladies to take on their travels and to friends' sewing circles, where the beauty of the etui would always impress. The contents of *Lady's Companion* are fairly standard and include sewing and writing implements as well as scent bottles. The box shown here has six compartments. It is lined with a floral-print paper and has velvet-covered supports for a pincushion and a thimble. Under the thimble holder is a hidden compartment for a thread spool. The manufacturer of this item is unknown, but it must have been made by a fancy goods manufacturer. *Lady's Companion*, a fitting title for this useful object, is the title of more than one nineteenth-century magazine that featured needlework projects.

The *Lady's Companion* was the successor to the French and English *nécessaire* of the late eighteenth and early nineteenth centuries, an all-purpose container for sewing and other useful tools that characteristically opens from the top (Rogers 1983, 49). The leather-covered box for the *Lady's Companion* was made on a form by wrapping layers of paper around a book-shaped armature made of wood or laminated layers of millboard. A spacer and decorative paper linings were added during wrapping to ensure a finished interior and a functioning top. Box ends and inserts were attached when the core was complete. The box was then covered in skiver and decorated with gold tooling and brightly colored, painted floral motifs. The same type of box in a sturdier construction, sometimes refered to as a Solander box, was developed in England in the late nineteenth century as a fire-retardant rare book box (Harrison 1950, 28–35).

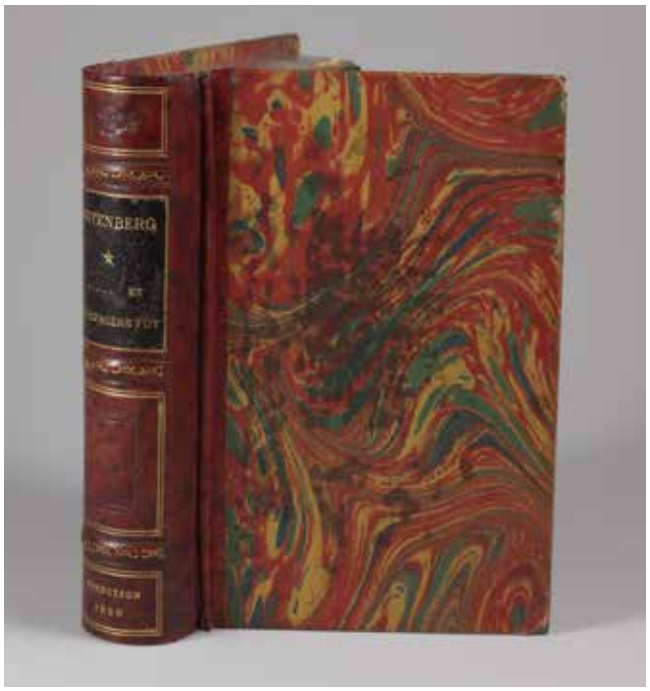


***Lady's Companion*. Etui, exterior and interior. Maker unknown. Multiple, number unknown. English. c.1850s–1860s. Paper, leather, paint, gold leaf, velvet. 9.7 x 5.8 x 4.2 cm (3.8 x 2.3 x 1.7 in).**

Pocket lantern: *Et La Lumière Fut* (And There Was Light). Gutenberg. Réédition, 1830.

POCKET LANTERNS IN BOOK FORM ARE RARE. I have seen two other "book" lanterns, one made of painted tin and the other of brass. This is the only one I have seen that is bound using traditional book-binding materials and methods. In 1861, United States patent number 31,896, for a pocket lantern in the form of a book, was granted to Georg H. Magersuppe of New York. In the patent description, Magersuppe describes the lantern as "a useful instrument for patrolmen, watchmen, policemen, soldiers and sailors and others in enabling them to bear the same conveniently in their pockets, when not required for use." This lantern, perhaps less practical because of the use of paper, was obviously made for the book lover. It is not known who made the lantern, or if it unique or a multiple.

Et La Lumière Fut is a mottled cordovan quarter leather binding with three decorated raised bands. The spine panels are framed in a gold-tooled double line and have central floral motifs, and text rather than floral motifs in the title and date panels. Both boards are covered in marbled paper in a swirl pattern in complementary colors. The edges and inner front board are covered in a combed marbled paper. In place of a text block, there is a folding candle lantern made of tin, with a glass front and reflective rear panel. The lantern mechanism hinges out from the fore edge.

