

## **PAPER HISTORY**

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### Deadlines for contributions: 1st January and 1st June

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## LETTER OF THE PRESIDENT, MAY 2020

Dear members of IPH,

Obituaries in this issue illustrate the sad news of the death of IPH President 2004 – 2008 Dr. Józef Dąbrowski in Poland, the death of Honorary Member of IPH Dr. Sidney Koretsky in United States and the death of former secretary of IPH 2002 – 2006 Ursula Reinhard in Germany. They have for many years been faithful and valuable members of IPH and we will commemorate them with gratitude.

Since the first IPH Congress in Mainz in 1960, it has for the first time in sixty years been necessary in our history to postpone an IPH Congress. Nobody knows for how long the Corona virus pandemic will force us to keep a safe distance between each other, to stay at home and to keep up a very limited contact to family and friends and to live with closed frontiers and cancelled flight connections. However, some day in the future these conditions will be over.

We cannot meet in September 15th – 18th this year as planned, but next year we can look forward to be coming together at the 35th IPH Congress in Washington, DC in United States of America. All information from the excellent planning committee in United States of America will be published on our website [www.paperhistory.org](http://www.paperhistory.org) and in Volume 24/ Year 2020, Issue 1 and 2 together with announcement and date of the General Meeting of IPH. In this strange year for all of us I expect that the annual paper historical meetings in Eu-

rope will be postponed as well as the plans for the NPH meeting in Finland of the Nordic association of Paper Historians.

Until the pandemic is a thing of the past it is important that we keep in touch not only by websites, mail and SMS as usual, but also by phone calls, distributions of new articles and ideas and by handwritten letters on paper. The updated list of IPH members with email and postal address is available for IPH members in the Member Section of [www.paperhistory.org](http://www.paperhistory.org). If you have not already access to this section via your user name and pass word, please contact Emanuel Wenger at [emanuel.wenger@oeaw.ac.at](mailto:emanuel.wenger@oeaw.ac.at).

Applications from new IPH members have increased considerably during the last couple of months, which is indeed very promising and inspiring for the development of IPH, our International Association of Paper Historians.

For new contributions to publication in 'IPH Paper History' please send your proposals to Patricia Engel at [drpatriciaengel@gmail.com](mailto:drpatriciaengel@gmail.com) and Aude Argouse at [oddargo@gmail.com](mailto:oddargo@gmail.com), both editors of the peer reviewed IPH periodical. Remember the new deadlines are January 1st and June 1st and follow the Guidelines, published in 'IPH Paper History', Volume 23, Year 2019, Issue 1 and 2.

Anna-Grethe RISCHHEL

## BRIEF DER PRÄSIDENTIN, MAI 2020

Liebe IPH Mitglieder,

*In dieser Ausgabe unseres Periodikums finden Sie zunächst die traurige Nachricht vom Ableben Dr. Józef Dąbrowski aus Polen, der zwischen 2004 und 2008 Präsident der IPH war, dann die traurige Nachricht vom Ableben unseres Ehrenmitglieds der IPH Dr. Sidney Koretsky aus den USA, sowie die traurige Nachricht vom Ableben von Ursula Reinhard aus Deutschland, die zwischen 2002 und 2006 Sekretärin der IPH gewesen ist. Wir gedenken ihrer in Dankbarkeit.*

*Noch nie in unserer 60 jährigen Geschichte, angefangen beim 1960 in Mainz abgehaltenen IPH Kongress, war es nötig gewesen einen Kongress zu verschieben. Im Moment weiss allerdiengs niemand wie lange uns*

*die Corona Virus Pandemie das Abstandhalten zwischen Menschen, das Zu Hause Bleiben oder den reduzierten Umgang mit anderen, sowie eingeschränkte Reisefreiheit aufzwingt. Irgendwann wird alles vorüber sein.*

*Wir können also nicht, wie es geplant war, vom 15.-18. September 2020 zusammenkommen. Im Moment planen wir den 35. IPH Kongress in Washington, DC (USA) für das nächste Jahr. Die genaueren Details werden auf der Website [www.paperhistory.org](http://www.paperhistory.org), sowie im VI. 24/2020 Band 2 zusammen mit der Bekanntgabe des Datums der IPH Generalversammlung veröffentlicht. Ich gehe davon aus, dass auch die Treffen der Europäischen Papierhistoriker verschoben werden,*

z.B. das NPH (Nordic association of Paper Historians) Treffen in Finland.

Bis die Pandemie der Vergangenheit angehört ist es wichtig in Kontakt zu bleiben; nicht nur durch das Besuchen der Webpage, durch E-Mails und SMS, wie üblich, sondern auch mittels Telefonanrufen, das Verbreiten neuer Artikel und Ideen und mit Hilfe handgeschriebener Briefe auf Papier.

Eine aktualisierte Liste der Mail- und Postadressen der IPH Mitglieder ist im Mitgliederbereich unter [www.paperhistory.org](http://www.paperhistory.org) zu finden. Sollten Sie noch keinen Benutzernamen und kein Passwort haben, bitte ich Sie Emanuel Wenger [emanuel.wenger@oeaw.ac.at](mailto:emanuel.wenger@oeaw.ac.at) zu kontaktieren.

## LETTRE DE LA PRÉSIDENTE, MAY 2020

Chères et chers membres de l'IPH,

Les nécrologies publiées dans ce numéro concernent la triste nouvelle du décès du président de l'IPH 2004 - 2008, le Dr Józef Dąbrowski en Pologne, du membre honoraire de l'IPH, le Dr Sidney Koretsky aux États-Unis, et de l'ancienne secrétaire de l'ISP 2002 - 2006, Ursula Reinhard en Allemagne. Tous trois ont été pendant de nombreuses années des membres fidèles et précieux de l'IPH. Nous nous en souviendrons avec gratitude.

Depuis le premier Congrès à Mayence en 1960, il a été nécessaire pour la première fois en soixante ans de reporter un Congrès de l'IPH. Personne ne sait pour combien de temps la pandémie due au corona virus nous obligera à maintenir une distance de sécurité entre nous, à rester chez nous et à avoir un contact très limité avec notre famille et nos amis, à vivre avec des frontières fermées et des correspondances aériennes annulées. Toutefois, un jour, ces conditions ne seront plus d'actualité. Nous ne pouvons donc pas nous réunir cette année comme prévu du 15 au 18 septembre. Cependant, nous pouvons espérer nous réunir au 35<sup>e</sup> congrès de l'IPH à Washington DC l'année prochaine. Toutes les informations provenant de l'excellent comité de planification aux États-Unis seront publiées sur notre site web [www.paperhistory.org](http://www.paperhistory.org) et dans le volume 24 / Année 2020, numéros 1 et 2, ainsi que l'annonce et la date de l'assemblée générale de l'IPH. En cette année étrange pour tous, je m'attends à ce que les rencontres annuelles en Europe autour de l'histoire du pa-

Anträge auf Aufnehmen sind in den vergangenen Monaten ständig gewachsen. Das gibt Mut und Zuversicht. Neue Artikel für die 'IPH Paper History' werden gerne von Patricia Engel [drpatriciaengel@gmail.com](mailto:drpatriciaengel@gmail.com) und Aude Argouse [oddargo@gmail.com](mailto:oddargo@gmail.com) entgegengenommen. Bitte denken Sie dabei an die neuen Einreichfristen, den 1. Januar und den 1. Juni eines Jahres und bitte beachten Sie die Autorenrichtlinien, die im Vol. 23, 2019, Band 1 und 2 der 'IPH Paper History' zu finden sind.

Anna-Grethe RISCHÉL

pier soient reportées ainsi que les projets de réunion de l'Association Nordique des Historiens du Papier en Finlande (NPH).

Tant que la pandémie n'est pas passée, il est important que nous restions en contact non seulement par les sites web, courriers et SMS comme d'habitude, mais aussi par les appels téléphoniques, la diffusion de nouveaux articles et de nouvelles idées ainsi que par des lettres manuscrites sur papier. La liste actualisée des membres de l'IPH, avec leurs adresses électronique et postale, est disponible dans la section «Membres» du site [www.paperhistory.org](http://www.paperhistory.org). Si vous n'avez pas encore accès à cette section via votre nom d'utilisateur et votre mot de passe, veuillez contacter Emanuel Wenger [emanuel.wenger@oeaw.ac.at](mailto:emanuel.wenger@oeaw.ac.at).

Les demandes d'adhésion à l'IPH ont considérablement augmenté au cours des derniers mois, ce qui est très prometteur et encourageant pour le développement notre Association Internationale des Historiens du Papier.

Pour de nouvelles contributions dans la revue «IPH Paper History», veuillez envoyer vos propositions à Patricia Engel [[drpatriciaengel@gmail.com](mailto:drpatriciaengel@gmail.com)] et Aude Argouse [[oddargo@gmail.com](mailto:oddargo@gmail.com)], rédactrices en chef de la revue. N'oubliez pas que les nouvelles dates de réception des propositions sont le 1<sup>er</sup> janvier et le 1<sup>er</sup> juin et que les normes éditoriales sont publiées dans «IPH Paper History», Volume 23, Année 2019, Numéros 1 et 2.

Anna-Grethe RISCHÉL

## ANNOUNCEMENT IPH Congress in Washington, DC postponed

It is with sincere regret that the IPH2020 Planning Committee announces the postponement of the 35th IPH Congress in Washington, DC originally planned for September 15-18, 2020. Although we all hope that the worst of the COVID-19 pandemic will be over by this fall, we cannot be certain that the outbreak will be resolved by that time. Travel within America and overseas travel from Europe to the US are both severely restricted for the foreseeable future. Potential conference speakers and attendees will wish to see how the situation resolves in their home state or country before they can commit to coming to Washington DC. It is a time when our mutual interest in paper history must yield to more pressing concerns.

Together with the IPH Council, the Planning Committee will announce a new date in 2021 for the Congress. We have planned an enticing program with thirty-two outstanding speakers from around the world, and we wish to give them the opportunity to present their research to the largest possible audience. The new date for registration will be announced after the Congress dates have been determined. We thank you for your understanding and flexibility.

Please check the [IPH website](http://www.paperhistory.org) for further notifications. To whet your appetite for next year, the website now includes an illustrated Invitation to IPH 2021, [http://www.paperhistory.org/Congress-events/congress2020/IPH\\_2021\\_PPT.pdf](http://www.paperhistory.org/Congress-events/congress2020/IPH_2021_PPT.pdf), featuring views of the three host institutions and some of their treasures, as well as the Congress agenda.

*Mit großem Bedauern sieht sich das Kongresskomitee gezwungen die Verschiebung des 35. IPH Kongresses, der für 15. bis 18. September 2020 in Washington DC geplant war, bekanntzugeben. Obwohl wir hoffen, dass das Schlimmste in der COVID-19 Krise im Herbst überstanden sein wird, können wir im Moment nicht mit ausreichender Sicherheit davon ausgehen. Die Reisefreiheit innerhalb und in die USA ist stark eingeschränkt. Die Redner und Teilnehmer der Konferenz werden voraussichtlich zunächst die Entwicklung in ihren Heimatländern abwarten, bevor sie an die Reise in die USA denken. Im Moment werden die Gedanken an die Papiergeschichte durch aktuellere überlagert.*

*Gemeinsam mit dem IPH Council wird das Kongress-*

*komitee ein neues Datum in 2021 veröffentlichen. Wir haben ein hervorragendes Programm mit 32 hervorragenden Rednern aus der ganzen Welt zusammengestellt und es ist unser Anliegen diesen die Möglichkeit zu geben ihre Forschungsergebnisse vor einem größtmöglichen Publikum zu präsentieren.*

*Die neuen Anmeldezeiten werden nach dem Festlegen der Kongresszeiten bekanntgegeben. Wir danken Ihnen für Ihr Verständnis und Ihre Flexibilität.*

*Bitte halten Sie sich über die [IPH Webpage](http://www.paperhistory.org) aktuell. Um Ihren Appetit anzuregen, gibt es einige Bilder der gastgebenden Institutionen unter [http://www.paperhistory.org/Congress-events/congress2020/IPH\\_2021\\_PPT.pdf](http://www.paperhistory.org/Congress-events/congress2020/IPH_2021_PPT.pdf)*

Le Comité Organisateur de l'IPH 2020 est au regret d'annoncer le report du 35<sup>e</sup> Congrès International des Historiens du Papier, initialement prévu du 15 au 18 septembre 2020 à Washington, DC. Nous espérons bien sûr que la pandémie du COVID-19 sera derrière nous cet automne, mais nous ne pouvons être certains qu'une solution sera trouvée d'ici-là. Des restrictions s'appliqueront probablement aux déplacements en Amérique ainsi qu'aux voyages entre l'Europe et les USA. Les conférenciers et participants voudront s'assurer de l'évolution de la situation dans leur état ou pays avant de s'engager à venir jusqu'à Washington, DC. Cette période exige que notre intérêt partagé pour l'histoire du papier s'efface devant des considérations plus pressantes. En accord avec le Conseil de l'IPH, le Comité Organisateur annoncera sur le site de l'IPH une date pour le Congrès en 2021. Nous avons préparé un programme très attractif avec ses trente-deux conférenciers internationaux et nous souhaitons leur permettre de présenter leur recherche au plus large public. La nouvelle date d'inscription sera annoncée lorsque les dates du Congrès auront été arrêtées. Nous vous remercions de votre compréhension et de votre disponibilité.

