“Life of Paper” Project Report: Quire Structures and Watermarks in 17th-Century Icelandic Manuscripts

In the three-year-project “Life of Paper. Cycles of Paper Production, Use and Reuse in 17th-Century Iceland”, we focus on paper history in Iceland during the 17th century. An essential part of the project is the analysis of material aspects, particularly watermarks and quire structures.

Watermark analysis was conducted with a hyperspectral camera from the Fraunhofer Institute for Factory Operation and Automation (IFF) in Magdeburg. This is a line camera which uses 320 spatial pixels and 256 bands in the range from ca. 1 000 to ca. 2 500 nm, ie. the spectral range in which iron-gall ink becomes invisible. Illumination is done by an off-axis halogen lamp. The scans of the watermarks are added to the *Wasserzeichen-Informationssystem* database, where we can compare the scans to other watermarks providing information on the production of the paper.

Information about the analysed watermarks is additionally added to the relevant online database for Icelandic manuscripts, Handrit.is. There, we provide links to the entries in question in *Wasserzeichen-Informationssystem* together with digital representations of the manuscripts’ quire structures, which allow the user to grasp more easily the physical and textual context of the watermarks’ occurrence. Our graphic representations are based on VisColl, an open source-model for modelling and visualising manuscript quire structures developed by Dot Porter and others at the Schoenberg Institute for Manuscript Studies. In order to incorporate the VisColl files into Handrit.is, however, some adjustments had to be made.

Finally, we will touch upon limits we encountered in our watermark research. For example, cases where there are no comparable and dated watermarks present in databases or because carbon ink on the paper prevents the analysis.

Silvia Hufnagel and Beeke Stegmann
Árni Magnússon Institute for Icelandic Studies
Árnagardur vid Sudurgötu
IS-101 Reykjavík

Silvia(at)hi.is

The Latin American database of underground watermarks

Luisa Martínez Leal
llm@azc.uam.mx
Universidad Autónoma Metropolitana
Mexico City

Abstract

The demand for paper in Spanish America became urgent in the 16th century, mainly to comply with administrative functions in New Spain, and it worsened with the imposition of the documentary validation tax.

The economic policy followed by Spain in the colony was characterized by hindering logical progress in all its aspects. All the laws issued by the Council of the Indies regarding industry were prohibitive for New Spain. The Crown did not promote the construction of paper mills in America since this product was, for long periods, a royal monopoly, especially due to the establishment of the stamp tax, which was a significant source of income for the economy.

Almost all the folios documenting the colony were made on European paper, imported from Spain but not necessarily produced there. A small portion was made using amate or bark paper, or paper from Mexican mills, which could have included wheat mills, fabric mills, or later, paper mills.

This situation encouraged and increased the clandestine production of paper in other types of mills, as well as paper smuggling, which persisted throughout much of the Crown's rule.

From November 7th to 9th, 2024, the International Seminar on Paper Conservation was held in Santiago, Chile, with participants mostly from Latin America and Spain During the seminar, I invited the attendees to create a new Latin American project to identify underground watermarks in each of our countries. The response was overwhelmingly positive, and we are now beginning to organize the project. It will be distinctly Latin American, and together, we aim to create a database of underground watermarks found in each of our countries.

Maria Stieglecker
Austrian Academy of Sciences
Institute for Medieval Research – Dep. Codicology and Paleography
Dominikanerbastei 16 / 4th floor
1010 Vienna
Austria

maria.stieglecker@oeaw.ac.at

Paper mixes and manuscripts

A feature of watermark repositories such as *WZMA - Watermarks of the Middle Ages* is the possibility to link identical watermarks from different sources. This makes the dating by watermarks more and more precise. It also makes it possible to investigate where a manuscript was produced. Analysing a critical mass of manuscripts and their watermarks can also provide further information about the history of the codices as objects. There are usually several different pairs of watermarks in a manuscript. If the same paper mixes are identified for different codices, perhaps other similarities can be identified? Similarities with regard to the text, the scribe, the illuminator, the binding, etc.? This is a new interdisciplinary research question in the field of manuscript studies and watermark research, which will be investigated in the near future, and first impulses shall be presented.