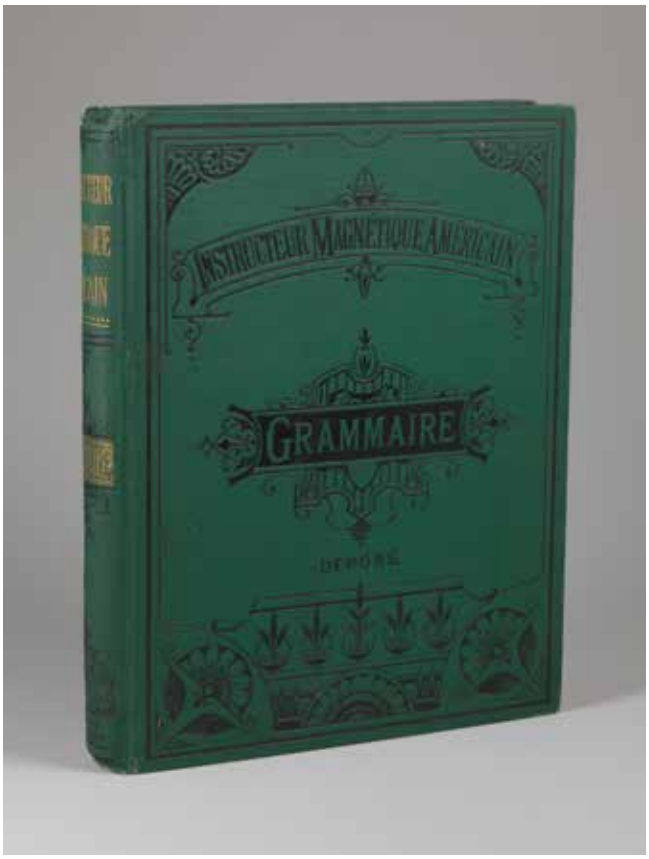


Et La Lumière Fut. Réédition, 1830. **Pocket lantern, exterior view and interior views with lantern collapsed and expanded. Maker unknown. Multiple, number unknown. Probably French. c. 1830. Leather, oil-marbled paper, millboard, tin, glass. 13 x 10 x 2.5 cm (5.1 x 3.9 x 1 in).**

French Grammar Teaching Device: *Instructeur Magnétique Américain. Grammaire.*

IN THE WORLD OF BLOOKS, there are many educational games and toys dating from the 1870s to today. The codex format is particularly compatible with the packaging of sets or "libraries" of games. Some of the earliest are book-shaped boxes for board games, Bible block sets, and the *Speaking Picture Book*. *Instructeur Magnétique Américain* is a French grammar teaching tool designed in the style of a publishers' cloth binding. From the outside, it looks exactly like a book made in a commercial bindery. It is bound in full green, fine-rib cloth and stamped in black with a typical Eastlake-style design. The title on the spine is stamped in gold. The inside of the front cover is lined in brown Bible paper printed in gold with instructions for use.

The game functions as follows: When the front cover is opened, a game is revealed embedded in a box that takes the place of a text block. There are two disks, numbered 15 and 16, with reverse-scalloped edges and printed with questions, and two corresponding numbered card frames printed with answers. Questions are printed on both sides of the disks, but the cards are blank on the verso. The instructions on the pastedown instruct the reader to align the point that is in the middle of a question with the black dot at the top of the disk pasted to the game face. The magnetic hand with a pointing finger will automatically spin to the correct answer.

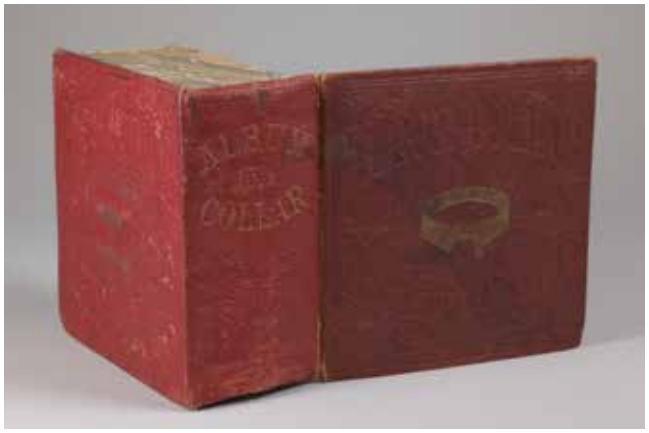


Instructeur Magnétique Américain. Grammaire **(front cover). French Grammar Teaching Device, exterior and interior views. J. & Co., New York. Multiple, number unknown. [American]. c. 1870–90. Paper, book cloth, glass, lithography. 21 x 16 x 3 cm (8.3 x 6.3 x 1.2 in).**

