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*Funori*: The use of a traditional Japanese adhesive in the preservation and conservation treatment of Western objects

Jillian Harrold and Zofia Wyszomirska-Noga

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Jillian Harrold and Zofia Wyszomirska-Noga

## *Funori*: The use of a traditional Japanese adhesive in the preservation and conservation treatment of Western objects

### Introduction

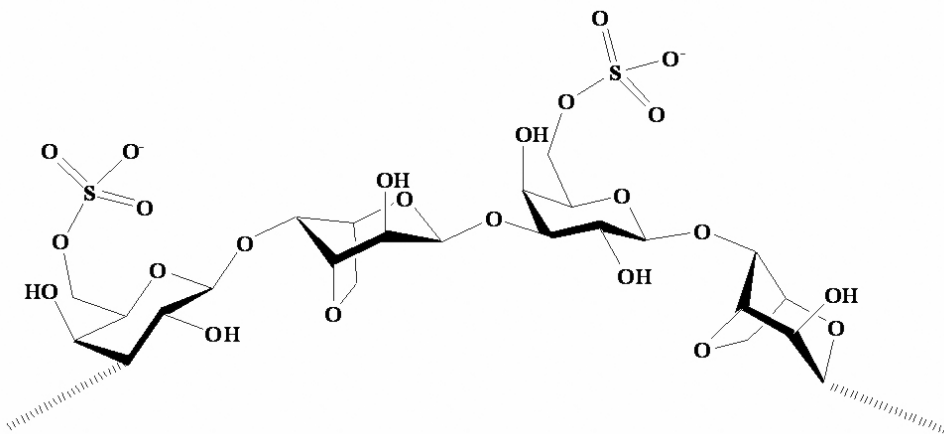
This paper is a discussion of the use of the traditional Japanese adhesive, *funori*, in conservation treatments. Both authors have been using *funori* in conservation treatments since 2008. Although initially encountered as a consolidant for matte surfaces, through research, reading and careful observation during practical application, the use of the material has broadened to other circumstances as well. In this discussion, a variety of Western objects, both contemporary and historic, that have been worked on over the last seven years, have been chosen to show how the characteristics and working properties of *funori* have suited some circumstances, and to demonstrate some of the range of possible uses for it as one of a number of treatment options when approaching a suitable object.

### Properties of *funori*

*Funori* is a polysaccharide extracted from the red algae *Gloiopeltis* species. This family represents a group of edible seaweed species widely used in the food, cosmetic and medical industries. *Funoran* has been characterized as a chemically heterogeneous polysaccharide with the major repeating unit of G6S-LA (b-D-galactose-6-sulfate e 3,6-anhydro-a-L-galactose diad (b-D-galactose-6-sulfate e 3,6-anhydro-a-L-galactose) diad; a diad being a sequence in which two constitutional units are continuing (Fig. 1). Red algae have a huge range of versatile properties: they are antibacterial, anti-inflammatory, they are anticoagulants, and scientists have also discovered their possible anti-tumour activity.<sup>1</sup>

Not all of these properties are useful in art conservation, but they certainly directed scientific interest toward *funorans*, and as art conservators we can

1 R. Tuvikene, M. Robal, D. Fujita, K. Saluri, K. Truus, Y. Tashiro, H. Ogawa and S. Matsukawa, 'Funorans from *Gloiopeltis* Species. Part I. Extraction and Structural Characteristics', *Food Hydrocolloids* 43 (2015): 481–92.



**Fig 1** *Funoran*—schematically drawn model of the major repeating unit of G6S-LA (b-D-galactose-6-sulfate e 3,6-anhydro-a-L-galactose) diad. This heterogeneous polysaccharide is able to build a great number of hydrogen bridges. This particular property is responsible for *funori*'s ability to bond large amounts of water, which results in the avoidance of tidelines during consolidation or cleaning procedures.

benefit of the new range of information recently available. Some of that information might be still difficult to interpret, however, it is already quite clear that we can confidently specify several *funoran*'s characteristics that can be beneficial in the field of art conservation.

