

THE HISTORY, TECHNOLOGY, AND CARE OF FOLDING SCREENS: CASE STUDIES OF THE CONSERVATION TREATMENT OF WESTERN AND ORIENTAL SCREENS

By Dianne Lee van der Reyden

(Revised from a publication by D. van der Reyden, prepared at the Smithsonian Center for Materials Research and Education - formerly the Conservation Analytical Laboratory, entitled [Technology and treatment of a folding screen: comparison of oriental and western techniques](#). In: *The conservation of Far Eastern art: preprints of the contributions to the IIC Kyoto congress, Kyoto, 19-23 September 1988* / Mills, John (ed.); Smith, Perry (ed.); Yamasaki, Kazuo (ed.); London: International Institute for Conservation of Historic and Artistic Works, 1988, p. 64-68)

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*Fig. 1: Hand-painted front, Victorian folding screen, c. 1880s, before conservation treatment.
From the Harral-Wheeler House, Division of Domestic Life, National Museum of American History, Smithsonian institution.*

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INTRODUCTION

There is extensive literature on [Oriental folding screens](#), their history, construction, care and conservation. Only a few publications exist on the history of [Western folding screens](#) [1, 2, 3]; even less has been written on their construction [4, 5, 6], and virtually nothing on their treatment. Knowledge of the structure and deterioration problems of oriental screens can aid a conservator in the treatment of western screens, as well as other western objects.

DEFINITIONS

The earliest surviving folding screens are Chinese. Existing **Chinese screens**, some of which are paper, date from the eighth century AD, although literary references date as far back as the Zhou dynasty (fourth to third century BC), and depictions of screens occur in Han dynasty tombs (200 BC-200 AD). However, it was in Japan that the screen form evolved into its most celebrated variations. **Japanese screen** variations include:

- **Byobu**: folding screen; translates roughly as 'protection from the wind' (Also referred to in English as '**beoube**' or in French as '**paravent**')
- **Tsuitate**: single panel entrance screen
- **Fusuma**: sliding door
- **Shoji**: the modern term for translucent paper doors or windows
- **Tobusuma**: wood sliding screen
- **Sugido**: cedar board

HISTORY AND TECHNOLOGY

Chinese folding screens, which served originally as partitions painted with serious works, were not intended to be moved around frequently. They were often heavy wooden structures hinged with cloth or leather thongs pulled through holes near the edges of the panels. The frame was prominent, and the image development was frequently vertical and confined to the individual panels, creating a pleasing pattern. **Japanese folding screens**, on the other hand, served many purposes, being used for tea ceremonies, as backgrounds for concerts or dances, as enclosures for Buddhist rites, and in outdoor processions [1]. The type of folding varied according to its function. For instance, small two-fold screens were used for tea ceremonies, while large, gold-leaf screens with up to eight folds served as backdrops for dancing. An emphasis on mobility required a structure that would be lightweight and flexible. A lightweight but strong core was produced with a lattice of a stable wood covered with many layers of paper applied in a specific sequence, in the manner of a **karibari** [8]. Flexibility was achieved by an ingenious system of strong paper hinges integrated in the panel construction, which allowed reversible folding patterns. The paper hinges brought the panels closer together, eliminating the need for intrusive frames separating panels and allowing a horizontal orientation of the picture plane which offered, through manipulation into different configurations, innovative approaches to the physical, psychological and narrative spatial relationships of the panels.

It was during the zenith of screen development in the East that Western traders, who had arrived in Malacca in 1543 from Portugal, became acquainted with the beauty and utility of screens, taking a special interest in the folding variety. Europeans adapted the screen form to their own needs. For example, folding screens were considered by Jesuit missionaries to be an ideal format for teaching western geography, customs and religious beliefs. However, this first encounter with Japanese screens had little direct effect on western art as such, since trade was severely reduced by a ban imposed in the mid-1600s [1, 2, 3].

A second major attempt to increase trade between east and west, the American government-sponsored visit by Commodore Perry in 1853, resulted in more long-lasting and significant influence of the Japanese screen on the west. The importation of oriental screens, both Japanese and Chinese, to major European cities (they were displayed at the 1867 International Exhibition

for Industry and Art in Paris) seems to have catalyzed the adaptation of the concept by Westerners. Numerous major European artists collected screens, and many others were so inspired by the form as to emulate it. The introduction of screens to Europeans was particularly well-timed, as it corresponded to a period of revived interest in decorative arts incorporated into interior architectural designs.