Watermarks and Paper Features in Modern Italian Manuscripts: A Digital and Archival Approach

Campagnolo Alberto[1 2], Elena Pierazzo[1], Robert G. Erdmann[3]

[1] CESR, University of Tours,
[2] Book Heritage Lab, KU Leuven,
[3] University of Amsterdam

alberto.campagnolo@univ-tours.fr

The ERC-funded PRIMA project, based at the Centre d'Études Supérieures de la Renaissance (CESR), University of Tours, investigates modern manuscript production, with a particular focus on Italian collections from the late 16th century to the end of the 18th century. Despite the widespread assumption that print replaced manuscripts, an overwhelming number of manuscripts continued to be produced during this period, accounting for a significant portion of Italian library holdings. Given the vast scale of this manuscript tradition, our approach prioritises the structured yet selective documentation of laid paper features, including watermarks. While full-scale recording of all paper characteristics is impractical, our methodology aims for a systematic collection of essential data to support research in watermark studies.

In parallel, we will conduct an archival study of paper production and trade, employing an archivist to analyse watermarks and paper features in archival documents from the period. This will include outlining paper acquisition records from family account books and other financial documents, shedding light on the economic networks behind manuscript production.

To enhance our analysis, we are collaborating with Robert Erdmann (University of Amsterdam) to apply machine vision and AI tools. His Magic Eraser technology (https://images.erdmann.io/magic_eraser/) will be used to digitally remove ink, allowing for clearer watermark identification. Additionally, a specialised imaging pipeline will be employed to help differentiate between felt and mould sides of paper.

Our findings and dataset will be made available for integration into the Bernstein database, contributing to the broader study of watermarks and historical paper research.

Stefaniia Demchuk, PhD,
Associate Professor, Department of Art History
Taras Shevchenko National University of Kyiv
stephanierom07@gmail.com

Paper, Prestige, and Recipes: Cataloguing Watermarks in Early Modern Cookbooks

My study of watermarks in early modern English manuscript cookery and commonplace books (c. 1650–1790) is focused on their potential connection to the books' contents. I aimed to explore whether a correlation existed between the choice of recipes and the quality or cost of the books. Although watermarks cannot definitively date or pinpoint the origin of a manuscript's creation, they proved valuable for establishing a general timeframe and providing insights into the economic status of their owners. The rarity and character of watermarks often reflected the costs invested in the manuscripts, which, in turn, frequently corresponded with recipes for either luxurious or more accessible dishes.

I catalogued approximately thirty English culinary manuscripts from the collections of the Getty Library and the Clark Memorial Library at UCLA, identifying patterns in watermark distribution. Up to the 1720s, two dominant watermarks – the Strasbourg Lily and the Amsterdam Coat of Arms – coexisted with a variety of others, hinting at diverse paper sources in France and the Netherlands. This period coincided with a surge in culinary manuscript creation in Britain. From the 1720s onward, however, Dutch paper featuring *Pro Patria* and *Britannia* watermarks became predominant, with the latter designed specifically for the British market.

To scale these findings, it is crucial to develop a database where watermarks from other recipe books can be continuously added to the core collection, allowing the pattern I observed to be tested against data from culinary manuscripts of different geographical origins. The online digital collection of watermarks from culinary and commonplace books, which were among the most important mediums in early modern households, will contribute to a deeper understanding of the connection between the materiality of notebooks and culinary discourse.

Printed versus digital databases of watermarks,

Marie Benešová

Abstract:

Digital databases have unlimited possibilities in the number of presented watermarks. But their use in direct comparison is very problematic. Tracing watermarks is also quite problematic for most archivists and librarians. Therefore the Filigranology is not a very popular and widespread auxiliary science of history. The possibility of easy use of printed watermark cards in praxes is provided by the printed chronological atlas of watermarks from Jihlava. This atlas will be published this year and will test the possibilities of its use.