When choosing *funori* for tests (either prior to consolidation, cleaning or stain removal) the following features have been taken into consideration: low viscosity when warmed up, low surface tension, and the fact that the molecule of polysaccharide of *Gloiopeltis* is able to build a large number of hydrogen bridges. This last chemical characteristic is responsible for *funori*'s ability to absorb and bond large amount of water (and this helps to avoid a creation of tidelines around the treated area). *Funorans* also are well known for their stable character, transparency and for not changing the appearance of the consolidated or cleaned surface.<sup>2</sup>

Regarding *funori*'s viscosity, liquids whose molecules can form hydrogen bonds are usually more viscous, but, as viscosity is shaped by the strength of intermolecular forces and also by the shapes of the molecules, viscosity of a liquid decreases as temperature increases. It means that when a *funori* solution is warmed up the molecules acquire more energy, they escape from their mutual attraction, subsequently hydrogen bonds (quite weak chemical bonds) can break and chain molecules can also wriggle around more freely and hence disentangle more quickly—this alongside low surface tension should be responsible for *funori*'s superb penetrating ability of porous surfaces.

Before attempting to use any consolidant including *funori*, one has to consider the various factors responsible for the working properties of a chosen consolidant. They depend on the permeability of the substrate to be consolidated, the presence and strength of capillary forces that are working, the ability to use gravity to work in aid of the treatment, and how the consolidant is applied to the treated surface.<sup>3</sup>

### Preparation

Much has been written and published about the preparation of *funori*, and there is a significant amount of good literature available in English.<sup>4</sup> As the research has evolved and new information becomes available, methods of preparation have changed. As with any treatment in conservation, practise is adapted as the research evolves.

A very good overview of preparation techniques is still provided by Joseph Swider and Martha Smith in their 2005 article for the *Journal of the American Institute of Conservation*, appropriately entitled, '*Funori*: Overview of a 300-Year-Old Consolidant'.<sup>5</sup> Their stated aim is to provide preparation guidelines for those wishing to use *funori*. In this discussion they compare a number of different preparation methods and establish six basic steps in the preparation of *funori* from dried seaweed: 'rinse, soak, heat, extract and then dry and reconstitute'.

Variations in methods of cultivation and processing the red alga as well as concerns about impurities, salts and variations in pH led to the development of an extraction method and purification process to produce a pure *funori* or JunFunori® that was intended to reduce impurities and minimize variations, creating a standardized product for use in conservation.<sup>6</sup> Although effective, the product was expensive, and excellent and consistent results can be achieved with preparation from the traditional dried *funori* sheets as long as they are prepared with care.<sup>7</sup>

Michel explored deviations in concentrations and looked to establish the best concentration to be achieved using dried *funori*.<sup>8</sup> The effectiveness of the solution was optimal at approximately 1% w/v in water. This optimal concentration is also related to the characteristic of *funori* to bind a lot of

2 Pauline Webber, 'East and West: A Unified Approach to Paper Conservation', *The Paper Conservator* 20 (2006): 46.

3 C. Reis Neyval Jr, Richard F. Griffiths and Jane Méri Santos, 'Parametric Study of Liquid Droplets Impinging on Porous Surfaces', *Applied Mathematical Modelling* 32 (2008): 348–50.

4 Sandra Grantham and Alan Cummings, 'Painted Japanese Paper Screens: The Consolidation of Paint Layers on a Paper Substrate', *The Broad Spectrum: Studies in the Materials, Techniques, and Conservation of Color on Paper*, ed. Harriet K. Stratis and Britt Salvesen (Archetype, 2002); Joseph Swider and Martha Smith, '*Funori*: Overview of a 300-Year-Old Consolidant', *Journal of the American Institute of Conservation* 44 (2005): 117–26.

5 Swider and Smith, '*Funori*'.

6 Thomas Geiger and Françoise Michel, 'Studies on the Polysaccharide JunFunori used to Consolidate Matt Paint', *Studies in Conservation* 50 (2005): 193–204; Françoise Michel, '*Funori* and JunFunori®: Two Related Consolidants with Surprising Properties' (CCI Symposium 2011: Adhesives and Consolidants for Conservation: Research and Applications, Ottawa, 17–21 October 2011).

7 The price issue may be resolved as new products come onto the market.

8 Best concentration in this case was defined as a solution with the highest amount of extracted adhesive. Michel, '*Funori* and JunFunori®', 3–4.



**Fig. 2** Fragile areas of two different study cases: distemper printed scenic wallpaper (*Grand Chasse au Tigre dans l'Inde*, Valey workshop, before 1818) and, below, 1980s painting executed on emulsion painted wallpaper (according to the information obtained from the owner, the painting is attributed to Damien Hirst). In both cases *funori* was successfully used for the consolidation of extremely friable matt layers. Both artworks from private collections. Image copyright Z. Wyszomirska-Noga.

water, and the lack of formation of tidelines.

