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Use of East Asian materials and techniques on papyrus: Inspiration and adaptation

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Eve Menei

Use of East Asian materials and techniques on papyrus: inspiration and adaptation

Egypt and Japan are quite far apart geographically, and the pharaoh civilization which started developing from the end of the fourth millennium BC knew nothing of the civilizations which were developing in East Asia.¹ However, through time and space, we were able to establish a connection between both cultural worlds, thanks to papyrus. The studies of Egyptian language and religion that preceded our qualification as paper conservators explain our choice in specializing in the conservation of papyrus. In the course of our research and practice, we were able to use our knowledge of East Asian materials and techniques.

For the last 20 years, Asian conservation techniques and the use of Asian materials have been taught in Europe. As a graphic art conservator, I have benefited from this training as well as two highly instructive visits to Japan. Thanks to a scholarship from the Japanese Foundation, I attended an IIC congress in Kyoto (where I was introduced to Japanese papermaking workshops and conservation studios), and followed this interest further by going on to complete the fascinating ICCROM Japanese Conservation course.

History of papyrus

Egyptian civilization developed in a particular geographical context, along the banks of the Nile, the source of legendary and fertilizing floods in a desert climate. *Cyperus papyrus* (a plant which can easily reach 4 m in height) was once abundant in the large marshes of the Nile delta (much more widely spread than today) (Fig. 1). Egyptians, using this plant, invented the first flexible writing support of vegetable origin.² Papyrus is not technically paper, since it is not made of felted fibres, but it shares with paper its vegetable origin, its composition mainly of cellulose, its form (rectangular sheet), its flexibility, its lightness and, above all, its function as writing support (Table 1).

¹ The theories of A.E.J.B. Terrien de Lacouperie (1845–94), a French orientalist, specialising in comparative philology about links between Middle East and Far East (cf. *Western Origin of the Early Chinese Civilisation from 2300 BC to 200 AD* (London, 1894)) are now found fanciful.

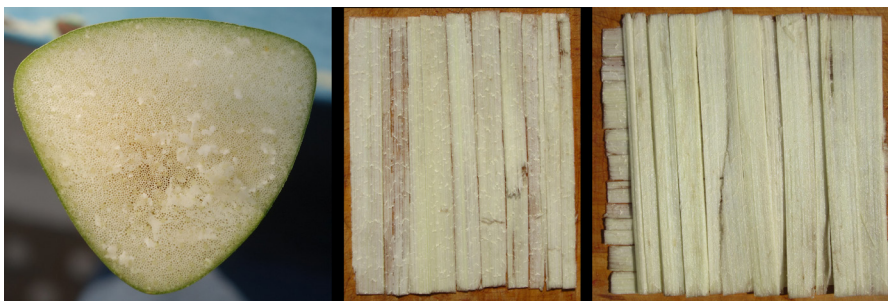
² For general references on papyrus, see P.T. Nicholson and I. Shaw, eds., *Ancient Egyptian Materials and Technology* (Cambridge University Press, 2000), 227–53.



Fig. 1 Hunting scene in the papyrus swamps, watercolour by H. Boussac. Musée du Louvre GAE 0004.

Table 1 Merits of papyrus and paper.

Papyrus		Paper
Plant as raw material	=	Plant as raw material
Raw fibers	≠	Refined fibers
Cellulose based	=	Cellulose based
Sheet formation by lamination	≠	Sheet formation by felting
Square sheet	=	Square sheet
Ivory to beige tone	=	Ivory to beige tone
Flexibility	=	Flexibility
Lightness	=	Lightness
Writing support	=	Writing support

**Fig. 2** Inner part of the pith and formation of the sheet (reconstitutions of papyrus-making were kindly provided from papyrus stems cultivated in the Giardini Botanici Handbury).

3 Cellulose 53.29–62.04% and lignin 22.42–32.77%, according to analysis on ancient samples of papyrus by H.G. Weidemann and G. Bayer, 'Papyrus, the Paper of Ancient Egypt', *Analytical Chemistry* 55, no. 12 (1983).

4 Cf. W.B. Emery, *The Tomb of Hemaka* (Cairo, 1938), 14, 'Flattened roll of papyrus (Cat. N° 429)'; 41 'Cat N° 432 Circular wooden box ... A small flattened roll of unscribed papyrus'.