27.01.2025

8th International Conference on Watermarks in Digital Collections 2025

Abstract for online presentation

Dr. Linus Hartmann-Enke, German Museum of Books and Writing, German National Library

The German Museum of Books and Writing, since 1950 a department of the German National Library, holds one of the largest collection of watermarks in the world. It is comprised of around 400,000 predominantly German pieces from the 15th till the 19th century. The main body comes from the private collection of Karl Theodor Weiß (1872–1945), which came to us in 1964 from the German Paper Museum in Greiz, led by his son Wisso Weiß. Since then, it is an invaluable scientific resource for dating manuscripts of various genres. The constant cataloguing and gained expertise by the responsible employees helped the scientific community in this regard.

Since the transformations of the digital age opened up astonishing new ways of research, the German National Library digitised around 23,000 watermarks of the culturally and historically significant Thuringia region. This means around 95 paper mills and 500 paper makers. Since the beginning of this year, all of these are searchable through the library catalogue: https://portal.dnb.de/opac/simpleSearch?query=cod%3Dd042&cqlMode=true

The online presentation will give an overview of the collections history and take a detailed look into the specific problems and solutions while digitising and importing this collection, which for example holds the key to date works of literature and music by Goethe, Schiller, Luther or Bach.

8th International Conference on Watermarks in Digital Collections
The Árni Magnússon Institute for Icelandic Studies
Reykjavik, Iceland 19-20 June, 2025

Cranach on Paper
An exploration of the graphic oeuvre

Thomas Klinke

'The graphic work of Lucas Cranach the Elder, his sons and the works' is currently being studied as part of an interdisciplinary research project (2023-2026), that focuses on about 400 drawings and over 700 woodcuts and engravings associated with Cranach and his workshop. It builds on the results of an earlier research project (2018-2022), which catalogued the Luther portraits of the early Reformation period.

In addition to the coloured and drawing media, the paper is also being examined and identified. The aim of the project is to date and classify the works, which include around 3,000 prints from c. 1500 to c. 1586. Transmitted light is used to analyse the paper structure and the watermarks, which are then measured and described according to accepted standards and recorded using high-resolution photographs.

Furthermore, the chain line intervals and the density of the wire lines are measured. When possible, the watermarks will be digitally processed to facilitate their interpretation. Our research team not only expects new insights into the workshop practice and the paper used, but also significant advances with regard to the dating and attribution of these graphic works.

It is already evident that about a third of the examined Cranach sheets exhibit watermarks. For the first time on this scale, they are being systematically documented, catalogued and analysed. The accumulated data is supplemented by c. 200 tracings and beta-radiographs of watermarks (primarily from German and Anglo-Saxon collections) compiled by the Cranach scholar Armin Kunz.

The project, which is funded by the Deutschen Forschungsgemeinschaft and the Ernst von Siemens Kunststiftung, is being carried out by the Cologne Institute of Conservation Sciences (Cologne University of Applied Sciences) in collaboration with the Kupferstichkabinett, Staatliche Museen zu Berlin, Deutschen Dokumentationszentrum für Kunstgeschichte - Bildarchiv Foto Marburg (Philipps-Universität Marburg), the Kupferstich-Kabinett, Staatliche Kunstsammlungen Dresden and the Museum Kunstpalast Düsseldorf. Around 25 other important collections in Germany and Europe are involved in this research network.

The results will be integrated into the Cranach Digital Archive (cda_) www.lucascranach.org, a database that already contains around 2,570 paintings from 350 cooperating museums, church communities and private collections. It also offers access to over 25,000 high-resolution images, more than 2,000 infrared and X-ray images as well as numerous documents and bibliographic references on Cranach's oeuvre.

The aim of this project is to make the data on the recorded watermarks and paper structure searchable within the cda_, allowing users to retrieve specific information. To this end the structure and classification systems already established by the Watermark Information System will be used. Furthermore, we are preparing for the integration of the data into the Bernstein Portal.

This proposal explains the methods used for the visualisation of paper structure and watermarks, how these are made accessible in the Cranach Digital Archive and how they can be used to answer interdisciplinary research questions such as the date of origin of an artwork. The latter is illustrated using the case study of the only portrait of Martin Luther as Junker Jörg printed in the Cranach workshop.