Veuillez consulter le site IPH pour les annonces à venir. Et pour vous mettre l'eau à la bouche pour l'année prochaine, le site comprend maintenant une invitation illustrée, [http://www.paperhistory.org/Congress-events/congress2020/IPH\\_2021\\_PPT.pdf](http://www.paperhistory.org/Congress-events/congress2020/IPH_2021_PPT.pdf), présentant des vues des trois institutions hôtes et certains de leurs trésors, ainsi que l'annonce du Congrès.



# IPH 35th Biennial Congress Schedule, Washington DC, 2021

	Monday	Tuesday	Wednesday	Thursday	Friday
	Early Registration	Library of Congress (LOC)	Library of Congress (LOC)	National Gallery of Art (NGA)	National Archives and Records Administration (NARA)
<b>8:00 AM</b>					
8:15 AM					
8:30 AM		8:30 - 9:30 <b>Registration Open</b>			
8:45 AM					
<b>9:00 AM</b>		9:00 - 9:20 <b>Opening Remarks</b>		8:30 - 9:15 <b>Breakfast</b>	Business meeting
9:15 AM					
9:30 AM		9:20 - 10:10 <b>Keynote Address</b>	9:00 - 10:30 <b>Presentations</b>		
9:45 AM					
<b>10:00 AM</b>		10:10 - 11:00 <b>Presentations</b>		9:30 - 11:00 <b>Presentations</b>	10:00 - 10:45 <b>Brunch</b>
10:15 AM			10:30 - 11:00 <b>Coffee Break</b>		
10:30 AM					
10:45 AM					
<b>11:00 AM</b>		11:00 - 11:30 <b>Coffee Break</b>	11:00 - 12:30 <b>Presentations</b>	11:00 - 11:30 <b>Break</b>	10:45 - 12:35 <b>Presentations</b>
11:15 AM					
11:30 AM					
11:45 AM					
<b>12:00 PM</b>		11:30 - 1:00 <b>Presentations</b>	12:30 - 2:00 <b>Lunchtime Talks by LOC Staff</b>	11:30 - 1:00 <b>Presentations</b>	
12:15 PM					
12:30 PM					
12:45 PM					
<b>1:00 PM</b>		1:00 - 2:00 <b>Lunch Break</b>	Boxed lunch	1:00 - 2:00 <b>Lunch Break</b>	12:35 - 1:45 <b>Lunch Break</b>
1:15 PM				Boxed lunch	On your own
1:30 PM					
1:45 PM					
<b>2:00 PM</b>		2:00 - 2:30 <b>Presentations</b>			1:45 - 3:15 <b>Presentations</b>
2:15 PM					
2:30 PM			2:15 - 4:30 <b>LOC Tours</b>	2:00 - 4:30 <b>NGA Tours</b>	
2:45 PM			Conservation and Preservation	Print and Drawings Study Rooms	
<b>3:00 PM</b>		2:30 - 5:00 <b>LOC Events</b>	Research and Testing	Paper Conservation Lab	3:15 - 5:00 <b>Various Institution Tours</b>
3:15 PM		Display of Special Collections and Rare Books	Watermarks Database	Paper Sample Collection	NARA Early American Documents
3:30 PM		Paper History Films	Practicum	Library Rare Books	Dard Hunter Paper Collection
3:45 PM					Asian Art
<b>4:00 PM</b>					U.S. Mint
4:15 PM					
4:30 PM					
4:45 PM					
<b>5:00 PM</b>					
5:15 PM					
5:30 PM	5:00 - 7:00 pm <b>Early Registration at Library of Congress</b>				
5:45 PM					
<b>6:00 PM</b>					
6:15 PM	OPENING GAVEL				
6:30 PM	Wine and cheese				
6:45 PM					
<b>7:00 PM</b>		6:30 - 8:30 <b>Opening Reception at Library of Congress</b>			6:30 - 8:30 <b>Closing Banquet</b>
7:15 PM					
7:30 PM					
7:45 PM					
8:00 PM					
<b>8:00 PM</b>					
8:15 PM					
8:30 PM					

# GRAVATÁ FIBER (BROMÉLIA BALANSAE). A BRAZILIAN ALTERNATIVE FOR THE PAPER OF THE XIX CENTURY

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## ABSTRACT

This study aims to identify the use of gravatá fibers at Orianda's factory paper production, for printing the newspaper Correio Mercantil, from 1856. This factory received financial incentives and privileges to find native fibers from Brazilian flora as an alternative to paper imported from Europe. To verify this hypothesis, micro-samples of paper extracted from different editions of the aforementioned newspaper and standard samples of paper produced with gravatá fiber were analyzed by Scanning Electron Microscopy combined with Dispersive Energy Spectroscopy (SEM-EDS). We were able to access the elemental composition of the samples. The obtained data were approached by multivariate statistical methods, allowing to verify the similarities and differences in the composition of other two samples, which led to confirm the use of this fiber in the production of national paper for the Correio Mercantil.

**Key words:** Orianda Factory; Paper making; Brazilian paper; Native fiber; SEM-EDS analysis; Analysis by PCA; gravatá fiber

## INTRODUCTION

With French troops closing to arrival at Lisbon in 1807, the transfer of the royal family and their court to Rio de Janeiro showed to be a strategy to preserve Portuguese sovereignty in tropical lands. This brought political and socioeconomic changes for Brazil. Measures were taken to match Portuguese needs to the reality and administrative-legal limitations of the colony. The commercial regulation from April 1st, 1808, opened commercial barriers, granting import duties on raw materials and subsidies for the construction of the first manufactures [1]. The embryonic national paper industry was searching for alternatives to replace imported flax and hemp

fibers and cotton rags with native Brazilian fibers. Their efforts received financial incentives, such as granting of lotteries and privileges from the Imperial Government, which turned the race to develop a paper made from national fibers a fierce dispute between manufacturers. The use of native fibers is mentioned by different paper producers in the 19th century. The Orianda factory, which operated between 1852 and 1859, and produced writing and newspaper papers [2; 3], possibly is among those producers. This article, which aims to identify gravatá fibers (*Bromélia balansae*) in the paper produced by the Orianda factory, is part of a broader study of the first paper factory installed in Brazil and their

production, raw materials and technology used between the 19th and 20th centuries. i

#### THE NATIVE FIBERS OF GRAVATÁ AND THE BRAZILIAN PAPER

The Orianda factory, owned by Guilherme Schüch de Capanema, located at Serra da Estrela, in Petrópolis, city of Rio de Janeiro state, was one of those that received loans and industrial privileges from the Imperial government to produce paper using native fibers. To keep the factory up and running, Capanema sought for production alternatives to make a national paper. However, he faced difficulties that included: unskilled workforce, rudimentary machinery and methods, and a shortage of raw materials. According to studies, this factory produced papers made from gravatá, corindíba, coconut, other species of malvacea and urtica palms [4]. The newspaper *Correio Mercantil* from Rio de Janeiro circulated between 1848 and 1868. The edition from September 7th, 1856, had a note stating that this edition was printed with paper manufactured with national raw material, without indicating which fiber was used [5]. However, Sebastião Ferreira Soares, when writing the book “History of the Orianda paper factory the defense of Dr. Guilherme Schüch de Capanema”, edited in 1860, states that gravatá fibers paper was used to print some editions of the aforementioned newspaper [6].

Copies from two decades of the *Correio Mercantil*, under the responsibility of the Biblioteca Nacional’s Periodicals Sector and Serial Publications, allowed us to propose an investigation to confirm the use of gravatá fiber in the 19th century Brazilian paper production.

To investigate the established hypothesis, four micro-samples from different editions of the *Correio Mercantil*, from July 24th, September 7th, October 1st and December 12th, 1856, and two micro-samples of paper known to be produced from gravatá fiber were analyzed using the Scanning Electron Microscopy technique combined with Energy Dispersive Spectroscopy (SEM-EDS). Those analyzes allowed us to obtain data regarding the elemental composition of the samples and images of the fibers present in the papers. Multivariate statistical methods from Principal Component Analysis (PCA), which allows investigating similarities and differences, was used on the elementary data composition treatment. Through its results was possible to verify that the sample extracted from *Correio Mercantil*, September 7th, 1856 edition, is distinct from the other samples from this newspaper and has similarities with one of the samples of reference papers produced with gravatá fiber.

#### USE OF BRAZILIAN NATIVE FLORA IN PAPER MAKING: A CASE STUDY OF CORREIO MERCANTIL, A 19TH CENTURY NEWSPAPER

The analyzes of the paper used in the September 7th, 1856, edition of *Correio Mercantil* began with the identification of the historical and physical characteristics macroscopically observable, in order to carry out its registration and documentation. These data served as informative guidance for knowing the paper and its constituent materials, in addition to enabling conservators to establish its state of conservation and the probable causes of deterioration.

##### Organoleptic Analysis

The analyzed specimen (Fig. 1a) is bound together with other editions of the same journal. These volumes were cut at the edges during the binding process, which reduced its dimensions. The paper presents a light beige color, medium opacity, regular physical resistance and flexibility when handled. The surface is smooth, which insure a good printing. In the examination using transmitted light (Fig. 1b), in which the paper were overlayed under a light source (9 LEDs, 45 lumens), it was possible to observe a uniform paste, characteristic production of continuous paper machine. According to Soares (1860), the Orianda factory had English-made machinery, identified as Sanford [6].

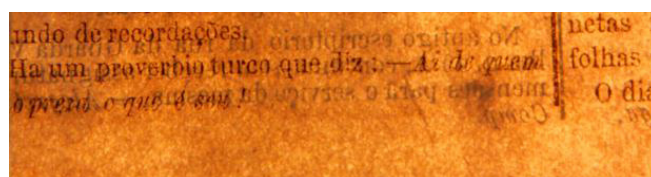
Documents from Orianda’ factory containing information about the loads used in the production of the papers were’nt found, nor about the native fiber papers, such as gravatá.



**Fig.1**

First page of *Correio Mercantil*, September 7th, 1856 (a) and detail of the paper fibers by transmitted light (b).

Source: Biblioteca Nacional do Brasil. Periodicals Sector and Serial Publications.



However, in the financial records of the Orianda factory, from January 1st, 1860, presented as part of the defense in favor of Guilherme Schüch, for the bankruptcy of the factory, there is a list of materials used in the processes



of bleaching and gluing paper. For bleaching were listed manganese, sulfuric acid, lime hypochloride and soda hyposulfate. The gluing products include: black resin, white resin, calcined soda, powder and humid stone. These products were identified as factory goods, and are part of a long list that also includes: felts, canvas, reams of paper, various machinery for the processes of paper production, animals and carts [6].

#### **Analysis by SEM-EDS and PCA methods**

Scanning Electron Microscopy (SEM) analyzes were performed on a Hitachi TM3000, which allows maximum magnification of 30,000X. This device is attached to a Dispersive Energy Spectroscopy (EDS) system, which permits to collect spectra of the elementary composition of the papers. All spectra were collected with the equipment operating at voltage of 15 kV and low vacuum, using the same magnification in all EDS analyzes and recording each spectrum for 120 s.

A micro-sample of paper extracted from the Correio Mercantil from September 7th, 1856 edition, three micro-samples of paper obtained from July, October and December 1856 editions of the aforementioned newspaper and two reference micro-samples of papers manufactured with gravatá fibers (35 g and 75 g) were analyzed by SEM-EDS. The analyzes of this set of samples provided data on the elementary composition and images of the microstructure of the papers, with which the sample from September 1856 edition was compared with the samples from other editions and with the gravatá fiber reference papers.

The micro-sample was extracted from the lower left edge of the September 1856 edition and has less than 1 mm of diameter. Those from other editions were taken from fragments that were found loose at the newspapers. ii The samples of paper manufactured with 35 g and 75 g of gravatá fiber, used as reference, were purchased at the Moinho Brasil factory, located in the municipality of Echaporã, São Paulo, which is dedicated to the artisanal production of paper from fibers such as gravatá, corn, cane, cattail, banana and cotton. For the analysis, all micro-samples were prepared with the same size.