5 Paule Posener-Krieger, *Les archives du temple funéraire de Néferirkarê-Kakaï*, 2 vols. Bibliothèque d'étude (BdE) 65, nos. 1–2 (Le Caire: Institut Français d'archéologie orientale du Caire, 1976). The Abusir papyrus are housed in Cairo, Berlin, London and Paris.

6 An Arabic document from 1087 is quoted in T.S. Pattie and E.G. Turner, *The Written Word on Papyrus* (London: BMP, 1974), and in Europe the papal chancellery used papyrus during the eleventh century (a papal bull by Pope Victor II, kept in Spain, is dated 1087) and documents on papyrus are found in the south of Italy. Cf. *Continuing Use of Papyrus through the Eleventh Century*, in <http://www.historyofinformation.com>.

7 Eve Menei, 'Éléments pour une histoire de la conservation des papyri', in ed. Mario Capasso, *Il rotolo librario: fabbricazione, restauro, organizzazione interna*, *Papyrologica Lupiensia* 3 (Lecce: Congedo, 1994): 189–221.

Let us briefly remind ourselves here that papyrus is made from pith, the naturally white inner part of the *Cyperus papyrus* stem, after the peeling and removal of the green and siliceous outer rind. The pith material is composed mainly of cellulose and some lignin.³ This pith was cut into strips, and then pressed down to form a sheet (Fig. 2). The vegetable material was used raw, without refining.

Papyrus was never sold in the form of a sheet, but always in the form of rolls of about 20 sheets joined together, which came in various heights, from 5 to 40 cm.

The oldest testimony of this material is an unwritten roll, found in the tomb of a chancellor of King Den (around 2800 BC).⁴ The oldest written documents discovered to date showing accounts (Fig. 3)⁵ are 500 years younger (administration already held a powerful place in society!).

The use of papyrus was spread, little by little, throughout the Mediterranean region. Most of the manuscripts we have were found in Egypt, because of the climate, favourable to conservation. Papyrus was used to transmit information written in the various Egyptian languages and writings (hieroglyphs, hieratic, demotic), but also in Greek, Coptic, Hebrew, Latin, Arabic and Farsi. Papyrus was used for writing until the eleventh century,⁶ but its production moved towards Sicily.

Most documents are now preserved in museums or libraries. Their preservation and conservation require an appropriate approach, different from that applied to Western paper. The material, often little known, also frequently suffered from inappropriate interventions.⁷



Fig. 3 *Abusir papyrus*. Musée du Louvre, E 25279.

We know that various qualities of sheets were used from the beginning, but preservation conditions obviously played a significant role in the present condition of the papyrus. The flexibility of the documents varies greatly but it has, in general, decreased considerably, and it is today very difficult to imagine how a scribe could roll and unroll these documents or fold them and unfold them without breaking them. The most frequent damage noted today are fractures, lacunae and degradations caused by some green pigments.

To give the best possible answer to the challenges posed by the conservation of these fragile objects, Eastern materials (wheat-starch paste, *funori*, *gampi* paper and *kōzo* paper) and techniques (facing, lining) have been derived and adapted.

Use of wheat-starch paste

Wheat-starch paste, prepared with the Japanese method, is the adhesive we prefer to use. We believe it to be particularly suitable, because the starch is present in the material in two ways. Starch grains exist naturally in the plant and certainly play a significant part in the adhesion of the pith strips. Egyptians had also discovered the principles of manufacturing and the use of this kind of adhesive: analysis of the adhesive used to produce the joins of rolls showed different forms of starch-based adhesive (wheat, barley and some other unspecified).⁸

Today, for papyrus, wheat-starch paste is used in a diluted form to re-fix fibres coming away from the surface, and is applied more thickly to secure local consolidations (Fig. 4). Because of its strong adhesive property, it is

⁸ F. Fliedner and E. Delange, *Le papyrus: nécessité d'analyse*, <http://www.cnrs.fr/cw/dossiers/dosart/decouv/papyrus/savoirplus.html#10> (accessed 19 June 2017).