In the future, the possibilities of developing models/neural networks with the help of AI will be explored and discussed. It is hoped that these will enable the automated detection of watermarks and paper structures, the extraction of the relevant information, their millimetre-precise measurement as well as their identification and contextualisation within the Cranach corpus and beyond.

Keywords: Lucas Cranach the Elder, Lucas Cranach the Younger, Hans Cranach, Workshop of Lucas Cranach the Elder, artist's papers, hand drawings, prints, woodcut, engraving, etching, photographic methods, recognition of paper structure and watermarks, imaging, image processing, classification in a database structure, research options

Watermarks and Artistic Practices: Drawings by the Neoclassical Artists Andrea Appiani and Giuseppe Bossi in the Brera Academy of Fine Arts Collection

Chiara Palandri (chiara.palandri@nb.no), Elisa Albano

Abstract

This presentation explores the drawing collections of Andrea Appiani (1754–1817) and Giuseppe Bossi (1777–1815) in the Brera Academy of Fine Arts, which serve as emblematic representations of Neoclassical artistic practices in Northern Italy. Particular attention is given to the material characteristics of papers and their role in the creative process. As part of the IartNET project—an international platform dedicated to artistic practice, research, and cultural heritage within Italian higher arts education institutions—this study examines the papers and watermarks in these collections. The project aims to analyze the relationships between the depicted subjects, the types and quality of papers, and the artistic techniques used, with the goal of reconstructing original notebooks and paper formats. This research will contribute to the field through the digital cataloging of the collection and the integration of data, offering new perspectives on Appiani and Bossi's work, while establishing a replicable model for future studies of Brera's historical collections. Furthermore, the presentation will explore the potential of these studies and methods to bridge historical materials with contemporary research. This integrated approach highlights the role of watermarks in understanding paper use in Neoclassical drawing practices and the broader implications for art history and material cultures.

LATE 19th–EARLY 20th CENTURY PAPER TYPES AND USES AT THE BRERA ACADEMY OF FINE ARTS.

As part of a PhD course at Brera Academy of Fine Arts—and other projects related to the reorganization, conservation, and digitization of photographs and administrative documents stored at the Historical Library and Archive—an initial survey is being conducted on watermarks found on correspondence, invoices, albums, registers, and volumes dating from the period 1880–1920.

This investigation aims to reconstruct the local and international paper production and trade connected with the Academy's activities, including teaching, collecting, and documenting students' work and teaching materials, as well as preserving and promoting cultural heritage.

Focusing on the characteristics of watermarks and the type of information they convey within this chronological range, which has traditionally received little attention, can provide valuable insights across various aspects.

First, it serves as a starting point for tracing significant changes in manufacturing processes—including the Fourdrinier and cylinder machines, as well as studies on dandy rolls and watermark applications—across Italian and foreign paper mills and companies identified in Brera Academy documents and works on paper.

Additionally, during this period, watermarks increasingly functioned as indicators of a paper's intended use—such as for drawing, printing, typewriting, or correspondence—in different qualities, formats and weights (e.g., extra strong, linen, imperial). This can be linked to price lists and commercial documents found in the archives of identified paper companies, which often reveal gaps in 19-century watermark databases.

Finally, this project will facilitate the digitization of watermarks, linking Brera Academy collections through the lens of papermaking, including the Historical Library and Archive, as well as its photographs, album, drawing and print collections.

CONTACT INFORMATION

Gloria Boero
PhD student - Brera Academy of Fine Arts, Milan – Italy.
gloriaboero@fadbrera.edu.it – glo.boero@gmail.com
+39 3383069181

ACKNOWLEDGEMENTS

Chiara Palandri, National Library of Norway, Oslo - Brera Academy of Fine Arts, Milan.
Nicoletta Leonardi, Albertina Academy of Fine Arts, Turin - Brera Academy of Fine Arts, Milan.