Collar Box: *Album Collar* (Size 15 ½)

THE ALBUM COLLAR IS THE EARLIEST book-shaped commercial novelty package for an article of clothing that I have seen. The book-shaped box has been used over the years as a suitable format for men's accessories and toiletry items, and I have seen it used as point-of-purchase and permanent packaging for suspenders, shaving kits, ties, and cologne. This box is one of a series of collar boxes made for different sizes of detachable paper collars, sold by the Reversible Collar Company of Boston. Three variants have been seen: this box in red cloth and two others in blue and green cloth for other size collars.

The *Album Collar* is designed in the style of realistic publisher's binding. The unknown manufacturer of the box took pains to make it appear more like a real book by making the spine round and the fore edge concave. The cloth is a pebble-grain pattern. Both covers are blind-stamped with the same design and feature the charming collar motif. On the inside of the front cover is a white paper pastedown, printed with text noting collar patents from 1854 through 1870. The box insert is covered in marbled paper in a nonpareil pattern. In the center is a round cutout for holding the collars. The insert originally had a wall of board inside the circular cutout to hold the collars in place, but this is now missing. The collars shown may not be contemporary with the box.

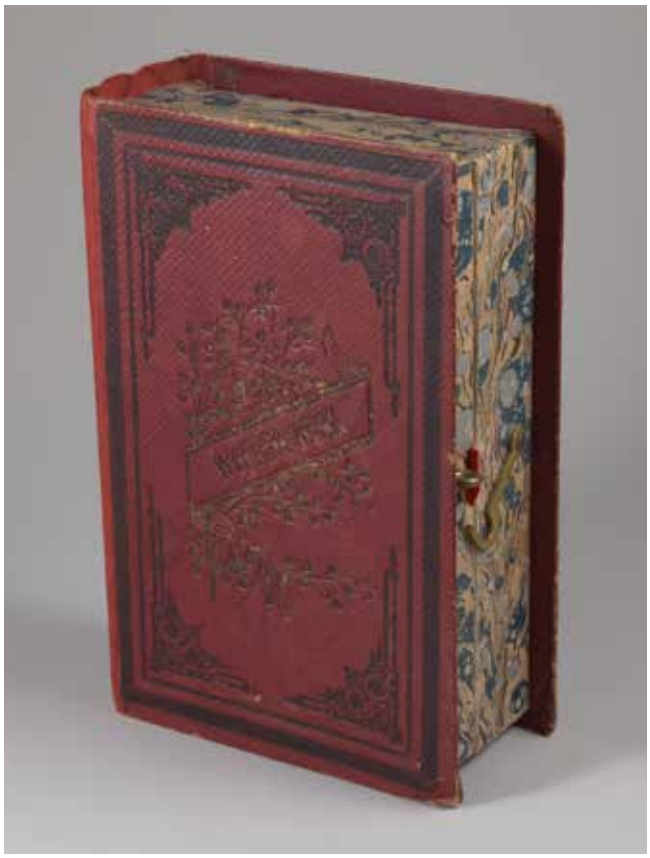


***Album Collar*. Collar box, exterior and interior views. Reversible Collar Co., Boston, Massachusetts, Multiple, number unknown. American. c. 1870s. Paper, bookcloth, marbled paper. 11 x 10.5 x 5.3 cm (4.3 x 4.1 x 2.1 in).**

Child's writing desk: *Writing Desk*

IN THE LATE NINETEENTH and early twentieth centuries, there appeared a number of advertisements in stationers', general goods, and novelty catalogs for inexpensive stationery objects in book format, sold as novelty items for children and adults. Items were sold both individually and at wholesale prices for resale. I have seen advertisements for book-shaped boxes, stationery sets, and inkwells for children, which would have been of interest to parents who wanted to encourage their children to read and write.