Further, several suppliers of the dried seaweed were compared and significant variations in pH were noted in some batches; thus PH should be tested with each new batch to check for variations that would make it unacceptable for treatment.<sup>9</sup>

It is also now clear that the 'rinse' step in the preparation of the *funori* is particularly significant. Accelerated ageing tests carried out in the last five years indicate that the more impurities that are removed, the better a *funori* preparation ages, particularly in terms of colour and transparency. It also seems clear that using lower concentrations (under 2%), as is often the case in paper conservation, decreases the potential of colour change as well.<sup>10</sup>

## Case studies

### 1 Consolidation

In 2008, *funori* was used for the consolidation of very fragile distemper-printed scenic wallpapers. The condition assessment was done on behalf of the conservation company Plowden and Smith Ltd for a private collector (Fig. 2).

The two separate wallpapers appeared to be distemper-printed nineteenth-century French scenic wallpapers: *Rives du Bosphore*, from the Dufour Workshop (1812–30) and *Grand Chasse au Tigre dans l'Inde*, from the Valay workshop (before 1818).<sup>11</sup>

The wallpapers were water damaged, and had been stored for a long period of time rolled with the printed side inward. The print had been applied in colour blocks, and there were as many blocks used as colours, so the print had a very heavy, layered structure. Because of the long-term inefficient storage, the layers of distemper print were very brittle, friable and powdery. Consolidation of vulnerable layers was an essential step prior to further flattening and mounting.

At this point, Merryl Huxtable, a talented and memorable paper conservator from the V&A, was asked for consultation. Amongst several consolidation methods we discussed, the one that was eventually chosen, after tests, was a *funori* solution.<sup>12</sup>

<sup>9</sup> Best concentration in this case was defined as a solution with the highest amount of extracted adhesive. Michel, 'Funori and JunFunori®', 4.

<sup>10</sup> Ting-Fu Fan, 'Evaluation of *funori* stability in preparation methods', *Adhesives and Consolidants in Painting Conservation*, ed. Angelina Barros D'Sa, Lizzie Bone, Alexandra Gent and Rhiannon Clarricoates (Archetype, 2012), 53–60.

<sup>11</sup> Odile Nouvel, ed., *Papiers peints panoramiques* (Paris, 1990).

<sup>12</sup> Susan Catcher and Lucia Burgio, 'Pugin's Wallpapers from The Grange', *V&A Conservation Journal* 50 (Summer 2005).

*Funori* (slightly lower than 1%) was applied from the front either directly onto printed surface with soft goat's hair brushes or, in case of very friable areas, through delicate tissue paper. This was repeated twice.

I observed and noted that two strong water stains present on the wallpapers' surfaces had been reduced during that process.

After being air-dried on big tables, the wallpaper was mounted onto layers of Japanese paper on stretchers—a structure that adapted the Japanese multi-layered underlining system known as *shitabari*. Paper layers were pasted in a way to provide pockets of air between them. This acts as a kind of cushion and evenly distributes the tension on the whole surface of the artwork, allowing for some movement and contraction.<sup>13</sup>

The second significant object in the journey of 'exploring *funori*' was a contemporary painted wallpaper attributed to Damien Hirst's workshop, dated to the 1980s.<sup>14</sup>

Contemporary household acrylic paint was applied on white emulsion-painted wallpaper. The wallpaper was water damaged and stored in rolls, with the paint layer on the outside. The light-damaged, discoloured paper had a tendency to stain the matte, white painted surface during local humidification tests. The painted layers were fragile, brittle and powdery. The white background paint with a matte appearance was in contrast to the glossy, acrylic painted dots—this contrast was to be maintained, as it seemed to be a substantial part of the design.

During initial tests *funori* worked very well as a consolidant, helping to relax the paper substrate, penetrating well and not causing any staining. The treatment included both consolidation of the painted layers and the removal of older tissues that were protecting tears and fragile areas when the wallpaper was in storage.

Immediate re-lining onto new paper support followed consolidation. This was necessary as paper substrate was very susceptible to staining and deformation when not controlled, so it was considered to be safer for the object not to repeat the wet process twice. The *funori* (slightly lower than 1% w/v) was applied from the verso, with soft brushes. It was applied in one layer.