Eventually, western screens became a feature in any well-appointed setting. The demand was so great that it often had to be met by furniture makers and other 'amateurs', eventually encouraging home-made adaptations, tailored to the owner's tastes [3, 4, 5, 6, 7].

The core structure of **western paper screens** is quite different from oriental folding screens, and may be traced to the history of **wallpaper** [1, 7, 9]. Eighteenth century European wallpaper was not attached directly to the wall but rather, after being strengthened with a backing of canvas or linen, stretched and hung on a frame. By the end of the century, wallpaper hanging and screen making had become interrelated [1]. (This is true, of course, only for western screens made of paper through the nineteenth century. Western screens made of other materials, or made in this century, have a wide range of structures.)

By the nineteenth century the popularity of screens led to the proliferation of **homemade folding screens**. This trend may have originated from the earlier use of **firescreens**, both the **four-legged "cheval" screen** and the adjustable **tripod pole screen** with swivel head, to show off ladies' handiworks [2]. Many western screens, especially homemade versions, appear to have more in common with Chinese screens, in their use of framing, vertical compositions and individual panels, than with the sophisticated paper-hinged Japanese screens.

The Smithsonian Institution has a western folding screen ([Fig. 1](#)) that in many respects shares characteristics with the homemade versions of screens. While it is an exceptional example, its structure and decoration mirror quite closely the instructions found in 'how to' articles of the day. For instance, while pre-covered screens, to be decorated at home, could be purchased 'at fairly reasonable prices in almost every upholsterer's shop' [6, 9], the Smithsonian core matches descriptions for home assembly using a 5cm-wide wooden interior frame with mortised joints and a cross-bar for stability, covered in 'canvas' glued down along the edges, then sized and covered by a heavy white sheet of paper for smoothness. Additional finishing advised by one manual included toning exposed paper, before sizing, with a 'weak coffee wash' and varnishing after decorating [6]. Popular decorating suggestions for do-it-yourself screens included 'Photograph Screens', 'Christmas Card Screens', 'Foreign Postage Stamp Screens', 'Scrap Screens' and 'Wallpaper Screens' [6, 7, 8, 9]. For further inspiration, it was suggested that 'The celebrated Japanese design books now sold at the Oriental shops . . . will supply a hint of the exquisite arrangements by which the Japanese artist decorates without overcrowding' [6].

The back of the Smithsonian screen is covered by wallpaper friezes and dados, matching published suggestions of 'natural branches of some creeper' and 'floral designs' [6]. The front ([Fig. 1](#)) has a vertical composition, separated by ornamental borders employing gold highlights. Energy dispersive spectroscopy analysis (EDS) indicated that the 'gold' paint, which appears to have oxidized, resembles brass, composed primarily of zinc and copper; one contemporary article suggests using 'Bessemer or Judson's Gold paint' [6]. The images are a catalogue of those suggested by contemporary manuals: birds, butterflies, flowerpots, ships, uniforms, the tropics, and various seasons [4, 6]. The screen is hand-painted, but the medley effect resembles arranged picture scraps, and in fact the central grotesques of the side panels, resembling a cat and a dog, are copies of illustrations of the day [10].

CONSERVATION PROBLEMS AND TREATMENTS

There are innumerable problems associated with both eastern and western folding screens, many of which result from **human interference**. For instance, folding screens are often framed and mounted flat on walls, losing their spatial effects. Other screens are separated into individual panels for decorative purposes, perhaps displayed on opposite walls, or sold to different individuals in various auctions. As a result, their frames may be lost, or their sequence obscured. Separated panels may be cut down, or mounted as wall paintings. In an ironic twist, dealers also converted wall paintings and single screens into folding screens in order to capitalize on the popularity of folding screens after the turn of the century [3]. Paper screens are subject to **deterioration** from exposure to light, which causes fading and yellowing, and changes in temperature and relative humidity, leading to internal stresses resulting in tears. Because of their extraordinary susceptibility, few western paper screens appear to have survived. In addition, western folding screens were often re-covered [9].

On the whole, **oriental folding screens** of paper have fared better than their western counterparts. This may be due in part to the fact that, aside from works by known artists, westerners considered 'home-grown' screens as furniture, to be used and discarded when damaged. On the other hand, oriental screens were revered as precious art objects by westerners, who consequently **displayed** them as they would a painting. The western habit of displaying folding screens as open as possible can cause damage. While this affords a full view of the design, it not only loses the compositional interaction achieved by the three dimensional folding, but also strains the layers to which the hinges are attached into a more taut position. It must be remembered that, during construction, the hinges are applied to the screen panels in a folded position. In a flat position, especially if exposed to sunlight or heat, the paper will continue to shrink and tighten, and tears can occur from the hinges and elsewhere. By folding a screen slightly, the tension on the hinges is reduced. However, folding a screen in the reverse direction, while possible, can also cause strain.