This little writing desk is a very good replica of a nineteenth-century cloth publisher's binding. Its spine is covered in plain-weave, red book cloth, stamped in black with flower motifs. Both covers are paper, embossed in a diaper pattern and resembling book cloth. The front cover is stamped with a black border and corner ornaments, and, in faux gold, the title *WRITING DESK*, set into a bannerlike cartouche surrounded by a leafy spray. The back cover is undecorated. The edges of the desk are covered in marbled paper in a spot pattern and the inner compartments are lined with white coated paper. When open, the left side of the desk is lined in green paper to resemble blotter paper, and the compartment below must have held writing paper. The right side of the box was designed to hold writing instruments and an inkwell, and there is a small storage compartment. There is a brass swing-clasp on the fore edge of the desk and a small book-cloth tab to aid in opening the box. There is no date on this desk, but the box is rubber-stamped with the name of the firm L. H. Robinson (Advertisement, *Journal of Medicine and Science of the Maine Academy of Medicine and Science*, November 1902, 442).



Child's writing desk, exterior and interior views. Maker unknown. Distributed by L. H. Robinson, Foxcroft, Maine. Multiple, number unknown. American. c. 1900. Marbled and colored papers, binders' board, cloth, metal, blind, gold and black stamping. 18 x 11.7 x 5.3 cm (7.1 x 4.6 x 2.1 in).

Candy Box: *Life Savers: A Sweet Story in 12 Parts, Volume 1*

THE PACKAGE DESIGN FOR THE *Sweet Story* box is an excellent example of paper engineering and efficient packaging. It is a flexible, one-piece paper design that is appropriate to many situations, and I have seen variations used on children's toy packaging. The *Sweet Story* box design has been so popular that several other companies have copied the idea for their holiday packaging, and book boxes have be seen in recent years during the holiday season for SweeTarts, Dubble Bubble gum, and Trader Joe's hard candies.

Although Life Savers hard candy was invented in 1912, I speculate that the *Sweet Story* boxes were initiated soon after 1938, when a variant of the Life Savers box was patented (Payne and Broderick 1938). I believe that this particular cover design was the first design used. It is the earliest design found to date, and it was illustrated in the December issues of *Life* magazine in 1941 (on p. 81) and 1948 (on p. 95). While the same lettering panels reappear on a box illustrated in *Life* in 1951, the covers have been modernized.

The design of the box is shown here in a diagram (without the inner slide-out trays). It is made from a single piece of card stock with applied cellophane windows on the inside of the box. This was a package to contain and view twelve rolls of candy, six in each tray, one on each side of the box. The covers are embossed with a leather-look pattern on silver foil paper and decorated with a design in the style of a traditional sixteenth-century strapwork binding. Blue lines were printed at the head and tail panels of the box to indicate the paper edges of a book. There are thumb cuts at the fore edge of each cover to make it easy to slide out the two paper trays that are in each side of the box.

***Life Savers: A Sweet Story in 12 Parts. Volume 1.* Candy box, exterior view. Life Savers Candy Company. Multiple, number unknown. American. nc. 1941–1948. 14 x 9.5 x 4.5 cm (5.5 x 3.7 x 1.8 in).**