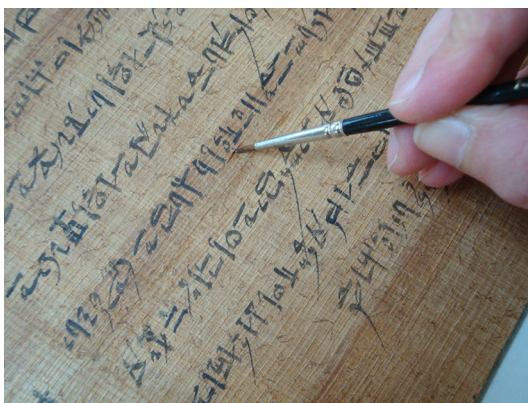


Fig. 4 Consolidating papyrus fibres with diluted wheat paste.

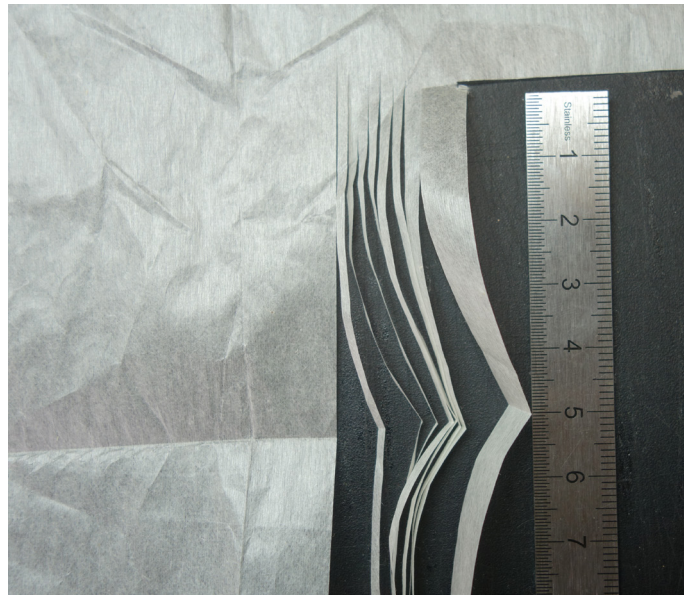


Fig. 5 *Gampi* paper strips for consolidation (thin one) and mounting (large one).

possible to use a very small amount. The papyrus is not left brightened or browned. However, we never use it for overall consolidation because we do not believe it to have sufficient qualities of flexibility.

Use of *gampi* fibre paper

We use *gampi* paper for local consolidations (Fig. 5) and facing. As far as I know, *gampi* paper is not used traditionally as a paper for conservation. It is characterized by the paper's slightly glossed appearance and by its fibres, shorter than *kōzo* fibres, which is more commonly used in conservation. This sheet can be compared with the surface of high quality manufactured papyri. Its natural beige colour is close to that of the papyrus and it can generally be used without having to be tinted.

Besides its attractive appearance, tests carried on 18 g sheets of paper showed that its resistance qualities are completely satisfactory when used for local consolidations.⁹ Various laboratory tests have measured its resistance (Table 2). The double-folding endurance tests are particularly astonishing. When the fold line is parallel to the direction of the fibres, we find the weakest resistance with an average number of 52 folds for a weight of 500 g. When the fold is perpendicular to the direction of the fibres, we obtain an average number of 511 folds with a weight of 1 kg!

⁹ Tests carried in the laboratory of the former CRCDG, now CRCC, with the help of Mrs F. Leclerc in 1991 on *gampi* paper purchased from Canson under the reference 'papier verger G2 18G'. Fold endurance measures the durability of paper when repeatedly folded under constant load, determining how many times the paper can be folded until it breaks. The folding strength is quoted as the number of double folds.

Table 2 Folding strength test of 18 g *gampi* paper samples.

Load	Parallel folds to the fibres direction	Perpendicular folds to the fibre direction
500 g	Mean value 52	One test 3173
100 g	No test	Mean value 511

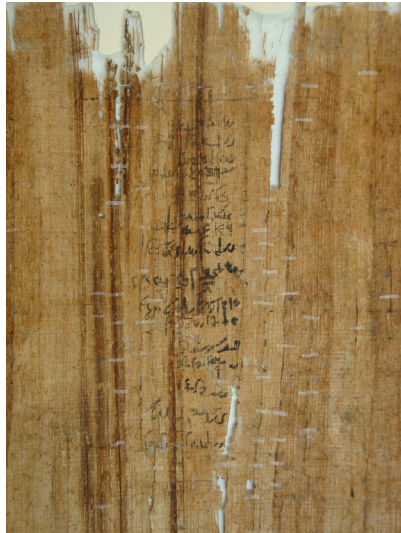


Fig. 6 Local consolidations in *gampi* paper on the verso of a Hieratic contract. Musée d'archéologie Méditerranéenne inv. 296.

