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A survey of Chinese paper preserved in French collections: Research into their recognition and conservation

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ABSTRACT

This paper reports on the findings of a two-year national project (2013-2015) undertaken by the Center for Research and Conservation of the Museums of France (C2RMF) and related institutions. The main goal has been to investigate the different types of Chinese artifacts on paper in the French collections and gather information worldwide from museums and other specialists. Part of this project deals with the identification and recognition of different papers by giving them appropriate names. Another focuses on the research developed to improve their conservation, and more specifically the question of lining. Non-destructive methods of analysis (3-D microscopy and surface metrology) have been used. The initial results are presented here.

INTRODUCTION

French collections have historically been rich in Chinese documents. However, it is currently observed that there is confusion concerning the identification of Chinese papers, which are often misnamed¹ or sometimes confused with Japanese paper, so the characteristics of these specific materials are often not considered in conservation.

A major objective is to link observations on the collections (by curators, conservators and researchers) with optical observations and non-destructive measurements in order to improve identification and physical knowledge of the materials.

HISTORICAL BACKGROUND

Many of the Chinese papers belonging to the French collections were obtained through diplomacy or French missions in China.² They are often associated with major figures in French sinology (Edouard Chavannes, 1865–1918; Paul Pelliot, 1878–1945) who contributed to the establishment of the discipline.

These collections concern various fields (botany, history of art, popular art, Buddhist studies) and many techniques (manuscripts, paintings, prints, rubbings, decorative objects and so on), which allows them to be conserved in different places: libraries and natural history museums, as well as art museums.

Despite the fundamental studies led by Jean-Pierre Drège in the field of codicology, Chinese papers in French museums are not as well studied as their contents (Drège 1985). Their diversity in terms of chronology, geographical origin and social status implies a large variety of forms. Though Chinese paper is often mentioned in ancient texts³ (Du Halde 1735, 442), the different types of papers may not be identified precisely.

RECOGNITION: SOURCES, SURVEY AND OPTICAL CHARACTERIZATION

After the study of documentary sources concerning Chinese papermaking, mountings and conservation, a survey of the French collections was made 17th Triennial Conference 2014 Melbourne

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using visual analysis and non-destructive surface metrology in order to record the characteristics and evaluate the impact of treatments on paper.

Sources

The authors started with English, French and Chinese sources, including oral sources at Chinese paper mills. Exchanges were previously established with the French National Library, the Institute of Paper Historians, the Center for Research on the Conservation of Collections (CRCC), the Chinese National Library, the Center for Scientific Studies on Cultural Heritage (Beijing), the Conservation Center of Nanjing Museum and Fudan University. A major rise in literature and scientific research on this subject has been observed in China over the last ten years.

A few existing databases are known, devoted to paper materials (Khartasia, France), or focused on a specific area (Dunhuang Project) or on a type of documents (Chinese rubbings in the database of the East Asian Library or the French School of Oriental Studies).⁴ Information was also collected from different conservation studios in China, such as the Henan Museum (Zhengzhou), the Palace Museum (Beijing) and the Shanghai Museum. Through the varying approaches, different ways were found to group and characterize Chinese papers.

Survey in French collections

Collaboration with French institutions preserving Chinese papers is essential:⁵ curators were asked to fill in a questionnaire which evaluates the difficulties in identifying Chinese papers. The questionnaire is also used to record terminology, describe the support and evaluate its state of conservation.

The questionnaire concerns:

- ancient and modern types of paper
- manuscripts, prints, rubbings and paintings on paper
- documents of different status (popular or prestigious)
- the treatments used
- Chinese or western mountings, the type of conditioning and display solutions.

It is already possible to confirm that the term "Chinese paper" is inadequate, since many different kinds of paper are involved (among them hemp paper, bamboo paper and *xuan* paper or pith paper) and the problems associated with their conservation should thus be differentiated.

Characterization of Chinese papers

To identify the main characteristics of the different Chinese materials, the authors chose to focus on simple visual observation (with the naked eye and microscope analysis), and record sheet structure and surface. This information will be published in the form of a guide containing photos, descriptions and identification, and will include an English-French-Chinese dictionary.