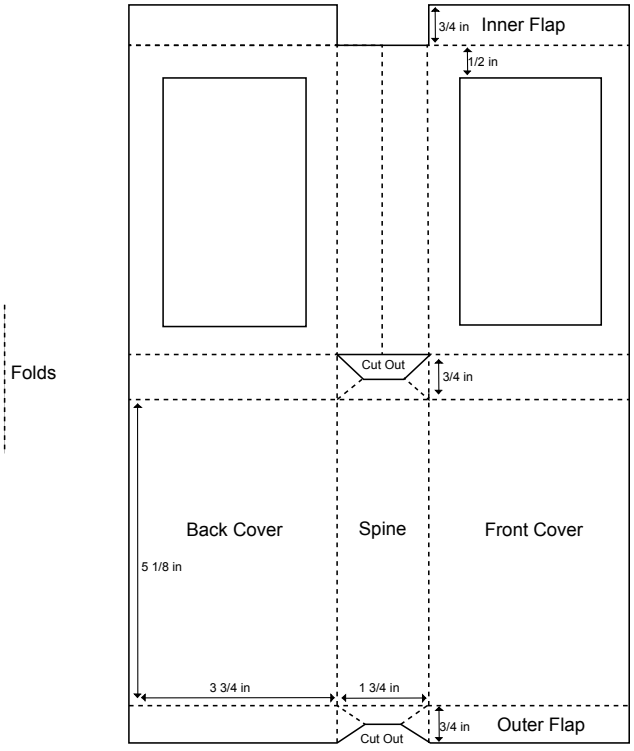
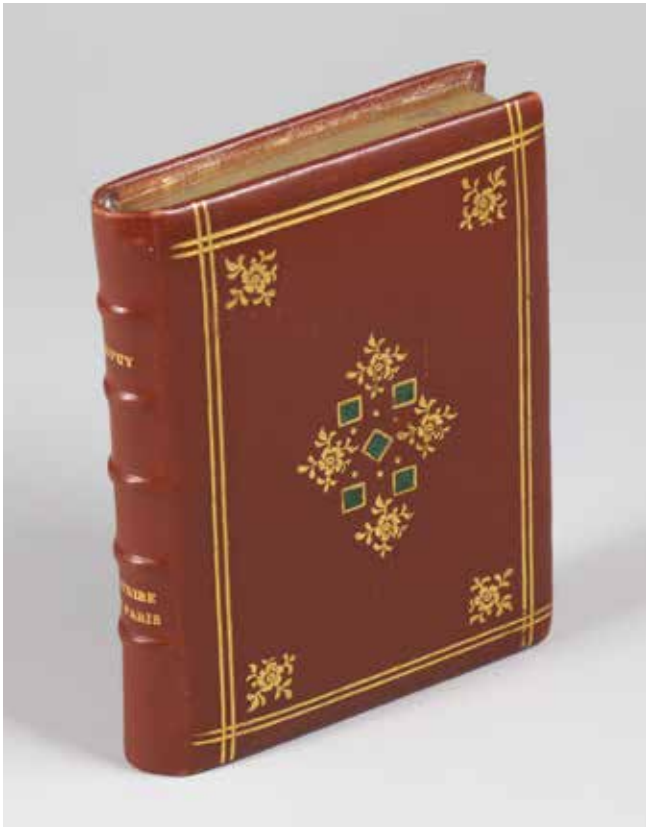


Diagram showing construction of *Life Savers: A Sweet Story* from a single piece of card stock. Windows are made from applied cellophane on the inside of the box.

Lady's Compact: *Sourire de Paris* (Smile of Paris), *by Dupuy*

LADIES' POWDER BOXES and compacts in book form have been popular in Europe, England, and the United States since the nineteenth century and perhaps earlier. They were made of many luxurious materials and were highly decorated in the style of the French ladies' almanacs of the eighteenth century. Like the fanciful almanacs, the compacts were used daily in public situations and were a fashion statement. This compact is for powder alone. Many have a compartment for rouge as well. The brown full calf binding is cushioned; it is gold-tooled with double line borders and floral motifs in the corners and center. There are green square onlay motifs in the center design. The spine has five raised cords and is gold-stamped with the maker name and title. The edges of the blook are gold-toned metal. Inside the front cover is a mirror; the box contains face powder and an ostrich feather powder puff.