Other problems result from the formation of the **core of the screen**, which can make it sensitive to environmental changes. The problems afflicting Japanese paper screens can result from the make-up of the panel. While some panels are made of recycled paper such as ledger sheets, the best ones are composed of many layers of paper, like a **karibari** [8]. The number of layers and their names vary slightly, owing to differences in terminology between eastern and western Japan, but are generally **honeshibari, minobari, minoshibari and ukebari** [11]. There are two different ways in which the minobari layer may be attached to the layer underneath. The minobari layer can be attached at the lateral edges of the panel, or in a shingled sequence. The latter technique, if the relative humidity drops, can result in tension in the lower edge, causing **tears** [11]. Panels with fewer layers of paper are more susceptible to tearing [12]. The paper layers shrink more than the wooden lattice, and the tension can cause vertical tearing in the center of the panel along the grain or fiber direction. Diagonal tears across corners may result from a tendency of the wooden lattice to distort into parallelograms if the core is not countered with diagonal support brackets [11].

Another problem noted with oriental folding screens appears as **corner waves** often associated with gold-leaf screens, resulting from slow drying under the foil, during which time the wood expands and stretches the corner sheets [11]. After the wood dries and shrinks back to shape, these corners retain their stretched position, forcing the waves.

To alleviate the tear problems, methods of mounting have been modified by some mounters who, for instance, apply layers alternating grain directions, or cover the corners of gold-leaf screens to control the drying rate. A modified mounting procedure has been published [11], suggesting that the ukebari layers alternate in sequence from top to third row down, then back to second row. This could counter the tendency of the surface layer to pull down in one direction.

The traditional way of repairing screens often involves remounting, and this can destroy the critical balance of tension of papers and paste [12]. With care, local repairs may be made, especially if there is no apparent evidence of former remounting.

For example, a screen attributed to Kano Tensetsu (c. 1636) had a diagonal split, which appears to have resulted from being displayed in a somewhat opened position. In addition to the split coming from the top hinge, the hinges had pulled out as the paper shrank along the grain. The split was repaired in the following manner:

- a) A polyester web (Pellon) was inserted under one edge of the split.
- b) A feathered, lightweight Japanese tissue mend, pasted out on a blotter with water-thin wheat starch paste, was transferred with tweezers, paste side up, to an angled polyester film spatula (Mylar, 5mil), which was guided under the split edge.
- c) The mend was pulled into contact with the underside of the split edge by raising the polyester spatula.
- d) The polyester spatula was removed and the mend allowed to dry.
- e) After all mends were applied to one edge and allowed to dry, a thin blotter was inserted under the mends, and the exposed half of the mends was pasted out with water-thin paste. A straight polyester film spatula, acting as a lever to raise the opposite split edge, guided the mends under the opposite edge and into place.
- f) The mends were lightly attached to the underside of the split edges.

The mends were intended only to hold the split together, flat, in plane, without pulling (which would create more tension). If the screen is ever strained again, the lightly attached mends will split before the screen itself. After repairs, the split and exposed hinges were inpainted over an isolating layer of methylcellulose with light-stable Winsor and Newton watercolors.

The same technique was used on a second screen, from the Edo period (c. seventeenth-eighteenth century), which had a tear along the upper edge, possibly resulting from the parallelogram problem. In another case, a gold-leaf screen of the Rimpa school had a wave or dent in the gold foil, associated with a puncture. The tear was mended as outlined above but, to work out the dent or wave, the area was lightly dampened with a moist cotton swab and gently dried with a blow drier to ease the distorted fibers back into plane. In each of these cases remounting could be avoided and the repair techniques were secure and sensitive. An example of a less sensitive mending approach was found on a previously repaired screen, attributed to Shu Shin Kano (c. 1725), where small losses from insect damage were covered with large patches of goldcolored paper. Fortunately, these were removable with methylcellulose, and the tiny losses could then be filled with paper pulp and inpainted [13].