The Principal Component Analysis (PCA) multivariate statistical method was applied to perform a comparative study using the data obtained by SEM-EDS. It is a statistical method widely used in analytical data obtained from historical artifacts, which allows verifying similarities and differences between the set of analyzed samples [7; 8; 9]. The PCA investigations occurred from the data collected by EDS, regarding the elementary

spectra of samples. Data from the entire spectra were used, which consists of 1024 channels that accumulate photon counts and refer to the elements detected in the samples. These data were used without any previous treatment and formed a data matrix with dimensions of 6 rows and 1024 columns, which was investigated using PCA through the software The Unscrambler X. This method was chosen because it was successfully employed in the investigation of similarities between marajoara ceramic materials, combining data obtained by elementary analysis and PCA [9].

#### **Results Discussion**

In elementary analyzes by EDS, the elements C (carbon), O (oxygen), Na (sodium), Mg (magnesium), Al (aluminum), Si (silicon), S (sulfur), Cl (chlorine), K (potassium) and Ca (calcium) were characterized in all samples. The high intensities of C and O are justified by the composition of cellulose fibers, which are polymers with long chains of C and O [10; 11]. The other elements are explained by the agents used as bleachers, binders and loads. Elements such as Na, S, Cl and Ca are part of the molecular formula of compounds such as sulfuric acid, lime hypochloride and soda hyposulfate, which were used as bleachers at the Orianda factory, as described above. While elements such as Mg, Al, Si and Ca are part of the molecular formula of kaolinite ( $\text{Al}_2\text{Si}_2\text{O}_5(\text{OH})_4$ ), aluminum hydroxide ( $\text{Al}(\text{OH})_3$ ) and calcium and magnesium salts, which are commonly used as loads in paper making and influence the connections between fibers [12; 13].

In the 19th century, elements such as kaolin (aluminum silicate), calcium carbonate and magnesium were used to give the paper a greater opacity. Aluminum sulphate and potassium (potassium aluminum), known as humid stone, was used as a gluing element and as a biocidal agent. Other substances were used in the gluing of fibers, such as pitch resin or colophony, which has sulfur in its composition. [12].

The EDS spectra collected on the six samples, seen in Fig.2, show great similarities. The main difference between them is in the intensity of the detected elements. The PCA result can be observed through the score plot, shown in Fig. 3, where the first two components PC1 and PC2 respectively correspond to 95% and 4% of the variance between the samples, totalizing 99%. This observed variance is due to differences, although small, in the composition of the papers, which may be a reflection of different manufacturing processes or in the use of different raw materials (fibers, bleachers, loads and gluing material).

From the score plot, it is possible to verify that the sample of the September 1856 edition differs from the other samples of the Correio Mercantil editions. This difference can be explained by the spectra of the elementary analysis of July, October and December editions (Fig.2), which presented higher intensities of Al and Si, when compared to the September sample. Also in Fig.3, it is possible to notice that the sample of the September 1856 edition is closest to the 75 g gravatá fiber sample, indicating similarities in their elemental composition.

The comparison between the microstructure images of the samples obtained by SEM (Fig.4 a, b and c) reveals similarities between the thickness of the fibers present in the gravatá paper 75 g and in the September 1856 edition (Fig.4 a and b). However, the microstructure's image of gravatá paper 35 g, shown in Fig. 4c, it is possible to see thinner fibers, which differ from the shape of fibers present in the two papers previously observed (Fig. 4 a and b).

## CONCLUSIONS

Through the results of SEM-EDS and PCA, it was possible to verify that the paper employed in the September 7th, 1856 edition of the Correio Mercantil newspaper was manufactured with gravatá fiber. The results also indicated that the elements detected are part of the molecular formula of products, in the goods inventory of the Orianda factory, indicating that the paper has been manufactured in this location. Interestingly, it was possible to verify that the paper produced in this factory followed manufacture recipes used in international pro-

ocols, in view of inferred compounds [14].

The analyzes confirm that, although it was difficult to keep the Orianda factory up and running for different reasons, Capanema was able to research and add the native fibers into the paper matrix and produce quality papers, as evidenced by the excellent conservation state of the edition. His entrepreneurship and perseverance boosted a nascent paper industry in 19th century Brazil. Reports from newspapers and publications from that period show part of the memory from the beginning of industrialization in the country and point out that this paper factory helped composing the trajectory for the search of self-sufficiency of raw material (fiber) and product (paper).

Throughout the 19th century, other paper factory sought for new fibers, abundant in Brazilian flora, to replace or reduce the amount of imported raw materials or papers from Europe to supply the Brazilian market. However, until this study, it was this paper from the Orianda factory that made it possible to confirm the use of native fibers in this attempt to produce a national paper.

<sup>i</sup> Gravatá (*Bromelia balansae*) is a perennial, upright plant, 40 - 90 cm high, found in central Brazil and on the coast of the Atlantic Forest. Gravatá has a high content of lignocellulosic fibers [15]. Gravatá fibers are used by local communities in the manufacture of ropes and handicrafts. Gravatá fibers have good thermal and mechanical properties and high cellulose content [16].

<sup>ii</sup> This measure was necessary to maintain the integrity of the newspaper's copies, given its historical value.

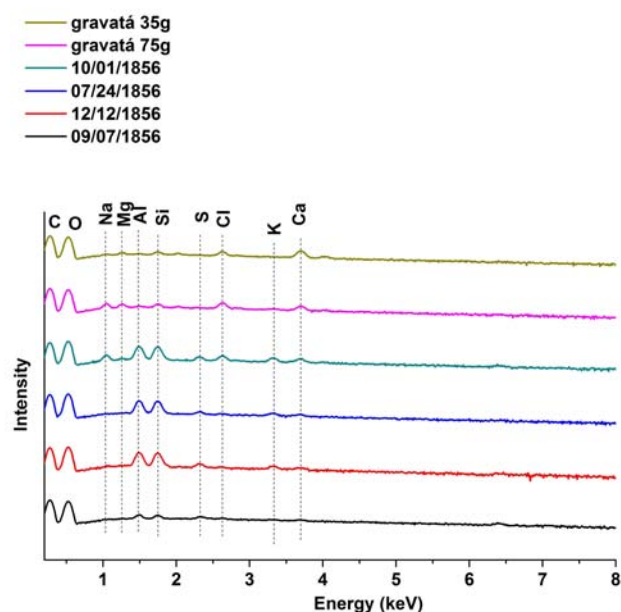


Fig. 2 Spectra of elementary analysis obtained by EDS.

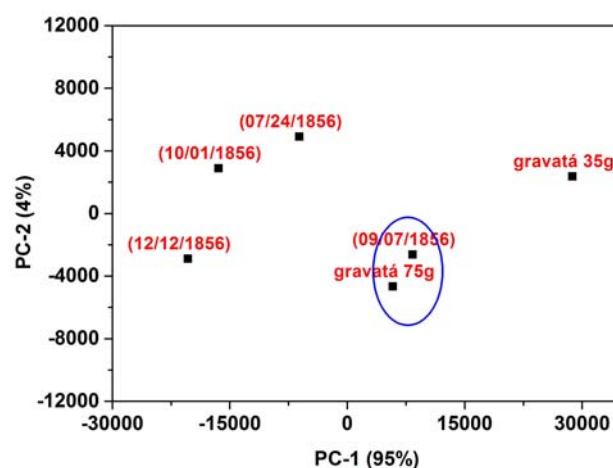
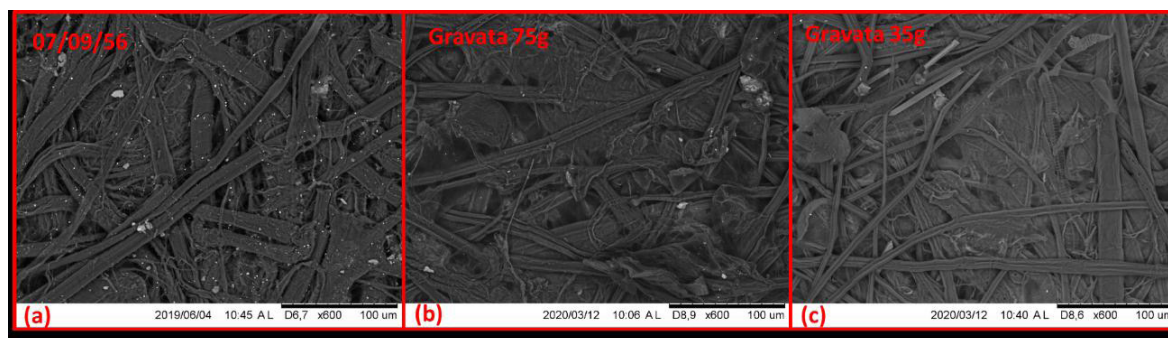


Fig. 3 Graph of the scores obtained by PCA.



**Fig. 4 (a, b and c)** Images of the microstructure of papers from the September 1856 edition, gravatá 75g and 35 g, respectively.

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## IN MEMORIAM DR. SIDNEY KORETSKY (1921-2020)

Honorary Member of IPH, Dr. Sidney Koretsky died peacefully in his home in Brookline, Massachusetts after a long and active life a few days after his 98- year's birthday. He was born in Chelsea, Massachusetts in December 1921 and received his AB degree at Harvard in Biochemistry in 1943. In 1946 he finished his studies with his MD at Jefferson Medical College and served as medical officer in the US Army in Korea and Japan from 1947 – 1948. After his return to United States he was employed as a resident in Internal Medicine at Boston City Hospital.

Sydney Koretsky was a deeply dedicated and devoted physician who in his career combined patient care at his medical practice in Brookline with teaching medical students at Tufts University School of Medicine as well as research in cardiology at Beth Israel Hospital. He was a member of the medical staff of Beth Israel Hospital and Tufts New England Medical Center and President of the Greater Boston Medical Society.

Sidney Koretsky maintained his medical practice for 40 years in Brookline until his retirement in 1997 at the age of 76. Since then he concentrated nearly full time on researching in paper history together with his dear wife Elaine Koretsky.

Sidney and Elaine were married 1953, and they created a wonderful home for their children, grandchildren, friends and colleagues during their 65 years long and happy marriage. They were complementary to each other during their unique skills and common interests in horticulture, travelling, paper history, papermaking, tools and technology.

Elaine's research in handmade paper and her establishment in 1974 of The Studio Carriage House Paper together with their daughter Donna Koretsky caused Sidney's interest in paper history several years before his retirement. For more than thirty years they travelled together on numerous papermaking tours around the world. As a most talented and skilled amateur photographer and videographer he assisted Elaine in documenting her observations of the still existing handmade paper production and tools in remote places and thus preserved valuable information of the very art of papermaking. In 2001, Sidney Koretsky received a Lifetime



Achievement Award from the Friends of Dard Hunter, an international organization dedicated to papermaking. I have known Sidney and Elaine Koretsky since 1986, where we met at the IPH Congress in Copenhagen. We shared a common interest in studying the still existing handmade paper production in Asia, and in 2007 I joined their China-Expedition to Sichuan and Yunnan. They had joined in IPH since 1984 and attended faithfully 14 IPH congresses in total. In Stockholm 2008 at the General Meeting of the IPH Congress Sidney and Elaine Koretsky were unanimously accepted as Honorable Members of IPH. At their last IPH Congress 2012 in Basel and Upper Rhine Region they both contributed as speakers with presentations of Sidney Koretsky's documentation on video and film.

In spite of his total blindness since 2000 Sidney Koretsky kept his rich and valuable photographic collection of more than thirty years research of handmade paper production completely updated and documented his slide, movie, video and digital images. According to the Koretsky New Year's Letter 2016 and 2017, he worked almost daily at his desk with the help of assistants on publishing a book of all Elaine's 58 articles, written over a period of 17 years, with illustrations of his photographs.

With his organizational skills, interest and dedication to this opus I do hope that he succeeded in finishing this manuscript.

Anna-Grethe Rischel

## IN MEMORIAM URSULA REINHARD (1938-2020)

Am 8. April 2020 ist in Hemer in Westfalen Ursula Reinhard gestorben. Sie wurde am 16. Dezember 1938 in Essen als Ursula von Münster geboren. Die Eheschließung mit Peter Reinhard führte die gelernte Kauffrau nach Hemer, und die Papierwirtschaft wurde für Ursula Reinhard bestens vertrautes Umfeld. Die Papiergroßhandlung Gebr. Reinhard, Hemer, wurde 1988 eines der Gründungsunternehmen der Papier Union, bis die bisherigen Gesellschafter im Jahr 2000 ihre Anteile an die Inapa-Gruppe mit Sitz in Lissabon veräußerten.