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Figure 1 Fabrication of *xuan* paper in Anhui province. © Pauline Chassaing

Figure 2

3-D microscopy (HIROX KH 8700). Pith paper covered with white and blue irregular-sized pigments. x500. © C2RMF – Dominique Robcis

Figure 3

Painting on pith paper. Private collection. H. 23.5; L. 18.5 cm. © Pauline Chassaing The 3-D microscopy equipment (Hirox KH 8700) at the C2RMF helped to define the characterization of the papers. Multi-focus images of great depth can be taken which give a clear idea of the morphology of the paper surface, the structure and order of the fibers and the degree of their deterioration. The ease with which this technique can be used is appreciable: one can control and take images at any moment during the course of treatment in the studio, in the case of an object which can be moved; and results are obtained very rapidly (in less than two minutes). Representative samples of ancient and modern papers from study collections were observed to obtain a reference table of morphologies. Among them, *xuan* paper was studied as a support for artworks and also as a material used in the Chinese conservation process (Figure 1).⁶ Compared to other conservation materials, a dense structure and fiber width of about $6-7 \mu m$ was observed, which is wider than rice straw (about $4 \mu m$) and narrower than Japanese gampi (about 10 µm), mitsumata (16 µm) or mulberry paper (18 µm) (Collings and Derek 1978). Xuan paper is made mainly from fibers from the bark of blue sandalwood and rice straw. It is smooth, white and has specific properties very suitable for lining and backing paintings and calligraphy.

Pith paper also offers interesting research possibilities, as French collections contain numerous Chinese export paintings. Pith paper from the *Tetrapanax* papyrifer plant (formerly known as "rice" paper) is not made from rice and is not a paper. In fact, it is the cylindrical core of a tree, prepared and cut into a thin layer by means of a sharp knife. Therefore, this support does not react like real paper. Graphic techniques fix to it differently and conservation is difficult (Chassaing 2013). Microscopic observation presents a honeycomb cellular structure instead of a fibrous mat. There are some empty areas in the structure (about 100 µm, the size of a hair) and it has to be determined whether these are holes (due to degradation, or the manufacturing process) or part of the normal structure (Figure 2). One of the hollows was measured by surface metrology and was found to be 96.6 µm deep by 149 µm wide. Moreover, the repetition of a motif was observed by the naked eye, which could be marks made by a knife (Figure 3). These marks are parallel but their spacing is very irregular. Two of them, 15 mm apart, have been measured by surface metrology and are currently being analyzed: the elevation cycle is irregular and it seems that the cells are quite different in the lows as compared to the highs. This material has a very particular structure and optical reactions, so care is needed during interpretation. This also makes it a difficult material to treat, as any degradation has a visual (brilliance) and structural (breaking) impact (Figure 4).

SURFACE METROLOGY ANALYSIS AS AN EVALUATION METHOD FOR TREATMENT

The next step concerns the different conservation problems related to Chinese papers. The influence of lining on the surface state of rubbings was selected to better understand the physical behavior of paper (loss of relief, memory capability and reversibility) and to evaluate the characteristics of the different treatments.

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Figure 4

3-D microscopy (HIROX KH 8700). Broken area on a pith paper. x35. © C2RMF – Pauline Chassaing

It can be observed with the naked eye that these treatments appear to modify the various intrinsic qualities of the paper. The fibers are crushed or raised or embossed elements are flattened. The comparison of the texture of the paper before and after treatment is rarely done in the studio today. In the case of non-movable artifacts restored in museums, a non-destructive and mobile instrument had to be used for analysis.