In **western screens**, systems of canvas and wood strainers are more apt to be plagued by **punctures** than shrinkage tears. Punctures (resembling those which might be caused by a mop handle) formed the main problem with the Smithsonian folding screen, which was damaged through the canvas layers and had been previously dismantled. The canvas was removed by moistening it with water applied by small cotton wads, then quickly rolling it off in one piece. The adhesive appeared to be a mixture of starch and protein when tested microchemically with ninhydrin and potassium iodide-iodine, but it was not readily soluble. Since it was so uneven, thick and insoluble, it had to be removed before a new backing could be applied. The only way to remove the adhesive was with enzymes. Because the screen was extremely sensitive to moisture, a variety of enzymes and application techniques was tested. Although infrared

spectroscopy indicated a larger amount of starch present, the most effective enzyme combination was pancreatin and diastase, a mixture that has a wide pH range and works for both starch and protein, and which had been used for adhesive removal on wallpapers [14]. In the case of the wallpapers, the enzymes were sprayed on and allowed to sit 60 seconds; we tested several techniques including an enzyme saturated blotter, enzymes in methylcellulose and in an agarose gel [15], applied in cubes and as a spread.

The agarose had better working qualities than the methylcellulose and, by spreading out a thin layer, it could be worked over a larger area more quickly.

To realign the losses on the wallpaper side, a stencil of the pattern was made on polyester film and used as a guide for tipping the edges together with wheat starch paste. The tears were mended with Japanese tissue and the losses were then filled with layers of Japanese tissues, pre-toned with Liquitex Acrylic. Tear edges were filled with powdered cellulose, pre-toned by slightly heating the powder on a hot plate.

To remount the panels, a structure was designed that combined a modified version of a karibari-type core with elements of the original core.

CARE AND STORAGE

Literature on the treatment of oriental screens warns that incorrect remounting can destroy original materials, upset the balance and tension between the paste and paper [12] and lead to splits [16]. Other publications advocate the use of enzymes for adhesive removal on oriental screens [17], and acrylic resin emulsions for the consolidation and fixing of flaking paint [18,19]. Literature on the treatment of western folding screens does not exist, but publications on the conservation of wallpapers have information applicable to both western and oriental screens [e.g. 14].

No explicit recommendations for care of western screens have been published, but they do exist for oriental screens. Environmental controls such as 55-60% relative humidity and low temperature are suggested [20]. Change in RH and temperature can occur when exhibits are crowded with viewers or, for example, when television lights are reflected off gold screens. While on display, screens should not be under tension, but folded up to half way [21]. Screens should be stored folded closed, in an upright position, held together with broad linen tape [22]. In some cases, folded screens could be flanked by acid-free rigid boards on either side, to provide solid support. Suggestions for shipping include packing with cotton pads on all four edges to absorb mechanical shocks and buffer changes in relative humidity [11].

CONCLUSION

While some publications touch on the use of oriental methods to treat western objects, little has been published on western methods applied to oriental objects, such as the use of leaf casting to repair losses. Most western references cite a combination of oriental and western materials and techniques. As more techniques are published, more interaction between traditional and innovative methods will occur, to the benefit of objects as complex as folding screens, both western and oriental.

ACKNOWLEDGEMENTS

Special thanks go to Rodris Roth and the other curators of the Division of Domestic Life, National Museum of American History, Smithsonian Institution (SI) for permission to write about the Harral-Wheeler folding screen and for their supplementary information, and to Michael Komanecky and Virginia Butera, for personal communications. Additional thanks go to Lambertus van Zelst,

director of the Conservation Analytical Laboratory (CAL), the conservators and scientists on staff, especially Melanie Feather for her EDS analysis and Walter Hopwood for IR spectroscopic analysis, and CAL's information center staff, particularly Sherri Medley, and the staff of the Museum Support Center Library; to colleagues who shared information on the treatment of western folding screens or similar objects, especially Konstanze Bachmann, Kendra Lovette, T.K. McClintock and Carl Patterson; to Michele Hamill for her help in preparing this information, and Yoshi Nishio for his review of the material.

MATERIALS AND SUPPLIERS

- **Enzymes:** Diastase Type VI-A (A6880) and Pancreatin Grade VI (P1750) from Sigma Chemical Company, P.O. Box 14508, St Louis, MO 63178, USA.
- **Agarose:** Agarose Type M (121922) from Calbiochem Brand Biochemicals, P.O. Box 12087, San Diego, CA 92112-4180, USA.
- **Powdered cellulose:** Whatman Cellulose Powder CF-I, 0.015% ash, W. and R. Balston Ltd, Catalog Number 110 11, from Curtin Matheson Scientific, Inc., (Order No. 245324), 8291 Patuent Range Road, Suite F, Jessup, MD 20794, USA.

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