Die Tätigkeit der Internationalen Arbeitsgemeinschaft der Papierhistoriker (IPH) unterstützte Ursula Reinhard in vielfältiger Weise über Jahrzehnte hinweg u.a. durch von ihr zusammengestellte Reisebegleiter zu den Kongressen in Malmedy (1990), Wien (1992), Annonay (1994) und Leipzig (1996), durch Vorträge bei den Tagungen in Porto (1998) und in Dortmund (2000), nicht zuletzt als Sekretärin unserer Assoziation in den Jahren 2002 bis 2006.

Der Deutsche Arbeitskreis für Papiergeschichte (DAP) konnte sich auf ihr kontinuierliches Mitwirken bestens verlassen. 1997 organisierte sie zusammen mit ihrem Mann Peter Reinhard die Tagung in Hemer und fasste die gehaltenen Vorträge in einer Publikation zusammen. Zu den Jahrestagungen des DAP verfasste sie stets auf den Tagungsort und die entsprechende Region bezogene informative Reisebegleiter, die von ihrer langjährigen Tätigkeit als Organisatorin von Kulturreisen profitierten. Über lange Jahre bildete die von Peter und Ursula Reinhard jeweils per Diavortrag gewährte Rückschau auf die Tagung des Vorjahrs ein stabiles inneres Band für alle teilnehmenden Freundinnen und Freunde der Papiergeschichte.

Das besondere Engagement von Ursula Reinhard galt der 1991 begründeten Städtepartnerschaft zwischen Hemer und Doberlug-Kirchhain in Brandenburg sowie dem Felsenmeermuseum im heimatlichen Hemer. In Anerkennung dieser Verdienste durften Ursula und Peter Reinhard am 27. März 2020, wenige Tage vor ihrem Ableben, aus der Hand von Landrat Thomas Gemke und Bürgermeister Michael Heil-



mann das von Bundespräsident Frank-Walter Steinmeier verliehene Bundesverdienstkreuz am Bande der Bundesrepublik Deutschland in Empfang nehmen und sich in das goldene Buch der Stadt Hemer eintragen. Bereits diese feierliche Amtshandlung musste in Zeiten der Corona-Pandemie in kleinstem Kreis stattfinden, nun fand auch die Trauerfeier im engsten Familienkreis statt.

Frieder Schmidt

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## IN MEMORIAM DR. JÓZEF DĄBROWSKI (1940-2019)

From Anna Kulnicz I received the sad news of the death of her father Józef Dąbrowski December 30th 2019, together with the beautiful photo. He was a most gifted and respected scientist and for over fifty years he dedicated his life to research into the history of paper. Józef Dąbrowski was born in Warsaw and graduated 1962 in chemistry with a specialization in pulp and paper technology from the Technical University of Lodz. At this centre of papermaking and bibliographic studies in Poland he received his Ph.D in 1974 and in 1989 was appointed Assistant Professor. From 1992 until his retirement 2005 he worked as Scientific Secretary at the Pulp and Paper Institute (ICP), where his research in the history and development of paper production and technology was especially focussed on the permanence and durability of hand- and machine-made paper production.

Józef Dąbrowski was introduced into the field of paper history by Honorary Member of IPH Prof. Jadwiga Siniarska-Czaplicka (1913-1986) in Lodz. Here they worked together on the Polish monograph REKOD-ZIEŁO PAPIERNICZE (The Papermaking Craft) that was published in 1991. The detailed English summaries of part I and II 'Papermaking craft in the world' and 'Polish papermaking craft' with bibliographies make this Polish publication a most valuable and unique contribution to the history of paper to non-Polish paper historians as well.

When I met Józef Dąbrowski in 1994 at the 22nd IPH Congress in Annonay he gave me a copy of this Polish monograph with the following handwritten text 'This copy of the book entitled 'The papermaking craft' – which is entirely devoted to the ancient and most noble art of papermaking, and which commemorates five centuries of Polish papermaking – is dedicated to Mrs Anna-Grethe Rischel; with warm regards – Józef Dąbrowski, co-author of this book, 5 September 1994, Annonay, France.'

Two years earlier Józef Dąbrowski had presented his paper 'THE BEGINNINGS OF PAPERMAKING IN POLAND' at the 21st IPH Congress in Vienna (Austria), where he was elected as corresponding member of IPH. Except for the 25th IPH Congress in Dortmund 2000 (Germany) he participated in all IPH congresses



from 1992 – 2008 with valuable contributions within the history and development of handmade and machine-made paper and its permanence and durability.

His cooperation for more than ten years with Honorary Member of IPH Dr. John S. G. Simmons of All Souls College in Oxford is illustrated with their joint papers presented at the 22nd IPH Congress 1994 in Annonay (France) and at the 24th IPH Congress 1998 in Porto (Portugal). Dąbrowski was a member of Dr. John S. G. Simmons' Codrington Club 'Four C's Club', built on the four fundamental concepts for the society of scholars devoted to the book: Conserve, Consider, Contribute, and Cooperate.

Józef Dąbrowski was elected President of IPH at the 27th IPH Congress in Duszniki Zdrój – Kraków (Poland). During his IPH presidency 2004 - 2008 two important paper historical congresses took place in 2006 – 'European Paper Days' in June in Fabriano (Italy), organized by the Cartiere Miliani Fabriano – Fedrigoni Group – and the 28th IPH Congress in Capellades – Montserrat, Barcelona (Spain) in October.

During the planning of the 28th IPH Congress in Stockholm 2008 (Sweden) Göran Wohlfahrt, President of the Nordic association of Paper Historians (NPH) and I were in close contact as congress coordinators with Józef Dąbrowski and the IPH Council.

After Dąbrowski's retirement as President of IPH 2008,

he contributed with valuable articles to the restarted periodical 'IPH Paper History' and our contact through correspondence since 1994 continued. In spite of severe health problems during his last years he finally succeeded together with Andrzej Ulewicz to finish his studies of watermarks with the Polish monograph *FILIGRANY – w zasobie Archiwum Państwowego w Olsztynie* (Watermarks in the resource of AP at Olsztyn). It was published in commemoration of the 70th anniversary of the State Archives (AP). I received a copy of the monograph with a dedication, dated 2018-11-18, Łódź, Poland from Józef Dąbrowski.

I learned from his last letter to me in December 2018 how important it was to him that the corrected version

from the Special Edition of the 2006 IPH Congress Book was available on [www.paperhistory.org](http://www.paperhistory.org) of his paper 'Remarks on the invention of true paper by Cai Lun'. This version is in gratitude published in Volume 24, Year 2020 Issue 1 of our periodical IPH Paper History to the memory of Józef Dąbrowski, 6th President of IPH 2004 – 2008, Honorary Member of the scientific board of FFF Fondazione Fedrigoni Fabriano and member of 'Four C's Club'.

Anna-Grethe Rischel

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Józef Dąbrowski

## Remarks on the invention of true paper by Cai Lun

“Where shall I begin, please your Majesty?” he asked.  
“Begin at the beginning,” the King said gravely,  
“and go on till you come to the end: then stop.”  
Lewis Carroll (1832-89), *Alice in Wonderland*

To Suzanne Ackerson-Addor, my dear friend at the IPH

### Summary

Different approaches to the invention of paper in ancient China are thoroughly discussed, together with aspects of technology in the manufacture of both bark cloth (*tapa*) and paper. In the author's opinion, the history of true paper begins with the Paper of Marquis Cai.

### Zusammenfassung

Verschiedene Ansichten über die Erfindung von Papier im altertümlichen China werden eingehend diskutiert, zusammen mit Aspekten der Technologie bei der Herstellung von Rindenbaststoffen (*Tapa*) und Papier. Nach Meinung des Autors beginnt die Geschichte des echten Papier mit dem Papier von Marquis Cai.

### Résumé

Les différentes approches relatives à l'invention du papier en Chine ancienne sont âprement discutées, tout comme certains aspects de la technologie de la manufacture du tissu fait d'écorce (*tapa*) et du papier. L'auteur défend l'idée selon laquelle l'histoire du vrai papier commence avec le Papier du Marquis Cai.

According to Ling, the beginning of paper-making in ancient China is closely associated with the manufacture of bark cloth. In his 1961 essay [1], Ling stated:

In every probability, the Chinese invention of the art of paper-making and of printing could be attributed to the influence of the bark cloth culture, which had been in existence in China since time immemorial. [...] It is universally known that the art of paper-making was created by Ts'ai Lun in the year 105 A.D. But, as a matter of fact, two kinds of paper had been used for writing previous to the time of Ts'ai Lun: one was silk paper, made of the refuse silk of animal fibres; the other, made of bark cloth, was called *heh-ti* paper or *nieh-ti* paper. What Ts'ai Lun actually invented was the 'true paper', as called by Hunter. He made it by means of employing the silk paper manufacturing process, but using plant fibres as raw material instead of the refuse animal filaments. [...] From long before the birth of Christ, bark cloth had been used not only for making clothes and hats, but for writing purposes as well.

In the opinion of Ling, the Malayo-Polynesian word for bark cloth, *tapa* or *kapa*, appears in ancient Chinese literary records in the forms of *t'a-pu*, *ta-pu*, *tu-pu*, *na-pu*, *ka-pu*, *ku-pu*. He recalled *Shih chi* (The Historical Memoirs) written by Ssu-ma Ch'ien in the second century BC, where (in volume 129) *t'a-pu* is mentioned. It was merchandise at that time. In *Shih chi*, the word *t'a* (in the term of *t'a-pu*) means 'beat' [2]. Ling remembered also Chinese records of the third century AD, describing *ku-pu* as bark cloth, as well as *ku-pu* paper, manufactured in the form of a long web, pure white and shining. In his opinion [3]: "This *ku-pu* paper can be compared in length to the

Polynesian-made *tapa* carpets, which were also generally several hundred feet long.” In accordance with Chinese records, bark cloth in ancient China was also used for making hats, headbands, raiment, screen curtains, etc., and the earliest record of such uses dates back to the third century BC [4]. While discussing the geographical distribution of bark cloth in southern China and other areas, Ling quoted remarks from ancient Chinese chronicles about the use of bark cloth and its manufacture by hard pounding of the bark of *ku* (paper mulberry). Written records of the Chinese bark cloth began to appear as early as the sixth century BC [5].

According to Ling, there had been *fan* paper, silk paper and *heh-ti* thin and tiny paper before Cai Lun [I am writing the surname of the inventor in the official Romanisation system known as *Pinyin*; the Chinese term means “transcription”. The older system was known as *Wade-Giles*]. Fine-weave silk strips were used as a writing substance; however, it was very difficult to write on them, because of their uneven surface. To overcome this difficulty, *fan* paper was developed. The manufacturing method of *fan* paper was described in AD 232, and is quoted by Ling [6] as follows: “The plain silk of old times could be cut into a piece of any size to accommodate the required text. A number of such pieces, forced together in the manner of fulling, was called *fan* paper.” However, the definition of paper quoted from *Shuo wên chieh tǐ*, completed by Hsü Shên in the closing year of the first century AD, is evidence for Ling that the method of making true paper was known before the time of Cai Lun. In the English translation by Ling [7], the definition is as follows: “Paper is a sheet of intertwined fibres of refuse silk well beaten in the water and lifted out of the water in the form of a thin layer by the medium of a moulding mat.” Ling therefore recapitulated the issue as follows [8]:

It seems probable that Hunter was unaware of the historical data as referred to above, when he arrived at the conclusion that the paper-making art was originated by Ts’ai Lun. In truth, refuse silk made of animal fibres was used as raw material for making paper prior to Ts’ai Lun, so such paper was called the silk paper. On this same account, the Chinese word for paper, 紙 (*chih*), even in its earliest form, is composed of the radical 糸 (a root in the Chinese written language, meaning silk).

Moreover, a character 𦉳 (*tī*) is found in Hsü Shên’s *Shuo wên chieh tǐ*, which differs slightly from the word 紙 in that it has an additional short

line at the bottom of the radical 糸, and it means “refuse silk”. However, these two characters have been used promiscuously and interchangeably in later times.

The two Chinese characters mentioned above by Ling are enlarged in Figure 1.