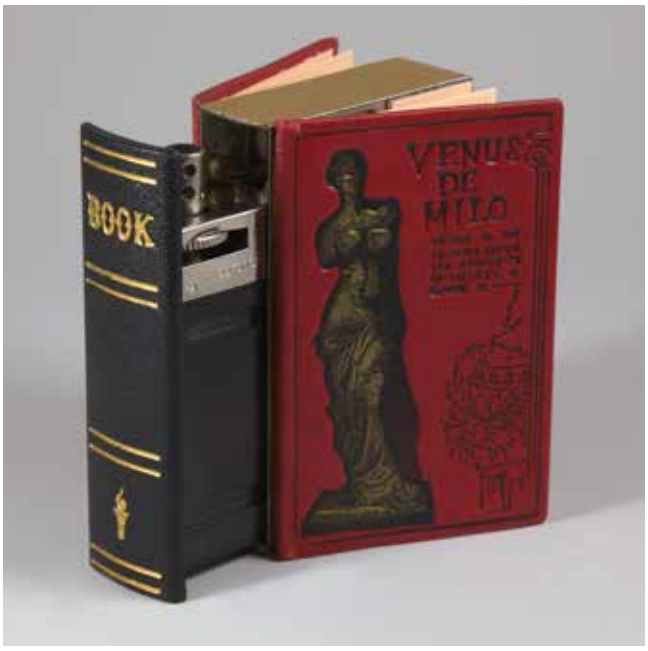


***Sourire de Paris*. Lady's compact, exterior and interior. Dupuy. Multiple, number unknown. French. c. 1920–1940s. Leather, gold tooling, metal, powder, ostrich puff, mirror. 9.4 x 7.2 x 1.5 cm (3.7 x 2.8 x .6 in).**

Table Lighter: *The Book of Smoking Knowledge*

THIS ODD, COMPLEX OBJECT was manufactured by Ross Electronics of Chicago, known as the first company to establish manufacturing operations in Tokyo after the war with Japan ended. Ross Electronics designed, marketed, and imported consumer audio equipment and home entertainment devices. Working with new Japanese manufacturers, Ross Electronics, a longtime supplier to the incentive, premium, and catalog markets, was credited with bringing miniature transistor radios into the US and developing specialty electronics, placing radio technology inside items such as stuffed animals, sunglasses, and cigarette consoles (*Chicago Tribune* 2006).

I have seen the *Book of Smoking Knowledge* table lighter with two very different cover designs, one with an all-over traditional painted and gold strapwork design; and this, the Venus di Milo cover, which I have also seen with black covers. The covering material is plasticized cloth, slightly padded, and the design is stamped in black and gold. The back cover on this lighter has a black double-line border, a central palmette and floral motif, and the Ross logo and address at the bottom. The rounded plastic spine is embossed with with a blind leather-like texture and gold-stamped with four pairs of gold lines that create three panels. The word "BOOK" is gold-stamped in the upper panel and a small design with a torch motif is in the bottom panel. The spine of the blook is attached to a butane lighter that pulls out from the book block. The edges are gold-toned metal, textured with lines simulating pages. Both book covers open; they reveal a title page and four pages of text on the history of tobacco. This copy of *The Book of Smoking Knowledge* still retains its Christmas dust jacket, with instructions for use printed on the verso.



***The Book of Smoking Knowledge*. Table lighter, exterior view and interior views with and without dust jacket. Ross Electronics Corporation, Chicago, Illinois, 60611. Multiple, number unknown. American, Made in Japan. c.1960s. Metal, cloth, paper. 10.3 x 7.1 x 2.8 cm (4.1 x 2.8 x 1.1 in)**

Snake Book Gag: *Souvenir of Atlantic City*

IN THE WORLD OF NOVELTIES, objects with snakes springing out to scare the handler have been very popular. These have been made all over the world for a long period of time, at least since the mid-nineteenth century, both in book form and in other formats. Handmade and manufactured versions were popular toys and gift items. They were sold through novelty catalogs and in toy, magic, and souvenir shops. The popular theme of original sin is apparent, especially in those made in the mid-twentieth century in several variants by the S. Adams Company, entitled *What I Know About Women.*

Making homemade snake books was a common pastime in the nineteenth century. Beautiful examples can be seen in folk art collections and dealer's catalogs. They were carved from wood, using different decorative techniques such as chip carving, marquetry, painting, and collage. The snakes, which were made in as many variations as the book boxes, are often fitted with biting metal tongues and cold glass eyes.

Souvenir of Atlantic City is the only snake book I have seen made with a hinged ejector box attached to the front cover. This structure ensures the speed at which the snake escapes, to shocking effect. The book is covered in black fine-rib embossed paper. There is only one gold paper corner on the front cover with no evidence of another. The spine has two gold paper bands; both the spine and the fore edge are rounded, further adding to the bookishness of the object. The cheery snake is about twenty centimeters in length.

Souvenir of Atlantic City. **Snake book gag, exterior and interior views. Maker unknown. Multiple, number unknown. American, Made in Japan. c. 1940s. Paper, board, hand-painted spring snake. 8.7 x 7 x 3 cm (3.4 x 2.8 x 1.2 in).**

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