Consolidating strips are always cut in the direction offering the greatest resistance (Fig. 6). Using strips with a width of 1.5 mm to 2 mm, we have never observed any cracks.

Moreover, the shorter *gampi* fibres and the glossy surface of the sheet facilitate the reversibility of consolidations.¹⁰ It is quite often necessary to carry out a realignment of consolidating strips along a fracture in the papyrus. The *gampi* strips can be lifted off very easily, without leaving long fibres on the irregular surface. In addition, the relative weakness of the *gampi* paper does not over-stress the old papyrus fibres. We also use it to make strips for fixing the document onto a mount. The strips are always cut to offer best resistance, but are broader, of about 1 cm.

In addition, we use *gampi* paper as a facing paper. We always carry out preliminary tests but, generally, thanks to its very smooth surface, it does not lift any ink. We cut the paper in rectangles of approximately 15 by 8 cm, the smallest side being perpendicular to the direction of the fibres. The rectangles are then applied onto the surface, overlapping the zones to be faced by about 1 cm, and thus forming a mosaic on the surface (Fig. 7).

¹⁰ When removing *kōzo* paper strips, we often have fibres remaining on the surface of the document.

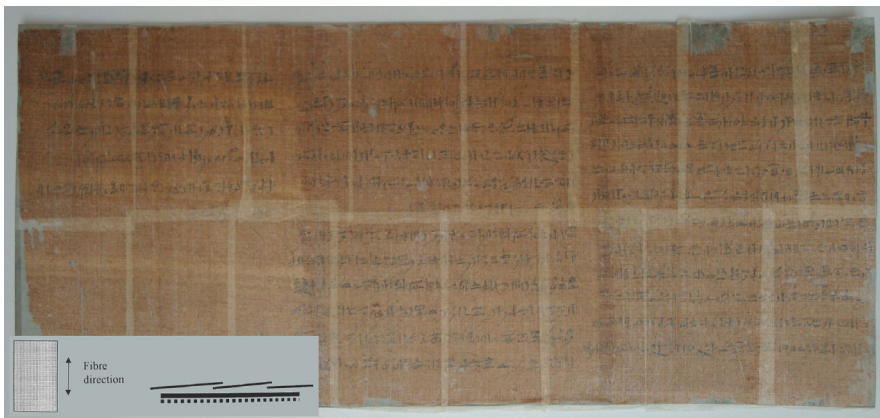


Fig. 7 Arrangement of the pieces of *gampi* for a facing. Musée d'archéologie Méditerranéenne inv. 292.1 during treatment.



Fig. 8 Distortions of the cardboard causing splits in the structure of the papyrus. Musée d'archéologie Méditerranéenne inv. 292.1 before treatment.



Fig. 9 Application of the facing with *funori*.

***Funori*, a Japanese seaweed adhesive**

Funori made from various types of seaweed from the *Gloiopeltis* family is another great friend to papyrus. It can be used as an overall consolidant. Tests on a very fragile document were more conclusive when *funori* was applied with a brush, through a sheet of very fine Japanese paper.¹¹ It can also be vaporized.¹²

This glue proved most useful as an adhesive for facing. In the French collections, a very large number of papyri were lined on cardboard (often blue), sometimes on cloths, rendering them easy to handle and display in showcases.

These cardboards are now distorted. The differential movement of the cardboard produces distensions within the structure of the papyrus: the layer of vertical fibres adhered on the cardboard suffers from the distortions generated by the cardboard, while the layer of horizontal fibres tends to become loose (Fig. 8). It produces surface cracking, swelling and fragment losses. In some cases, it was decided to simply peel off all but one sheet of cardboard in order to reduce its thickness and the stress on the papyrus; it was sometimes necessary to remove it completely.