Fig. 1: Two Chinese characters; the first (A) denotes ‘paper’ and the second (B) denotes ‘refuse silk’; according to Ling (cf. note 1, p. 37)

In the opinion of Ling, such silk paper (made from ‘refuse silk’) was manufactured not only before Cai Lun, but also after the invention of paper by him. Ling quoted a record concerning rattan rind and cocoon paper written in Vol. 12 of *Kao pan yü shih* by Tu Lung (in the 16th century) of the Ming era, as well as records on the manufacture of silk paper in Korea and the Chinese province of Sin-Kiang even during the Ching Dynasty. However, *heh-ti* or *nieh-ti* and *ku-pu* (formerly mentioned) were (in his opinion) kinds of bark cloth paper, and not silk paper at all. Ling stated clearly [9]:

In reality, this type of cloth paper had been in manufacture since the Wei and Chin Dynasties, through the T’ang, Sung and Yüan dynasties and down to the Ming period, and it had also been used for making paper currency, paper armour, paper dress and paper screen curtains, etc., in addition to its popular use for writing purposes.

In his opinion [10], “Ts’ai Lun thought out the measure of making paper by employing the old refuse-silk paper manufacturing process, but using the inexpensive plant fibres as a raw material, which may as well be described as the utilisation of waste substance.”

In his discussion of the ‘Biography of Cai Lun’ compiled by Fan Yeh (398-445), Ling highlighted the influence of the bark-cloth culture on Cai Lun’s invention of paper [11]:

Ts’ai Lun’s native place was in the district of Kueiyang, which presently belongs to the Department of Heng-chou, Hunan Province. In ancient times, Hunan was an important part of the State of Ch’u, and it had been famous for the production of bark cloth from the remotest time down to the Ming



Period. [...] It is noteworthy in this connection that Ts'ai Lun, the inventor of paper in 105 AD, was a native of Ch'u. [...] The language of Ch'u was close to the Tai tongue.

Ling believed that Cai Lun had made on-the-spot investigations in regard to the manufacture of bark cloth. He used only plant fibres for making paper, mainly the cheap bark of certain trees, with an admixture of such waste articles as hemp waste, old rags, and fishing nets. However [12]: "The old rags he utilised might possibly have been some sort of bark cloth." Ling recalled that the new character denoting paper had been introduced after Cai Lun's invention, with the 'cloth' radical replacing the former 'silk' radical [13]: "However, it is the one with the silk radical that has survived and is in common use today."

The highly interesting contribution by Ling has remained almost unknown to paper historians, and needs to be brought to wider attention. Ling's contribution presents the main aspects of Cai Lun's invention in a condensed form, namely those aspects which are characteristic of the approach to the issue in China where true paper was born. First and foremost, 'paper' meant different materials before Cai Lun's time; either woven silk fabric or such fabric transformed into *fan* paper, as well as bark cloth paper, such as *ku-pu* paper and *heh-ti* or *nieh-ti* paper. The same name was applied to the new product invented by Cai Lun, though its structure was basically different from former 'papers'. For us only the material invented by Cai Lun is true paper, and the other examples mentioned above should in our opinion be preceded by an additional statement such as 'so-called', for example, 'the so-called' *fan* paper. Nonetheless, this was not the case in ancient China before Cai Lun's time, when sheets of various materials of fibrous nature – with a good writing surface – were called 'paper', sometimes with additional information, such as 'the *fan* paper'. Similar conclusions may be drawn from discussions of the issue by Chang [14], and from original texts on Chinese paper history, which have been carefully edited in English by Tschudin [15].

Chang also recalled the definition of paper present in an etymological dictionary compiled around AD 100, in which paper was specified as a material of silk floss, according to Chang [16]; in the opinion of Ling, quoted above, refuse silk was used to manufacture such paper. This is another question linked to Cai Lun's invention. Both Ling and Chang are convinced that such 'silk paper' was manufactured before Cai Lun's time, and in Ling's opinion, 'silk paper' conti-

nued to be manufactured after Cai Lun. This, in their common opinion, is why the Chinese character for paper has the radical meaning 'silk'. However, together with propagating the paper invented by Cai Lun and its manufacture in the West, this ancient definition of 'silk paper' was also propagated. In the opinion of Kâğıtçı [17], the Turkish word <kâğıt> and the Arabic and Persian words *el-Kagıt* and *Kâgez* are derived from the old Turkic word <Kakat>, meaning 'dry sheet which was obtained from silk threads beaten with a mallet'. In Fabriano, where the genuinely European art of papermaking was developed, as well as in other locations in medieval Italy, paper was initially called 'silk paper', as it was found by Gasparinetti [18] in Latin documents: *carta banbaci-na*, *charta di bambacino*, or *carta bombycina*; and a master of this craft was accordingly called *magister cartarum bombycinis*, etc. The Latin word *bombyx* also denotes silk; nevertheless, it does not mean that silk paper was actually manufactured in these places.

After his investigation Ling came to the correct and highly interesting conclusion that Cai Lun's invention of the papermaking art was affected by the manufacture of bark cloth. Ling recalled a few scholars (none from China) who had earlier proposed this hypothesis alone; however, Ling's contribution presented the results he had discovered in his arduous research, together with his efforts at verification. Nonetheless, he was deeply convinced that the silk paper was really produced before Cai Lun's time, and so he believed that Cai Lun had employed the old refuse-silk paper manufacturing process to manufacture true paper from inexpensive plant fibres, mainly the bark of certain trees known to Cai Lun as having been utilised in the manufacture of bark cloth. Nevertheless, Ling's idea highlighted the importance of inventing true paper derived from bark cloth manufacture, which involved hard pounding of the inner bark, i.e. the bast layer, as it was practised in southern China from time immemorial. In fact, the making of bark cloth materials (*tapa*) was widespread in a belt running along the equator, as shown in Figure 2, according to Loeber [19].

The bark cloth is made directly from the bast fibres, without being spun into yarn or any subsequent weaving. Strips of the inner bark (the bast layer) from trees belonging to the family of *Moraceae* are the raw material for making *tapa*. Such strips are boiled over a slow fire in a cauldron containing water and wood ash, or they are fermented or treated with lime. After such treatment, the strips are thoroughly rinsed in water. Next, the fibrous strips are intensively beaten with hand-held mallets, or with other tools, to a cloth-



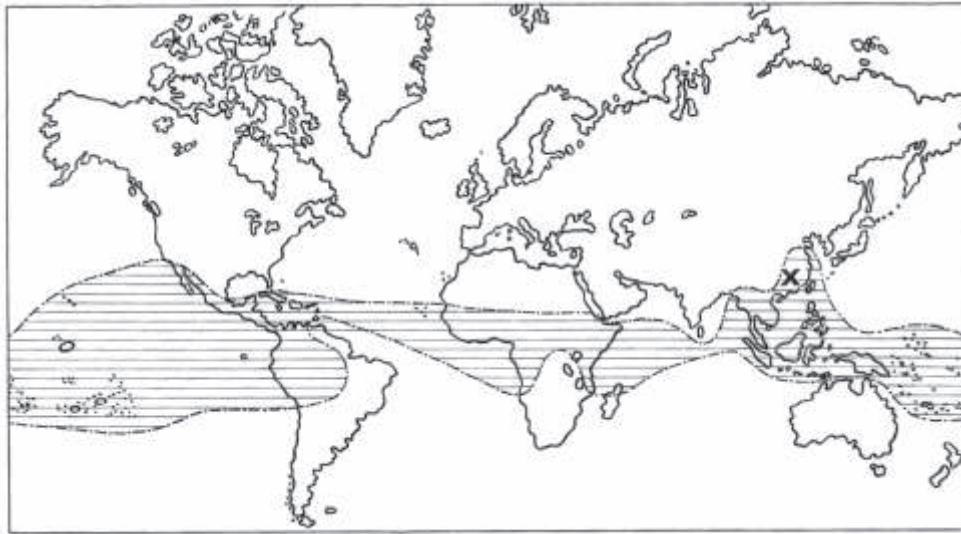


Fig. 2: Zone of bark cloth (tapa) manufacture, originating in the region (X) in which much later (c. AD 62) Cai Lun was born, according to Loeber (cf. note 19)

like product with gradual addition of additional strips, uniting them into a sheet or web, which are left to dry. Glazing could have completed the manufacturing process. Details were published by Hunter [20], and examples of other publications devoted to the manufacture of bark cloth (tapa) in various parts of the world are given below [21]. There is a strong resemblance in appearance between tapa and paper; nonetheless, the latter is formed upon mould from separated fibres dispersed in water, and therefore characteristic differences are perceived in the structural appearance of both materials when they are observed in an enlargement. Usually, however, a small sample is taken from the historical objects for fibre-furnish analysis, using different techniques and modern optical systems in microscopic examination, as well as undergoing examination in polarised light [22]. This requires breaking the fibrous substance into a fine suspension of individual fibres, and therefore the characteristic differences between tapa and paper, which are visible in their structural appearance, are lost. However, these structural differences are clearly perceived while comparing the look-through of both fibrous substances. To that end, it is possible to delaminate tapa for comparing the pattern visible in the look-through of the thin layer of tapa and of the thin paper formed upon the floating mould (see Figure 3 [23]).

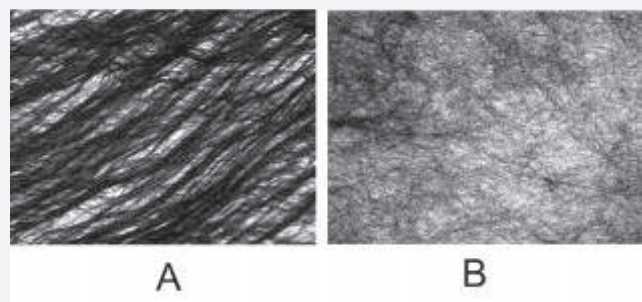


Fig. 3: Look-through of tapa (A) and of paper formed upon the floating mould (B). Both samples were manufactured in the 1960s, the tapa in Tonga Islands, and the paper in Nepal. Photographs by the author (cf. note 23; however, both photographs reproduced here were originally made at a higher magnification, 10x.)

Moreover, these differences are visible not only when viewed in the look-through under diffuse, transmitted light, but can also be perceived in the surface appearance of tapa and paper, when observed in enlargement under reflected light. The ability to recognise differences between bark cloth (tapa) and paper, without however delaminating the tapa, is of significance to the non-destructive investigations into historical samples of fibrous substances; see the photographs presented in Figure 4 in a black & white computer-contrasted version.

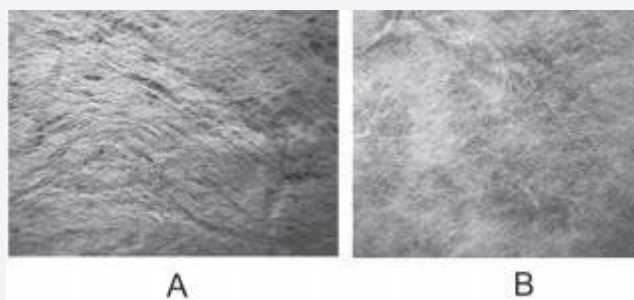


Fig. 4: Surface appearance of tapa (A) and of paper formed upon the floating mould (B). Photographs by the author of the same samples as in Fig. 3, but in reflected light

Nevertheless, Ling's contribution has been rather neglected in China. For example, Pan does not mention that Cai Lun knew bark cloth (tapa); in the opinion of Pan, Cai Lun improved the art of making hemp paper, and also developed his papermaking method by utilising tree bark as the starting material. Bearing in mind archaeological discoveries in Baqiao (Pa-ch'iao) and other places, Pan wrote [24]: "On the basis of these facts, it is now obvious that the art of paper making was invented one to two hundred years before the arrival of Ts'ai Lun – some time during the Earlier Han dynasty – by the working people." In his further publication [25], Pan presents his results gained in microscopic analyses of unearthed fibrous samples, among them the so-called 'Baqiao paper', discovered in 1957 at the Baqiao building site near the city of Xian (in north-western Shaanxi). This was the oldest one, as its manufacture was assessed as no later than 140-87 BC. Both the 'Baqiao paper' and other investigated historical samples contained hemp fibres, according to Pan, who wrote: "However, after we had done a microscopic analysis of the Baqiao paper in 1964, we found to our surprise that it was not made of silk, but hemp fibre." Once again, the belief in using silk fibres for making the earliest papers manifested itself. Nonetheless, it should be recalled that the dating of the so-called 'Baqiao paper' was criticised from the very beginning. In his 1959 article, Chang [26] also writes about the so-called 'Baqiao paper' excavated in 1957:

It has been held by some scholars that, judging from the bronze dagger, mirror and cash coins, the carved stone tiger, and pottery figurines and wares exhumed, the grave could not be later than the reign of Han Emperor Wu (140-87 BC). From this, they deduced that paper was invented much earlier than the Han Dynasty. But none of the bronze and other objects are dated, and it is not possible to establish a definite date for the grave. We feel that until it can be proved that the grave was from the

Former Han Dynasty, it would be premature to conclude that the fragments of paper found in it were made some two or three hundred years before Ts'ai Lun.