Method of study: Optical metrology instrumentation

A mobile instrument for surface characterization and complete topographic analysis with an integrated optical metrology station (Altisurf) allows measurements without contact by means of a high-precision integrated sensor. The instrument uses white light which does not heat the paper. As there is no backlash in the instrument, the measures are very precise. Moreover, the instrument respects the ISO 25178 norm concerning 3-D measurement of surface states. This comes with an analytical 2D-3D program (Altimap) with a choice of analysis tools which allow the surface modifications to be studied objectively, for example, due to lining (Sczepanowska 2013).⁷

First evaluation experiments on Chinese rubbings

Chinese rubbings are generally composed of different sheets of very thin assembled *xuan* paper, which can be several meters high or long. After rubbing, the document is often folded several times in order to transport it.

Because of the obvious fragility of these papers, and for display purposes, they have been lined using different methods. In China, rubbings are sometimes lined with a second layer of *xuan* paper and mounted on scrolls or albums. In France, other methods, such as lining with Japanese paper or backing with a thicker material, have been used. A selection of results are presented below from a series of tests made on prototypes aimed at measuring changes due to the introduction of different backings found in western practice (Manila paper, cardboard, canvas) or traditional Chinese scroll mounting.

Samplings

Samples of rubbings were prepared using the same reference paper (*xuan* paper, 18.6 g/m²) chosen for comparison with an ancient Chinese rubbing paper. This paper was compared with other actual Chinese papers for rubbing from the Henan Museum and some very regular results were found with surface metrology (the structure of the paper is 18.88 μ m in height and 20.69 μ m for the reference *xuan* paper). After evaluating variability and reproducibility, a reference sample was used and different treatments applied to other samples in order to measure and characterize them after treatment to compare the initial material to the lined material.

The samples before treatment were considered non-identical but comparable, as confirmed by the surface measurements (the amplitude of the initial relief is about 0.2 or 0.25 mm). Treatment samplings were lined or backed. The lining was made with *xuan* paper (the traditional Chinese method), Japanese paper (RK1 8 g/m², RK12 21 g/m²) or Manila hemp paper (9.3 g/m²) because of their current use in western conservation. A few samples were backed with cardboard (about 250 g/m²) or canvas, chosen for comparison with existing mountings in French collections.

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Figure 5 Area containing the detail chosen on a contemporary non-treated rubbing (wristband). © Altimet – Ulysse Mathelin

In order to represent the traditional Chinese mounting, the samples were completed with a real rubbing collected from three exemplars in the Henan Museum and prepared in the museum's studio in 2007: one was untreated, one was lined with *pizhi* (quite similar to hemp paper in appearance and thinness) and one was scroll mounted.

The authors chose to focus on certain methods only, involving starch paste with little difference in concentration (about 3%). A representative area for comparison was then selected (Figure 5). Thanks to other samples, the influence of the changes incurred during treatment (drying process and pressure) could be studied further.

Protocol

- description of the characteristics of the original papers and papers used for lining, with the aim of creating a reference for the different morphologies
- methods of treatments according to the different protocols and factors (e.g. flattening and drying systems, adhesives)
- description of the characteristics after treatment
- evaluation and comparison between the initial materials and those flattened (Figures 6–7).

The results should make it possible to establish the consequences of treating paper.

Results and interpretation

Measurement of the paper in the reference rubbing indicates a very tight structure, even if it seems transparent. From the height differences observed on the rubbed area, an appropriate sensor was chosen (with a 1.4-mm range).

Backing on canvas has less relief than backing on cardboard and the characters became narrower. The loss of relief is about 30% compared to the reference amplitude. This attenuation confirms the visual impression from the collections.

Comparison between the mounted scroll and reference rubbing indicates that the process (first lining with *xuan* paper and second lining with *xuan* paper for the back of the mounting, applied under pressure) has an effect on the fibers: some positioned on the top are wider. The detail cannot be distinguished by topography anymore and flatness is obtained. 3-D digital microscopy shows that it makes the inked fibers more diffused on the outside of the motif when the rubbing is mounted (Figure 8).