We had to work out a method for consolidating and maintaining the fragments of papyrus during this operation. This facing technique using *funori* has proved particularly suitable. We use a very thin adhesive (diluted about 0.5% with water) and carry out tests on a very small surface to check the behaviour of carbon inks. The adhesive is applied onto the smooth surface of the rectangles of *gampi* paper, not onto the papyrus. The dampened paper rectangle is then laid down with the same brush onto the recto of the document to be protected (Fig. 9). Once the entire surface is covered, the document is placed under a light press for drying, to avoid distortion. Removing the cardboard is then largely facilitated by the facing, which protects the surface from friction and maintains the fragments in place

¹¹ K. Masuda, 'Vegetable Adhesives used in the Workshop of the Hyogushi, Restorer and Mounter of Japanese Paintings', in *Adhesives and Consolidants: Preprints of the Contributions to the Paris Congress* (Paris: IIC, 1984), 127–28; H. Noriko, A. Tomonori, K. Satoshi, T. Tokuchi and K. Wataru, 'Characterization of *Funori*-Extraction from the Red Seaweed as a Restoration Material', in *Journal of the Japan Society for the Conservation of Cultural Property* 48 (2004): 16–32.

¹² Eve Menei and Laurence Caylux, 'Strategy in the Case of a Wrecked Papyrus'. Poster abstract. *Paper Conservation: Decisions and Compromises. Extended Abstracts presented at the ICOM-CC Graphic Document Working Group Interim Meeting, Vienna 17–19 April 2013*, ed. Lieve Watteeuw and Christa Hofmann (International Council of Museums (ICOM), 2013); Florence Darbre, 'The Papyrus Codex Tchacos: its authentication, conservation and future', *Papierrestaurierung* 9, no. 4 (2008): 19–25.



Fig. 10 Removing the cardboard. Musée d'archéologie Méditerranéenne inv. 296 during treatment.



Fig. 11 Removal of the facing.

(Fig. 10). In some cases, a much-diluted solution of *funori* can also be used to moisten the outer layer of the cardboard because its surfactant property encourages humidification.

Once the cardboard has been separated, the facings can be removed, one after another, after local dampening with a brush (Fig. 11). The papyrus can thus be restored and gradually consolidated. Residual *funori* definitely acts as a consolidant without brightening or yellowing.

Kōzo paper

We are also well aware of the possibilities offered by paper made of *kōzo* fibres, and we have developed it for use in mounting papyri.

Sheets of *kōzo* paper are used because of their strong resistance and because they can be tinted easily. They are useful for making various types of inlays for epistographic documents. The sheets are tinted with watercolour to suit the tint of the document. They are then doubled with starch paste. The number of layers is calculated to match the thickness of the papyrus as much as possible. If the papyrus is thin, we prefer to double two very thin sheets, rather than using one thick one. It was also found that two pasted sheets are more stable than a single one.

After flattening, the sheet is hollowed to house the document. We tested different ways of cutting: water-cut edges, trimmed water-cut edges, ripped edges and sharply cut edges (Fig. 12). The latter solution eventually proved to be the most aesthetic as well as the fastest. The package of the Japanese paper and the papyrus can then be mounted between two layers of glass:

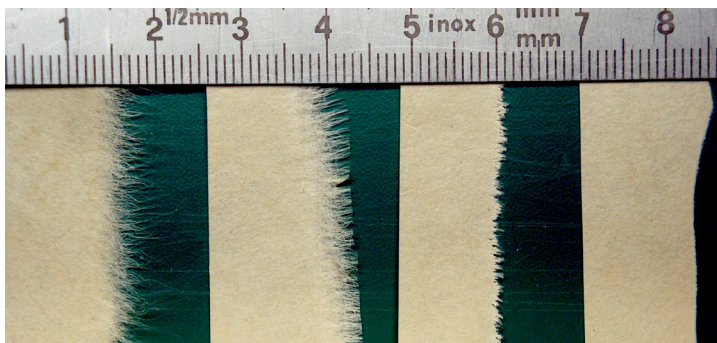


Fig. 12 Samples of *kōzo* paper with water-cut edges, trimmed water-cut edges, ripped edges and sharply cut edges.