The history of paper and printing in China elaborated by Tsien [27] is highly recommended to paper historians. We owe a debt of gratitude to Tsien, who presented many aspects of these topics in his extensive (almost five hundred pages) and magnificent work, which is a pleasure to read. However, there is a lack of written records about the very beginning of paper-making in China, and therefore the remarks presented by Tsien about this issue are sometimes no more than his own suggestions. Regarding the ancient definition of paper (AD 100), Tsien understands it differently than Ling and Chang, as "a mat of refuse fibres" which were obtained from rags or from boiling cocoons [28]. Concerning a possible use of silk fibres for making paper in ancient China, Tsien wrote [29]:

Mention of the use of silk fibres is based primarily upon philological speculation without sufficient evidence. It was thought that since the character of *chih* for paper bears the silk radical at its left, *chih* before Cai Lun's time must have been made of silk fibre. [...] At present, no actual paper made of pure silk fibres is known to exist, nor is their use documented in literature.

According to Tsien [30]: "It has been suggested that the manufacture of paper in China originated from the process of pounding and stirring rags in water, after which the wadded fibres were collected on a mat. [...] It is very likely that an accidental placing and drying of refuse fibres on a mat suggested the idea of making a thin sheet of paper." In his opinion [31]:

Tshai Lun was a native of Lei-yang in what is now Hunan province, and it was here that the bark was made into cloth by beating and then into bark paper after maceration. Since, then, the maceration process of turning rags into pulp was already known in China, it was very likely that the people in the south of the country were the first to convert paper mulberry bark into a pulp for papermaking.

However, the processes of turning rags into pulp and its further preparation for making paper are not easy, and such comments from Tsien suggest a not uncommon lack of knowledge about the technical aspects of making paper by hand. In Europe, for example, small pieces of rags were fermented over eleven days, were next de-fibred in a water-powered stamper for twelve hours, and finally beaten in another water stamper for twenty-four hours, with an admixture of lime, which

is rather a strong base [32]. Washing clothes and pounding & stirring of rags were carried out in ancient China, as in other ancient countries, under much milder conditions. But the labour required in the beating of bast fibres for bark cloth is tremendous, and therefore the people of central China could have learned for themselves how to beat bast fibres from the people of southern China who had practised that process since immemorial times, as well as for making fine kinds of bark cloth, known as bark cloth paper. Moreover, treating the bast strips with chemicals and/or their fermentation, as is done in the technology of tapa, could (when prolonged) weaken the bonds between fibres in the bast strips, resulting in the bast strips dividing during their intensive beating into ultimate bast fibres. The pulp for making true paper could have been prepared in such a way. The accidental drying of refuse fibres, which could have suggested the idea of making a thin sheet of paper, as imagined by Tsien, may also be an argument for initiating the papermaking art in the manufacture of tapa.

However, the number of paper specimens from the second century BC onwards discovered in China is, in Tsien's opinion, the main argument for starting the manufacture of paper from the process of pounding and stirring rags in water. Tsien repeats without any criticism the information about the 'Pa-chhiao paper' and other ancient fibrous specimens [33]. Nonetheless, he writes: "The existence of paper before Tshai Lun does not necessarily contradict the story of his contribution as recorded in the official history. It is possible that he was an innovator who used new raw materials in papermaking." Tsien [34] quoted the contribution by Ling only in this context. In addition, 'paper' *chih* (now *zhi*, in Pinyin) is mentioned before Cai Lun's time in several places in the ancient literature, and such examples (from 93 BC onwards) are presented by Tsien in his book as an argument against attributing the invention of paper to Cai Lun. After so many arguments by Tsien against the priority of Cai Lun, the historic information about the invention of paper by Cai Lun (present in his biography) seems to be of lesser significance. In the English translation by Tsien [35], this information is presented as follows:

In ancient times writings and inscriptions were generally made on tablets of bamboo or on pieces of silk called *chih*. But silk being costly and bamboo heavy, they were not convenient to use. Tshai Lun then initiated the idea of making paper from the bark of trees, remnants of hemp, rags of cloth, and fishing nets. He submitted the process to the emperor in the first year of Yüan-Hsing [+105] and received praise for his ability. From this time,

paper has been in use everywhere and is universally called 'the paper of Marquis Tshai'.

However, it was not only these pieces of silk used for writing which were called *chih*. The new writing material invented by Cai Lun was also called *chih*; however, it was the '*chih* of Marquis Cai'. Later, two different Chinese characters were used to denote 'paper'. Hunter points out that two prominent Chinese characters, of ancient origin, embody the meanings of both silk and cloth (see Figure 5 [36]). In the most common character for 'paper' (at the right of the A row) we find the radical meaning 'silk' (at the left of the A row), and the other, less common character for 'paper' (at the right of the B row) embodies the radical meaning 'cloth' (at the left of the B row). The remaining parts of these two characters, in the centre of both rows (A) and (B), are made up of the same phonetic radical (*zhi*) meaning a surname.



Fig. 5: Two Chinese characters for 'paper' (*zhi* formerly *chih*), the most common (A) and less common (B); according to Hunter (cf. note 36)

One should recall the opinion about these two Chinese characters which was published by Zhong [37] in 1985, when the book by Tsien had been edited:

In ancient China, wood and bamboo strips were the principal writing materials; only the privileged used materials woven from cocoon silk. In West Handays, such silk materials were named *zhi*, with the left half of the character representing silk. Definitely this *zhi* (paper) referred to silk woven writing material, and should be understood as ancient paper.

After the announcement of Tsai Lun's invention, another Chinese character also pronounced *zhi*, but written differently and specified by a Chinese character with the symbol for cloth written underneath it, came into existence. As years went by, both of these characters were taken to mean the same thing; gradually the former character with 'silk' at the left side took the predominate position. But it



is important that the word *zhi* (paper) with silk on its left half found in historical records before Tsai Lun's days stood exclusively for silk materials made for writing purposes. On the other hand, *zhi* (paper) whether with a left-half silk or a symbol for cloth, found after Tsai Lun refers to plant-fiber writing materials, or 'true paper'.

It should be noted that the character *zhi* (paper) with cloth written underneath cannot be found in any historical recordings before the days of Tsai Lun. To imply that the word paper (to be more exact, *zhi* with a left half silk) appeared in historical recordings before East Han, and to come to the conclusion that paper was invented during the West Han period, is unconvincing.

This means that the 'silk paper' mentioned by Ling and by Chang was not manufactured before Cai Lun's time, and therefore Cai Lun could not employ the old refuse-silk paper manufacturing process to manufacture true paper from plant fibres, as suggested by Ling. The silk woven writing material was that 'silk paper' before Cai Lun, and at that time it was represented by the character with 'silk' at the left side. Zhong [38] showed a commonly written version of these two Chinese characters denoting 'paper' (Figure 6).



Fig. 6: Two Chinese characters *zhi* denoting 'paper', with a left half silk (A) and with the symbol for cloth written underneath it (B); according to Zhong (cf. note 38)

Zhong recalled that the biography of Cai Lun had been selected and entered into Fan Yeh's writings from the "History of East Han Compiled in the East Temple" (*Dong Guan Han Ji*). He highlights the fact that the biography of Cai Lun was originally written by Cao Shou, Yan Du and others as early as in 151, i.e. thirty years after Cai Lun's death. The entries about his work should therefore be reliable [39]. The earliest translation of the biography of Cai Lun into a European language was published in French by Edouard Chavannes in 1905, according to Tschudin, who published a German version of this document with many notes and explanations in 1954 [40]. Forty years later, Tschudin [41] published new translations of the biography of Cai Lun into IPH languages (English, German, and French).

However, such a multiplication of the doubts regarding the priority of Cai Lun by some Chinese scholars seemed to weaken the significance of a biography of Cai Lun. Visibly, such a strange conception of inventing paper from 'nothing', by sheer accident during the washing of cloth and rags, was stronger than the idea that making paper was derived from the manufacture of bark cloth (*tapa*). This was accompanied by the discoveries of a growing number of ancient papers, or paper-like structures, which had been recognised as papers manufactured before Cai Lun. After investigations into the so-called 'Baqiao paper', Pan [42] wrote: "Since then the excavation of ancient paper has been paid much attention to by Chinese archaeologists. Earlier paper made before Cai Lun's time has appeared gradually in various places; wonderful discoveries were made one by one." There was a lack of any initiatives in China aimed at continuing the investigations started by Ling directed to studying the associations between the invention of the art of paper-making and the manufacture of bark cloth (*tapa*), resembling paper. This fibrous material required very intensive beating of the strips of bast fibres during its manufacture, and later the beating process became of utmost significance in the papermaking art. In addition, refined versions of bark cloth were used in China as writing materials before Cai Lun.

Therefore the question is: what kind of new writing material did Cai Lun show the Emperor in AD 105? True paper or a modified version of bark cloth (*tapa*)? Fortunately, it is possible to answer this question. Tsien [43] wrote:

...Tung Pa of the early +3rd century said that 'The Eastern Capital (Loyang) has the paper of Marquis Tshai, which was the paper made by Tshai Lun; that made of used hemp is called hemp paper; that of tree bark *ku chih* (paper mulberry paper); and that of used nets net paper.'

Tschudin [44] published the same information, although drawn from another Chinese historical source: In the *Dongbaji* it is written: "In the eastern capital there was 'Master Cai paper', i.e. from [Cai] Lun. Paper made with old hemp was called 'hemp paper', that made from tree bark 'gu paper', that made from old fishing nets 'net paper'."

This means that Cai Lun was able to manufacture his new writing material from each raw material mentioned in his biography. However, the manufacture of bark cloth (*tapa*) from hemp waste or from old fishing nets is not possible, although each of these raw materials could be used separately to make true paper. So

this information from these ancient Chinese historical sources about the ‘hemp paper’ and ‘net paper’ made by Cai Lun is trustworthy evidence that Cai Lun showed the Emperor samples of true paper, and not just an improved version of bark cloth. Nevertheless, these historical sources do not mention the ‘rag paper’ (!) Cai Lun made. Most likely, Ling is right to suggest that Cai Lun used worn bark cloth (*tapa*) to make his paper, which Cai Lun’s biography described as ‘rags of cloth’. Together with a fresh bark of paper mulberry, the main raw material for Cai Lun (and formerly the main raw material in the manufacture of *tapa*), he used rags of this unwoven fabric to manufacture a paper called *ku chih* or ‘gu paper’. It would be hard to explain in any other way why Cai Lun employed four different fibrous raw materials (the bark of tree, remnants of hemp, rags of cloth, and fishing nets) and why, despite being able to manufacture paper from each one, he finally prepared only three kinds of paper, not four. It should be emphasised that the bark of tree and the rags of bark cloth (i.e. *tapa*) are, from the technological point of view, sources of the same fibres. Therefore the above-quoted information, which has been discussed in two different Chinese historical sources, is also convincing evidence that in his invention Cai Lun had nothing in common with typical rags, such as those from the woven fabric of hempen (or any other) threads, or with any possible technique of making pulp for paper-making, such as those which originated in central China from the process of pounding and stirring such rags in water, as imagined by Tsien and others – even if such techniques had existed before the time of Cai Lun’s invention.

Having prepared the fibrous slurry for making paper, there was a need for a papermaking mould, the most essential tool in making paper by hand. Chinese sources are silent about the constructions of the mould in ancient times, and Tsien therefore recalls the results obtained by Hunter in his field investigations of traditional papermaking in China and in other Far Eastern countries, according to which the floating or ‘wove’ type of mould could be the earliest form employed by the ancient Chinese [45]. In his book, Hunter [46] clearly states:

In my own numerous experiments in an endeavour to arrive at the methods employed by the actual inventor of paper, I have come to the conclusion that the ‘wove’ mould must have been the earliest form used, and that the beaten fibres were poured upon the mould and the moist sheet left to dry upon it. [...]

In Kwangtung Province, China, at the present

time, the ‘wove’ style of mould, upon which the fibre is poured and allowed to dry, is in use (Figure 46). There is no record as to the number of years this type of mould, or the method employed, has been used, but it is interesting to note that the locality where these ‘wove’ moulds are found is not more than two hundred miles from Lei-yang, near Henschow, Hunan Province, the seat of the invention of paper-making by Ts’ai Lun about A.D. 105.