The VSC: a new tool for watermark research at The Courtauld Gallery, London

At The Courtauld Gallery in London I was tasked to record, describe, measure and research all watermarks in our collection of around 7,000 drawings. This was made eminently easier when, in 2020, we procured a Video Spectral Comparator, or VSC. Originally developed for the detection of fraudulent bank notes and identity documents by banks and customs officers, this scanner has been repurposed by museums for the technical examination of works on paper. Using a combination of transmitted and infrared light, we are able to obtain new digital images of our watermarks, which are nearly always more legible than those taken with only transmitted light. This process has the added advantage that we usually do not need to remove our drawings from their mounts, thus saving previous time and not requiring specialist handling by a Conservator. We are able to digitally measure and annotate the watermarks and the distance between laid and chain lines to the hundredth millimetre, allowing unprecedented precision in the comparison of watermarks and detection of possible mould-mates. There is a 3D modelling feature which maps the topography of the paper, in some cases allowing us to generate a 3D model of the watermark, particularly useful when watermarks are obscured by media.

With the implementation of our new collections database in 2021 and website in 2023, we have begun been adding these new images to our website, so that they can be searched and viewed by any member of the public, with the aim to ultimately upload all watermarks in the collection. This is a relatively unusual step amongst our UK cohorts, but we hope to encourage our colleagues to follow suit, enabling a wider range of high resolution digital photographs of watermarks and their cataloguing data for research by anyone anywhere in the world.

Dr Rachel Hapoienu
Assistant Curator of Works on Paper
The Courtauld Gallery
Somerset House
London WC2R 0RN
United Kingdom
rachel.hapoienu@courtauld.ac.uk

8th International Conference on Watermarks in Digital Collections

Title: *The Watermarks Project: documenting watermarks from the 17th century Dutch drawings collection at the Rijksmuseum with low-energy X-ray radiography*

Abstract

The Conservation and Science Department of the Rijksmuseum is currently working on the Watermarks Project. Employing low-energy X-ray radiography, the ongoing documentation campaign focuses on the most prestigious section of the museum's drawings collection: Rembrandt, his pupils and other 17th century Dutch artists.

Low-energy X-ray radiography is combined with imaging plates as it enables the visualization of the watermark without interference from unpigmented drawings or sketches. Within the project, not only high-resolution digital images of the watermark (when it is present) are taken, but the entire sheet of paper used for the drawing is captured, unveiling the chain and laid line structure.

Radiographs of several thousands of Dutch drawings are expected to be taken over a period of two years with the aim of making the high-resolution images available to the Watermark community and to the broader audience by publishing the results online, freely available, on the museum website.

As the project progresses, the digital images are being systematically organized and shared internally with colleagues as an initial step. Concurrently, a preliminary index of the identified watermarks is being compiled.

The imaging campaign has been ongoing for over a year, during which the use of the X-ray unit has garnered interest from others as well. Through the museum's Research Request Form, artworks on paper from various collections have been analyzed, yielding new and fascinating insights. This demonstrates the technique's versatility and utility for studying a wide range of paper-based artworks.

Contact information:

Aurora Belli, Hobbemastraat 22, 1071 ZC Amsterdam, a.belli@rijksmuseum.nl, +31 648283915

Abstract:
Innovative watermark research in Dutch drawings: a pilot project at the RKD

Sytske Weidema / Sabine Craft – Giepmans

February 10, 2025, RKD / The Hague

The RKD – Netherlands Institute for Art History in The Hague provides access to knowledge, research, and information about Netherlandish art in an international context. In the pilot project, "Innovative research into watermarks in Dutch drawings," the RKD systematically investigates watermarks in a set of c. 500 seventeenth century Dutch drawings, focusing on those in the oeuvre of Rembrandt and his circle. The project involves collaboration with six Dutch and French collections to analyze 17th century drawings and aims to present freely accessible watermark data within RKD Research, linked to artwork and artist information.