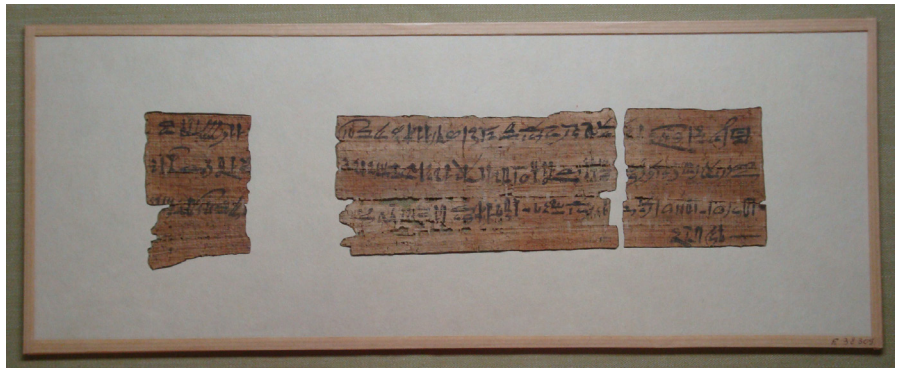


Fig. 13 Epistographic document mounted. Musée du Louvre E 32309.

the Japanese paper maintains the document without having to add adhesive, and prevents it from being crushed by glass (Fig. 13). However, for security purposes, if the document is to be moved or stored vertically, some strips, in *gampi*, for example, should be placed to fix the document.

Inspiration and research

Before concluding, I would like to point out the benefits of observing Eastern traditions and techniques with regards to our ongoing research in order to understand the manufacture and use of papyrus.

We have very little no information about the manufacturing process of papyri at the time of the pharaohs. Pliny the elder's text is the earliest reference we have. It comes late (77 AC) in the timeline of this ancient craft and, moreover, the author never saw what he speaks about, neither in Rome, nor in Egypt. The sole information we have coming from Egypt at the time of pharaohs consists of images of harvesting and representations of scribes at work, which show how the finished product was used. Unfortunately, no archaeological remains representing the manufacturing process of papyrus sheets and rolls were found. We must focus on the observation of the documents and possibly learn from the cultures which have developed similar forms of writing material.

While studying the manufacture of a roll of Japanese paper in Japan, we were astounded to discover that the papyrus roll has much in common with the Japanese roll.

We have a common basic unit, the sheet, more or less rectangular, and an almost identical end product, the roll. Studying the making process of a roll in a Japanese conservation workshop makes it clear that the final product is the result of strategic economizing of means and operations: sheets are the same size to facilitate handling and alignment, joins are water cut to avoid thickness and, to ease pasting, always run in the same direction.

What about papyrus?

Within a papyrus roll, the sheets are almost all the same size. We can also observe that all the joins within a roll have the same direction, just as in a Japanese roll.

However, the edges of the papyrus sheets cannot be fibrillated in the same way as Japanese paper. The Egyptian craftsmen therefore worked out a technique to obtain the same result as fibrillation. The meticulous observation of joins shows that the sheet was made with the top layer of horizontal fibres overlapping the left edge. The craftsman was then capable of making joins with three layers of fibres, overlapping in parallel in the joining zone (Fig. 14). As for fibrillated edges, these facilitate bonding and

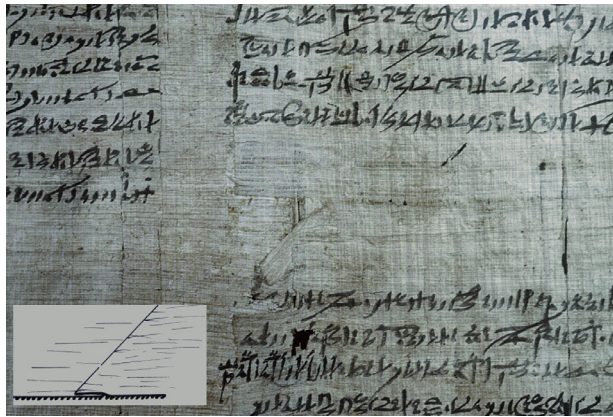


Fig. 14 Schema of the structure of a joint and detail of a flawed joint showing the three layers of papyrus.

reduce the joint's thickness to give a stronger and more homogeneous roll. Thus we can easily imagine that the Eastern craftsman's technique echoes the technique of the Egyptian craftsman through the centuries.

On the basis of these observation criteria, we explored further the manufacture of the large rolls of funerary texts. We have been able to identify two types of join production. On the one hand, the production carried out in a workshop by craftsmen according to a skilful and meticulous process is characterized by same-sized sheets and three layers of refined joins running in the same direction. On the other hand, the production of joins in scriptoriums by the scribes is characterized by four layers of joins fixed with a thick and overlapping adhesive in various directions. This production was used for different purposes. It was useful for lengthening a roll (it was necessary to join several rolls end to end to make oversized documents running several tens of metres). It was also used to correct a mistake without having to rub it out (in that case, a piece was cut out and stuck along the edges). Finally, it could allow several copyists to work on the same document at the same time.