However, the earliest mould employed in making paper is not under general dispute. An origin of the idea how to prepare the pulp for paper-making is still in dispute, though, and two options have been proposed, from the manufacture of bark cloth (*tapa*), or from the washing of cloth & rags. The latter technique is however not oriented towards the manufacture of any kind of material. Moreover, according to the latter concept, which neglects the influence of the manufacture of bark cloth (*tapa*) on the invention of paper, and diminishes the significance of the biography of Cai Lun, paper could also have been invented outside China, even in such countries where the process of making bark cloth (*tapa*) was not developed, but where a highly developed civilisation required a new writing material. Gosavi [47] published his suggestions about a possible invention of paper in India, much earlier than in China. In his opinion, some sources indicate that papermaking was well-known to Indians even as far back as the fourth century BC, and Indians used to make the paper pulp from beating cotton fabrics. However, the troublesome manufacturing process prevented paper from gaining popularity in India, and along with the Buddhist religion, the art of papermaking went from India to China (eastwards) and to Turkestan (westwards); nevertheless, this art came back to India with the Muslims in the tenth century AD [48]. McGovern [49], as a scientific papermaker, expressed his criticism of these suggestions by Gosavi; in addition, Tschudin [50] (as a paper historian) reported an error by Gosavi in his translation of the text by Megasthenes. However, immediately after these publications by Gosavi, many Chinese authors neglected the former doubts, and recognised Cai Lun as the inventor of paper, trying to highlight that paper was invented in China and not India [51].

Paradoxically, these suggestions by Gosavi also promoted scientific explanations of some questions associated with the invention of paper. Critical analyses began in China to verify the fibrous samples from excavations and the dates assigned to them; by Chen and Li [52] from the historical & archaeological point of view, as well as by Wang [53] from the paper-tech-



nology point of view. The results showed that so far no samples of true paper had been found which could be dated before Cai Lun in AD 105. Some remarks on the so-called 'Baqiao paper' are briefly recalled here as an example of the results gained in these investigations. In 1957, information came to light about small fragments of ancient paper found in an old grave at Baqiao; however, Chen and Li wrote [54]:

Unearthed ancient bronze mirror, iron lamp, pottery pot in square, lead bar, copper coins, etc...(including paperlike objects) was bulldozed during building the Baqiao Brick Factory in Xian City in 1957. The driver of the bulldozer had not found any tomb, coffin or remains; someone thought that the unearthed historical relics belong to the tomb.

In the opinion of Chen and Li, the paperlike object was a hempen mat of fibre bundle for another application; however, a young archaeologist had recognised it as paper because its appearance was similar, and its dating had been estimated without any research. They stated:

A young archaeologist reported the "Baqiao Paperlike Objects" to be a paper dating from the West Han Dynasty, not later than 10 days after the "Baqiao Paperlike Objects" had been unearthed. It was only a piece of news without any scientific appraisal. When some readers asked him how it was that the paperlike objects were dated from the West Han Dynasty, he used as supporting evidence some relics unearthed on the same spot, which were similar to others dated from the West Han Dynasty, such as bronze mirrors, copper coins and pottery square mouthed wine vessels, shown in figure 1 [55].

64 Banling copper coins were collected in a pottery pot covered by hempen mat when unearthed in Baqiao. A worker tore the hempen mat to pieces when he took it out. Later on, the pieces of hempen mat were clamped between two glasses by a young archaeologist, and these hempen mats became several pieces of hempen slice (and called paper dating from the West Han Dynasty) [56].

Therefore those other unearthed relics were carefully examined from the archaeological point of view by Chen and Li, who finally concluded that the 'Baqiao Paperlike Objects' had incorrectly been dated by the other relics as coming from the West Han Dynasty, without enough evidence, reliable analyses or studies [57]. In addition, according to the results gained by Wang [58], the hemp fibres in the 'Baqiao paperlike sheet' had neither been pounded nor beaten. In her

opinion, the paperlike sheet was not made by formation, but separated from the pile of hemp. Some fibre bundles were found lying across the 'paper' surface and breaking at the edge of the sheet; the longest of them was about 7 cm. This means that the fibres have never been subjected to the shearing or cutting necessary for papermaking. The individual fibres appeared to be rather stiff and their fibre walls remained intact, without any signs of fibrillation. A Scanning Electron Microscope/Energy Dispersion X-ray Analyser (SEM/EDAXA) was used to examine both the 'Baqiao paperlike sheet' and the market hemp. The market hemp contained quantities of calcium similar to those detected in fibres of the 'Baqiao paperlike sheet'. This was evidence that the fibres present in the 'Baqiao paperlike sheet' had not been subjected to a special treatment with lime to improve their papermaking ability. In Wang's opinion, the 'Baqiao paperlike sheet' is not a paper but a mat of waste hemp fibres.

These investigations, carefully carried out by Chen & Lin and also by Wang, have revealed two important aspects of the latest discoveries in China (before their investigations) of ancient paper or paper-like objects. The first of them is very positive, showing a high level of scientific standards in China in both a historical & archaeological approach, as well as with respect to the examination of such specimens from the paper-technology point of view. The second aspect, however, is rather unusual, showing a lack of any careful analysis before an official announcement of the new discoveries of specimens of ancient paper or paperlike object. Such unreliable announcements (lacking appropriate scientific investigations) of having discovered "paper samples made before Cai Lun's time" are later propagated worldwide, and are finally quoted in scientific publications, as in the book by Tsien and in other accounts, thus suggesting a scientific basis for these announcements. Many efforts of this kind to sort out the priority of Cai Lun meant that the great anniversary in the year 2005, marking the 1900th anniversary of paper, was not celebrated [59].

Paper historians in China are still divided into two separate views with regard to the time when paper originated in China. In April 1999, an expedition of International Association of Paper Historians (IPH) to China was undertaken. The expedition was led by Elaine Koretsky, director of the Research Institute of Paper History & Technology at Brookline (Boston), USA; but Albert Elen, President of the IPH at that time, played a dominant role during formal meetings between the IPH and Chinese scholars & officials.

The Research Institute of Paper History & Technology explores and carefully documents traditional techniques of papermaking around the world [60], and the close contacts of the Institute with Chinese paper historians made the IPH's expedition to China possible. Its participants, a group of 16 Europeans and Americans, also attended a Congress held in Xian on the origin of paper in China, where a sharp division between two groups of Chinese scholars manifested itself in heated discussions among the members of these groups. One group attributed the origin of paper to Cai Lun; an opposing group attributed the origin of paper to a time approximately two centuries earlier, during the Western Han Dynasty [61]. This is documented on the available video focused on the Congress held in Xian [62].

The latest announcement of the discovery of "a paper sample made before Cai Lun's time" was propagated worldwide in August 2006. Macartney published some remarks about this event in her short article [63]:

A scrap of paper made from linen fibre was found by archaeologists picking through an ancient rubbish tip at the Yumen Pass, the gate between China and Central Asia. Measuring just 1.6 square inches, it is believed to have been made in 8 BC, or 113 years earlier than the first known paper. Fu Licheng, the curator of the nearby Dunhuang Museum, said: "This is very important evidence to show that paper was invented in China."

In curator Fu's opinion, the discovery of paper-like material made from silk in northwest China and other parts of the country has fuelled debate in recent years as to whether paper could have been invented two centuries before Cai Lun. According to curator Fu, the paper found at the Yumen Pass was a more developed material than the disputed silk-based substance. Archaeologists had found several pieces of paper while carrying out restoration work on a garrison in use during the Western Han (206 BC – AD 25). However, only one scrap contained writing; Macartney presented a colour photograph of it. According to curator Fu, more than 20 characters on the paper had been identified. In his opinion, more time is needed to make out the meaning of the note. In his opinion, more time is needed to make out the meaning of the note. In this announcement, China has not given even the least information about the scientific institutions involved in detailed analyses of the fibrous substance found at the Yumen Pass, regarding its fibrous composition, its structure (bark cloth, paper, or something else), and – first and foremost – its dating. The Chinese interlocutor has mentioned

restorative work on a garrison in use during the Western Han dynasty, and that making out the note's meaning needs more time; nevertheless, "it is believed to have been made in 8 BC" (!). This resembles previous Chinese statements about, for example, the so-called 'Baqiao paper', "which was only a piece of news without any scientific appraisal", as was quoted above (after Chen and Li). This sensational news about the find in a rubbish tip at the Yumen Pass is additional evidence of a strong tendency in China to prove that paper originated in China not from the bark cloth (tapa), but 'out of thin air'; as well as to 'move' the invention of paper in China far to the north of the southern provinces, where the bark cloth (tapa) had been manufactured since immemorial times.

This tendency is probably linked to the traditional Chinese conception of history. Larre, a French Sinologist, in his essay on the empirical apprehension of time and the conception of history in Chinese thought [64], has specified seven special features of the Chinese conception of history, commenting as follows:

In speaking of the 'special features of the Chinese conception of history', I have in mind a number of traits distinguishing the Chinese historiographers' conception of history, but have no wish to imply that the same features may not be found elsewhere.

Larre highlighted the following features: (1) the breadth of the historical panorama, (2) the central position given to the Han, (3) an inward-looking approach, (4) the dominant rural note, (5) the spirit of democracy, (6) a communal type of life, exemplified in the clan and the extended family; and (7) formalism in thought and expression. Two of them are quoted below from this essay by Larre:

*The central position given to the Han.* No one who has lived in China can fail to be aware of the persistent rivalries between the ethnic groups making up the Chinese nation today. History gives special prominence to the Han, a race of eastern origin established far to the north of the Yang tze Kiang, and the fame of the huge areas around Shanghai (the ancient kingdom of Wu) and north of Canton (kingdom of Yüeh) has undoubtedly suffered as a result.

*The inward-looking approach.* What is more serious - and accounted for partly by the isolation of the Chinese territories from other parts of Asia, and partly by the relatively late development of maritime communications - Chinese history was written on the assumption that human life was essentially what went on in central China, China

itself being the centre of the world, washed by four seas and casting its brilliant light over the less fortunate and inhospitable regions inhabited by barbarians on the borders of earth and heaven.

In summary, we may describe the matter in the following terms:

Cai Lun, as a native of Ch'u, was acquainted with the manufacture of bark cloth (*tapa*). Employing subsequent steps of this manufacturing process, he was successful in his attempts to develop a new writing material, mainly from an inner bark (the bast layer) of paper mulberry, the raw material in the manufacture of *tapa*, with a possible admixture of other raw materials from recycling, such as remnants of hemp, rags of cloth, and fishing nets. Cai Lun was able to manufacture this new writing material from each of these raw materials, according to the information in Chinese historical sources about the various kinds of paper made by Cai Lun. This is trustworthy evidence that Cai Lun developed true paper, and not merely an improved version of bark cloth (*tapa*), because the manufacture of bark cloth (*tapa*) from remnants of hemp or from old fishing nets is not possible, but the fibrous slurry prepared from them could be processed into true paper when poured upon the mould.

These historical sources do not mention any 'rag paper' having been made by Cai Lun. This means that Cai Lun used a worn bark cloth ('rags of cloth', i.e. *tapa*, an unwoven fabric) together with a fresh bark of paper mulberry to manufacture paper from the bast fibres of paper mulberry (*ku chih* or 'gu paper'). Cai Lun did not employ typical rags, from the woven fabric of hempen (or any other) threads, in his new substance.

It showed great promise as a writing material, and a new form of the Chinese character *zhi* was introduced

to distinguish the '*zhi* of Marquis Cai' from former kinds of *zhi*. However, the older form of the character *zhi* (with the silk radical) has survived, and this form is in common use today to denote true paper in Chinese.

Chinese civilisation, which badly needed a new writing material at Cai Lun's time, was of utmost significance for Cai Lun's invention of paper, as 'necessity is the mother of invention'.

The invention of paper in China by Cai Lun (AD 105) is documented in the biography of Cai Lun compiled by Fan Yeh (398-445); however, the biography of Cai Lun as entered into Fan Yeh's writings was originally written as early as the year 151, i.e. thirty years after the death of Cai Lun.

In my opinion, the attempts to separate the invention of paper from the manufacture of bark cloth (*tapa*), made mainly in China, but also in India – are bound to fail, and the history of true paper does indeed begin from the Paper of Marquis Cai: 蔡侯紙.

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My grateful thanks are also directed to my dear friends at the IPH: Dr Peter F. Tschudin, Honorary President of the IPH, and Dr Frieder Schmidt, the Curator of the Paper-Historical Collection of the German Book and Writing Museum at the German Library in Leipzig – for their friendly offer of the copies of some of the booklets and articles used in elaborating this account.