The average amplitude of the sample lined with Manila hemp paper (3% starch paste) is about 0.3 mm. Contrary to all expectations, it seems that the amplitude of the relief in rubbed areas increases when the paper is lined. This increase is probably linked to the pressure from the back during lining and brushing: flattening the back causes the relief to show on the recto side. The relief remains the same, but the aspect of the fibers is noticeably different. Thanks to the profiles, greater rugosity is observed after lining with hemp paper and the fibers are more visible. This may

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Figure 6 Detail of the wristband before treatment. © Altimet – Alexandre Dembicki

Figure 7

Detail of the wristband after lining with *pizhi*. © Altimet – Alexandre Dembicki

Figure 8

3-D microscopy (HIROX KH 8700). Detail of the wristband after traditional mounting. X35. © C2RMF – Pauline Chassaing be due to swelling of the fibers when the starch paste is applied, which introduces water to the structure.

The results of lining with Manila hemp paper show that the relief remains largely unmodified to the naked eye even if the structure is different. The visual appearance and legibility of the character in relief is satisfying and this method was found to be interesting for the treatment of rubbings that do not need to be rolled.

Study of the surface state of the rubbings leads to the consideration of further questions about the mechanical role of flatness (which facilitates the rolling-up in the context of traditional scroll mounting), as well as its aesthetic and cultural importance. Measurements show that sometimes the rubbing appears flat, but this impression is not confirmed. In some cases, the flatness has been suggested only by a change in the state of the surface. In fact, it is the legibility of the subject which is modified; in the case of Chinese characters, calligraphy is as important as the meaning.

Generally speaking, in the domain of graphic arts, reinforcement and flattening treatments are current practices used to consolidate paper and give it a more satisfactory visual aspect. Even though such practices have proved to be useful, their impact on the grain of paper has recently been questioned. A comparison of the texture of the paper before and after treatment is rarely done in the studio today and could sometimes be taken into account. Studies of this sort can be performed with surface metrology analysis and can help specialists to choose between different treatments and priorities.

PERSPECTIVES

Follow-up involves multiple examinations of a large number of Chinese documents to create a reference database of both materials and treatments. Until now, these tests have mainly been conducted on new material, but they will be applied to a larger number of works of art in 2014–2015.

The project will then have an international dimension, through exchanges with Chinese collection specialists worldwide. Partnerships will be developed with Chinese museums in order to pool observations and information about the conservation of Chinese documents on paper as well as Chinese paper used for conservation. These links will concretize collaborations or exchanges in museums and scientific research centers to further deepen existing relationships and perhaps create new ones.

CONCLUSION

In conclusion, the authors consider that a deep awareness of the cultural identity of artifacts is necessary in order to conserve them and that a decision concerning treatment is better guided by historical and scientific knowledge, concrete practice, interactions such as exchanges and an understanding of Chinese ethics.

Results obtained with non-contact 3-D analysis yield a lot of useful information (knowledge of the fabrication processes and evaluation of conservation treatment) even about paper, which is often studied as two-

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In the long term, the authors hope to undertake research into papers and adhesives in conjunction with Chinese specialists, and to benefit from ancestral traditions. Through these exchanges, it is hoped to refine the terminology used and to integrate ways to define "conservation"/"restoration" in the West and in Asia as an extension of the Nara Document on Authenticity.

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NOTES

- ¹ Such as "rice paper" instead of "pith paper."
- ² From Jesuit missions in the 17–18th centuries to archaeological missions such as the one by Pelliot (1906–1909).
- ³ « Il est si fin, que plusieurs ont cru en France, qu'il se faisait de soie » [It is so thin that it was thought in France to be made of silk].
- ⁴ Khartasia (http://www.khartasia-crcc.mnhn.fr).
- ⁵ The survey is undertaken in Chinese collections, such as the Guimet Museum of Asian Art, Cernuschi Museum and the National Library of France in Paris, but also in other collections in France, such as the Museum of Textiles and Decorative Arts (Lyon), the Orbigny-Bernon Museum (La Rochelle), the Dobrée Museum (Nantes) and the Museum of Asian Art (Toulon).
- ⁶ The traditional art of making *xuan* paper has recently been listed (2009) by UNESCO as intangible cultural heritage.
- 7 This instrument was used to characterize fungal development on paper at the Smithsonian's Museum Conservation Institute in Washington in 2012.

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