Being aware of the craftsmen's know-how helps us to better understand the way papyrus was used. We hope that Eastern paper traditions will continue to help us in our research.

We are currently interested in pith paper manufacture. If we compare two strips cut from *Tetrapanax papyrifera* and *Cyperus papyrus*, we are struck by the similar structure.

Several methods for cutting the papyrus stem were investigated by Egyptologists, as can be seen here in summary.

The technique for cutting *Tetrapanax* stems corresponds to the hypothesis made by Professor Hendriks concerning pith layers. We are lucky to have images of the process used for pith paper and to be able to observe tools such as those preserved in the collections at Kew Gardens (Fig. 15). We have successfully tried to use the same technique on a papyrus stem. Perhaps this comparison will allow us to consider Egyptian archaeological tools and vestiges differently. We are also researching ideas and indications which could help us to identify the methods used for pressing wet sheets and for hammering them after drying.

Pressing is an essential step, allowing two layers of papyrus pith strips to adhere to one another. However, we have no details of the Egyptian technical process. Various comments in literature mention the process of hammering sheets. It is probably a step following the pressing and drying in order to thin the sheet and also to improve the surface regularity, making the sheet smoother under the scribe's brush.



Fig. 15 Tools for pith paper manufacture from the Economic Botany Collection, Royal Botanic Gardens, Kew, and experiments on papyrus pith with a similar technique.

We hope that an inventory of the various pressing and hammering processes in Asia will help us to understand how Egyptians worked. Eastern craftsmen are active guardians of ancestral traditions and preserve a repertoire of technical processes that could in our opinion, help us rediscover lost practices of ancient Egyptian craftsmen.

For all graphic art conservators, the exploration of products and methods developed in East Asia has generated a new way of approaching our work. But, if a good knowledge of the origins is necessary, we have to assimilate, adjust and really recreate the methods and adapt them to solve current problems.

Acknowledgements

I would like to thank the Curators of the Egyptian Antiquities Department in the Louvre Museum and of the Archaeological Museum in Marseille for their consideration and for allowing me to publish the pictures taken during the conservation of some of their documents. Thanks to Mark Nesbitt, Curator, Economic Botany, Royal Botanic Gardens, Kew for the informal pith day held at the Royal Botanic Gardens in 2014—it was very inspiring and fruitful. I would also like to express my warm thanks to my friends Amy, Brigitte and Laurence for their help and support.

Abstract

In our practice of papyrus restoration, we have been able to establish a connection between Japan and Egypt through the use of East Asian materials and techniques. Egyptian scribes made a writing support that is not technically paper but which has the same function, form and essentially cellulosic nature. Restoration of these exceptional documents requires an appropriate approach, different from that applied to occidental paper. The material has lost its suppleness, suffers from various alterations and has often undergone restorations that are unfortunate because they were unsuitable. This paper presents the profitable use that has been made of *gampi*-based paper combined with glue made from *funori* algae for producing facing and with starch glue for consolidation. In the framework of research concerning papyrus-making processes

still underway, the discovery of Asian papermaking techniques is of particular importance. We are particularly interested in the techniques of making scrolls from sheets, pounding techniques and the techniques of cutting pith paper.

Biography

Eve Menei graduated in Egyptology in 1988 with a dissertation on funeral texts and in Paper and Papyrus Conservation (INP) in 1990. She completed internships on papyrus conservation at the Department of Papyri (Papyrussammlung) of the Austrian National Library and at the British Museum. In 1991, she was a boarder at the Académie de France (Villa Medici) in Rome and studied the Vatican Library's papyrus collection. She participated in a one-month research program in Japan during the 1988 IIC Kyoto Congress and attended the Japanese Paper Conservation Course (ICCROM) in 1993. Since 1991 she has worked as a freelance paper and papyrus conservator for various institutions in Paris and France. She has worked on the papyrus collection of the Louvre Museum since 1990 and has been notably in charge of the conservation and mounting of the papyri displayed in the exhibition rooms at the time of the reinstallation of the collection in the Department of Egyptian Antiquities. She is particularly interested in issues relating to mounts for papyri, especially large-sized or opisthographic papyri and her ongoing research focuses on methods for making papyrus and related documentation.

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