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**Frieder SCHMIDT, Stuttgart**

Schmitz, Wolfgang: Grundriss der Inkunabelkunde. Das gedruckte Buch im Zeitalter des Medienwechsels. Stuttgart: Hiersemann, 2018 (Bibliothek des Buchwesens, Band 27). X, 420 Seiten, ISBN 978-3-7772-1800-7. 169,00 EUR (D), 173,70 EUR (AT)

Wer ein Standardwerk zur Inkunabelkunde in die Hand nehmen wollte, sah sich lange zu einem Rückgriff auf Konrad Haeblers Handbuch der Inkunabelkunde (Leipzig 1925) genötigt. Für den Papierhistoriker und vor allem den Wasserzeichenkundler bedeutete dies jedoch eine ziemliche Enttäuschung. Haebler (1857-1946) hatte sich zuvor mit seinem Typenrepertorium der Wiegendrucke einen Namen gemacht. Während er in diesem Werk gewissenhaft das Typenmaterial der Frühdrucker zusammen trug, sah er dies beim Druckträger Papier ganz anders: „Aus diesen Tatsachen ergibt sich, daß einwandfreie Schlüsse für die Beurteilung der Wiegendrucke daraus im allgemeinen nicht zu gewinnen sind, und daß die universelle Erforschung der Wasserzeichen in den Wiegendrucken keine Ergebnisse erhoffen läßt, die im Verhältnis stehen zu dem außerordentlichen Umfang der Arbeit, die ihre Feststellung erfordern würde.“ (Haebler, Handbuch, S. 38) Folgerichtig fand die Erfassung der Wasserzeichen keinen Eingang in das Regelwerk für den Gesamtkatalog der Wiegendrucke (GW), auf dessen Gestaltung er als Vorsitzender der entsprechenden Kommission ganz erheblichen Einfluss hatte.

Wolfgang Schmitz, langjähriger Leitender Bibliotheksdirektor der Universitäts- und Stadtbibliothek Köln und Direktor des Universitätsarchivs Köln sowie Professor für Bibliothekswissenschaft an der Universität zu Köln, lässt nun dem Papier und der systematischen Erschließung der darin enthaltenen Wasserzeichen die gebührende Rolle zukommen. Das ursprünglich als zeitgemäß bearbeitete Form von Haeblers Inkunabelkunde gedachte Verlagsprojekt führte zu einem völlig neuen Text, der sich nicht mehr als Handbuch, sondern als Grundriss versteht.

Dieser konzentriert sich auf Inkunabeln „als materielle Objekte, d. h. auf das ganze Spektrum von den Schriftträgern über Ordnungssysteme, Typen, Satz und Druck, den Buchhandel, Paratexte, Schriftformen bis hin zur Bebilderung.“ (S. VII)

In der Einleitung werden die Beziehung zwischen Inkunabeln und Blockbüchern und das Miteinander von Handschriften und Druck erläutert. Der Buchdruck wird als höchste Vollendung des mittelalterlichen Schriftwesens und „Heraufkommen eines völlig Neuen“ (S. 2) verstanden. Als Leitmotiv jeden Kapitels wird der „Prozess der Emanzipation der Drucke von der handschriftlichen Tradition“ verfolgt. Ein Überblick über die Geschichte der Inkunabelkunde (S. 42-70) gibt erhellende Einsichten in Fragestellungen, Arbeits- und Dokumentationsmethoden. Anhand der Statistik des GW wird eine quantitative Einschätzung des aus dem 15. Jahrhundert überlieferten Bestands gegeben. Im Jahr 2015 sind darin einschließlich der Einblattdrucke 34459 Einträge erfasst, davon sind 52,5 % ohne Angabe der Drucker, 51,1 % ohne Druckort und 43,5 % ohne Datierung (S. 48).

Den Wasserzeichen im Papier wird in der modernen Inkunabelforschung (zusammen mit anderen Indizien) eine wichtige Rolle bei der Bestimmung des Entstehungszeitpunkts zugewiesen, wohingegen aufgrund des weiträumigen Papiertransports eine örtliche Zuweisung unfirmierter Drucke anhand der Wasserzeichen nur schwerlich vorgenommen werden kann. Es wird deutlich auf den Tatbestand verwiesen, dass in einem Exemplar Papiersorten mit unterschiedlichen Wasserzeichen zum Zug kommen können und dass das Papier einer Auflage von Exemplar zu Exemplar variieren kann. Als Forschungs-



desiderat bei den Schriftträgern wird die Beschaffenheit des parallel zum Papier für den Buchdruck verwendeten Pergaments benannt (S. 85).

In dem Vom Blatt zum Buch überschriebenen Kapitel wird differenziert die Formatfrage dargelegt und zwischen dem gemessenen Format (die Buchrückenhöhe der Preußischen Instruktionen) und dem „natürlichen“ Format (abhängig von der Faltung des Bogens) unterschieden. Wichtig ist der Hinweis, dass es durch Beschneiden der Bücher beim Binden zum Verlust der breiten unbedruckten Ränder kommt, weshalb „Exemplare ein und derselben Ausgabe sehr unterschiedliche Größen aufweisen können.“ (S. 91) Unter den herausragenden Großformaten wird auf das Graduale Romanum (GW 10982) verwiesen, das in Pergament ein Blattmaß von 503 x 367 mm aufweist, in Papier hingegen beim Exemplar Music Library von Berkeley 556 mm Blatthöhe (S. 93).

Sehr informativ sind die Angaben zu den Lagen. Während bei den Pergamenthandschriften überwiegend vier Doppelblätter (Quaternio) eine Lage gebildet hatten, sind es bei Papier häufig sechs Doppelblätter (Sexternio) oder mehr. Inkunabeln des Folio-Formats weisen recht früh fünf Folio-Doppelbögen (Quinternio) auf, das Quartformat erst fünf, dann vier Bögen. Quartlagen aus einzelnen, doppelt gebrochenen Bögen werden erst in der Reformationszeit die Regel (S. 94).

Beim Oktavformat bildet ein dreifach gebrochener Bogen eine Lage, auch zwei Bogen zu 16 Blatt können zu einer Lage dienen. Es kann in einem Druck zu Wechsel von Lagen mit unterschiedlicher Blattzahl kommen, und noch irritierender ist diese Feststellung: „Innerhalb einer Auflage konnte es verschiedene, offenbar noch nicht gedeutete Lagenzusammensetzungen geben.“ (S. 95) Seit den frühen siebziger Jahren weisen Drucke Signaturen als Lagebezeichnungen sowie eine Blattzählung auf.

Zur Überlieferungslage lässt sich feststellen, dass zahlreiche Inkunabeln nur unikal überliefert sind, „davon ca. 10-15 % nur durch Fragmente.“ (S. 109) Laut dem ISCT (The Incunabula Short-Title Catalogue) ist von 7500 Inkunabeln nur ein Exemplar überliefert, laut dem GW ist dies bei 7900 der Fall. Häufig erfolgt die Überlieferung als zerschnittene Makulatur, wodurch eine enge Beziehung zur Ein-

bandforschung gegeben ist.

Das Kapitel Setzen und Drucken befasst sich nicht nur mit technischen Fragen wie der Typenherstellung (Stechen und Gießen der Typen, Metalllegierungen, Typenhöhe, Zahl der Typenalphabete einzelner Drucker), dem Setzen (hier finden sich die Erläuterungen zur Einphasenpresse und zur Zweiphasenpresse) und dem Drucken (die S. 127-129 befassen sich noch einmal zusammenfassend mit dem Catholicon-Druck, dessen drei Papiersorten vor vier Jahrzehnten ein bedeutendes Anliegen der Wasserzeichenforschung darstellten) sowie dem Layout der Druckseiten, sondern auch mit wichtigen verlegerischen Aspekten. Es werden Fragen der Textvorlage, der Druckvarianten und Korrekturläufe, die Ausdifferenzierung der Funktionen von Verleger, Drucker und Buchführer und der Auflagenhöhe behandelt. Hier werden für die Zeit zu Beginn des Buchdrucks 100–200 Exemplare als durchschnittliche Auflagenhöhe benannt, dann für die Zeit bis 1480 ca. 200–300, danach 400–500, teilweise bis zu 1000 Exemplare (S. 186). Schließlich befasst sich dieses besonders umfangreiche Kapitel auch mit den Fragen von Nachdruck und Privilegien, Zensur sowie den Vertriebswegen und den Bücherpreisen.

Ein eigenes Kapitel wird den Paratexten gewidmet, die den Text in Form von Titelblatt, Kolophon, Signet (d. h. Drucker- und Verlegermarke), Widmungsvorrede, Register und Inhaltverzeichnis begleiten. Die abschließenden Kapitel befassen sich mit Schrift und Type (lateinische, griechische, kyrillische und glagolitische sowie hebräische Typen, auch Musiknotendruck) sowie dem Bild im Buch (illustriert mit ergänzenden 16 Farbtafeln). Hilfreich ist der Anhang, der unter anderem auf Basis des ISTC die Verteilung der Inkunabeln nach Regionen, nach Sprachen und nach den wichtigsten Druckorten benennt. Zudem werden die größten Inkunabelbestände in internationalen und in deutschen Bibliotheken aufgelistet (genannt wird die Zahl der Exemplare, nicht die der Ausgaben). Sehr hilfreich ist das umfangreiche Literaturverzeichnis (S. 363–404).

## HAPPY 85TH BIRTHDAY TO ANNA-GRETHERISCHHEL

Anna Grethe Rischel (born May 7, 1935, in Copenhagen, maiden name Andersen) is a Danish paper conservator and paper historian and president of the Association of International Paper Historians ([https://de.wikipedia.org/wiki/International\\_Association\\_of\\_Paper\\_Historians](https://de.wikipedia.org/wiki/International_Association_of_Paper_Historians)) (IPH). Her special interests lie in macroscopic and microscopic studies of paper technology and paper fibres, covering both Asian and European paper.

== Vita ==

Anna-Grethe Rischel studied at the Textile Department of what is today Royal Danish Academy of Fine Arts, Schools of Architecture, Design and Conservation (KADK) and worked for many years as textile printer under the artistic name “Claus”. In 1961 she married Jørgen Rischel, a professor of linguistics at the University of Copenhagen. With him and their three daughters she moved to Birkerød in 1969, where she lives till today. In 1977 she applied for conservation studies at the School of Conservation of the KADK and received qualifications of a conservator of cultural heritage, in particular, paper and graphic art. From 1980 on she has been working as a conservator at the National Museum of Denmark ([https://de.wikipedia.org/wiki/Dänisches\\_Nationalmuseum](https://de.wikipedia.org/wiki/Dänisches_Nationalmuseum)) in Brede.

It was then that her interest in the 2000-year long history of paper really awoke. That interest was particularly stimulated during her preparation of an exhibition in 1983 featuring Japanese art. She went to Nepal, Thailand and Japan, later also to China and studied Oriental

paper making at its sources. She initiated research projects on the topic and published many papers.

Between 1993 and 2000 Anna-Grethe Rischel headed the section for paper technology and fibre materials of the National Museum Conservation Department. She continued to work as a conservator on the important collection of paper brought together from numerous countries and owned by the museum. This gave her the opportunity to do research on the technology and development of paper and became the starting point for the development of some specific macroscopic and microscopic survey methods.

This area of research – together with the dissemination of new knowledge acquired in the process – became the core of Anna-Grethe Rischel’s professional life from then onwards. Publications and numerous contributions to international conferences made her well-known in the international conservation community.

After her retirement she continued her analysis activity on handmade paper. From 2009 on she focused in particular on early Central Asian paper.

In 1986 Anna-Grethe Rischel became a member of the Nordic Paper History Association and of the International Association of Paper Historians (IPH) i. She also became member of the British Association of Paper Historians. In 2008 she was elected to be the 7th President of IPH as first Scandinavian and first woman. In this role she has been also editor of the „IPH Paper History” periodical until 2018 [1]. Since 2008 she has also been a member of the regional parliament of Birkerød.



== Publications ==

[1] IPH Publications - <http://www.paperhistory.org/Publications/>

Julius von Wiesner and his importance for scientific research and analysis of paper. In: Paper history (Bd. 18, 2014, Nr. 1: 31-38).

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Analysis of the papermaker's choice of fibrous materials and technology along the paper road. Paper as a medium of cultural heritage (2004: [202]-208).

Through the microscope lens : classification of Oriental paper technology and fibres. Looking at Paper: Evidence and Interpretation (2001: 179-188).

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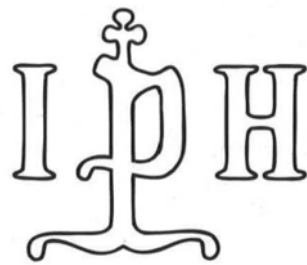
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