This initiative, funded by E-RIHS (European Research Infrastructure for Heritage Science) addresses the important role of watermarks in paper for understanding art production, dating, and provenance, while showring the RKD's engagement with computational art history and to enhance digital accessibility. As traditional watermark research methods are often time-consuming and yield noisy images, we assess with a group of students the opportunities of the new Watermark Imaging System (WImSy), developed by Yale University. This mobile device is capable of rapidly visualizing and capturing both surface and internal paper structures under various lighting conditions. Complementary video-overlay and marking-tool software facilitates precise comparison and identification of watermarks, significantly improving accuracy, especially as watermark libraries expand.

This project allows the RKD to contribute meaningfully to innovative art historical research and digital humanities. By showcasing the WImSy and associated software, the RKD aims to build a network of collaborators and promote knowledge sharing. This presentation will serve as a call to action for international collaboration and a demonstration of the RKD's commitment to open access resources and the sharing of data and expertise of Netherlandish artworks on paper to the community.

Title: Exploring Watermarks in Historical Sierra Leonean Documents

Abstract:

Watermarks in historical documents provide crucial insights into the origins, trade networks, and cultural exchanges of past societies. In Sierra Leone, a country with a rich history shaped by trade and colonial influences, many archival materials remain understudied, particularly in terms of their watermarks. This presentation will explore watermarks found in historical documents from Sierra Leone, focusing on their digitization and analysis. Using modern techniques, including AI-driven tools, the project seeks to identify and classify watermarks while connecting them to global historical narratives, such as the transatlantic trade and colonial administration. Additionally, this work highlights the importance of preserving these artifacts through digital platforms, ensuring their accessibility for researchers worldwide. By sharing this research, I aim to contribute to the broader understanding of watermarks in African historical archives and promote collaboration in the digitization of underrepresented collections.

Contact Information:

Name: Ibrahim Jabbie

Affiliation: Africa ReLeaf, YALI RLC Sierra Leone Alumni, Tour Guide Manager at Fambul Tik Heritage Company

Email: ibrahimjabbie10@gmail.com

Phone: +23279290812

Location: Freetown, Sierra Leone

Using multispectral imaging to augment digitized West African manuscripts

The Herskovits Library of African Studies at Northwestern University Libraries (NUL) is home to over 3,000 Arabic script materials from West Africa. The size, scope and uniqueness of these collections, along with increasing global scholarly interest, make them a priority for conservation and digitization. In collaboration with curatorial and digitization staff, the NUL Preservation Department has established protocols for capturing multispectral images (MSI) of the collections using a VSC®80 forensic questioned document examination workstation. These MSI – including annotated transmitted IR images of watermarks – are being integrated into the digital repository alongside the digitized West African manuscripts.

Paden 417 (مختصر في فروع المالكية), a copy of the "Mukhtasar" of Khalil b. Ishaq b. Musa al-Jundi, a fourteenth-century handbook of Maliki legal principles, is one of the oldest, largest and most complex manuscripts we have worked on. It includes watermarks commonly found in papers produced for the Islamic market, including variations of the crown-star-crescent motif and the *tre lune*. The VSC®80 allows us to quickly and consistently capture and annotate a wide range of MSI which make visible watermarks, inks, evidence of burnishing, and other materiality of the manuscripts. For this pilot project, leaves of Paden 417 were imaged in visible, raking, transmitted, ultraviolet, infrared, and transmitted IR light. Watermark measurements, chain line distances, and other relevant notations are added to the image during capture.

As of this writing, Paden 417 has been treated, housed, digitized, and VSC®80 images of select pages have been captured. We anticipate that the manuscript and associated MSI will be available in the digital repository by Spring 2025. This talk will include discussion of the digital workflow that supports making these images publicly accessible and explore the limitations and possibilities of local and global AI initiatives.

Contact:

Stephanie Gowler (she/her)
Book & Paper Conservator
Northwestern University Libraries
Evanston, Illinois, U.S.A.
stephanie.gowler@northwestern.edu

Co-presenter:

Nicole Finzer (she/hers)
Lead Digital Projects and Outreach Librarian
Digital Products and Data Curation
Northwestern University Libraries
Evanston, Illinois, U.S.A.
n-finzer@northwestern.edu