After treatment, the matte appearance of the background was preserved; tissue removal from the powdery surface was time-efficient and safe, there was some significant reduction of old water stains and this observation was noted and used in further projects.

A further example of effective consolidation is found in the treatment of a mid-twentieth-century map that forms part of the collection of the Imperial War Museum in London (Fig. 3). The map is titled 'Very large printed map



**Fig. 3** Very large printed map of North African coast belonging to Rommel, with inscriptions in Rommel's hand (IWM Documents, 20501/u). Powdery pigments consolidated using *funori*. Image copyright J. Harrold.

<sup>13</sup> Philip Meredith, Mark Sandiford and Phillippa Mapes, 'A New Conservation Lining for Historic Wallpapers' (Preprint from the 9th International Congress of IADA, Copenhagen, 15–21 August 1999).

<sup>14</sup> Restored on behalf of Plowden and Smith Ltd, 2011–12, owned by a private collector.

of North African Coast belonging to Rommel with inscriptions in Rommel's hand'.<sup>15</sup> It was conserved in 2014 to form part of the new WWII display at the Imperial War Museum in Lambeth in London.<sup>16</sup> Although it was decided that a facsimile of the map would go on display, treatment was still required in order to stabilize the map for storage, handling during photography, as well as handling by researchers or museum staff in the future.

The map had significant mechanical and light damage, surface dirt and ingrained dirt throughout as well as historic repairs using a number of different adhesives and tapes. Much of the damage had to be retained as it was important evidence of the object's use on a battlefield, but subtle repairs were carried out where necessary to strengthen the map. One of the most important elements of the map was the manuscript annotation, by Field Marshal Rommel himself, drawn on the surface of the map in coloured pencil. These annotations in black, blue, red and green were all found to be friable. The black was the most friable, as was evident by the smudging upon removal from storage. This was confirmed by testing. The other colours were less friable than the black, but all had a degree of friability.

A consolidant was needed for the matte and very friable drawing pencil that would allow the map to be handled and to allow it to be stored safely. Tidelines were to be avoided, as the map was to be lightly surface cleaned but not washed. *Funori* was prepared at 1% w/v and was tested as a possible consolidant using two application methods, brushing it directly on the pigment using a soft brush and brushing it through tissue. The tests were positive, no pigment was apparent on the brush using either application method, there was no visible change to the texture of the coloured pencil and no tidelines on the map (recto or verso). The lines were treated by brushing the *funori* solution, using a single brushstroke, directly onto the pencil. Several applications were required to achieve stable pencil lines that were no longer friable. It was allowed to dry completely between applications in order to monitor possible change and assess the process of consolidation. The red and green lines were fixed with two applications, the blue was fixed with three and the black required four.

## 2 Consolidation and cleaning

In 2012, Noga Conservation was appointed to carry out a condition survey and the subsequent treatment of two maps in the Churchill War Rooms, the map of the British Islands and North Sea and the World Map.<sup>17</sup> The Map Room was a 24-hour-a-day operations centre, where officers worked to produce a daily summary of the war. Much of their work was done using maps that covered two entire walls of the room.<sup>18</sup> During the war the rooms were in use constantly, lights were left on, coal braziers were used, staff smoked and an air-conditioning system cooled the air and brought polluted air in from London's streets.

The British Islands and North Sea Map and the World Map allowed officers to track the movements of ships and convoys of the Second World War in real time. They used push-pins to attach bits of coloured wool, and paper labels. When an area of the map was so damaged from pins that it became impossible to use, a new layer of printed map was immediately pasted over the top. This was repeated numerous times during the war, creating layers and layers of paper substrate weakened by the thousands of pinpricks.

After an initial examination, it became clear that most of the damage was historic, from the time of use. Further pH tests carried out on the map's surface by the IWM's paper conservator, Tina Kelly, revealed readings that were considered acceptable.

To add to the complexity of the objects and their treatment, it is worth mentioning that the conservators were expected to work in the map room,

15 IWM Documents, 20501/u.

16 The work formed part of the larger regeneration project, marking the centenary of the First World War.

17 As part of a collection care project at CWR, over 2500 items have been documented and conserved since 2011. See: Jillian Harrold, Emma Schmucker and Zofia Wyszomirska-Noga, 'The treatment of two WWII maps from the Map Room in the Churchill War Rooms', *Journal of the Institute of Conservation* 39, no. 2 (2016): 133–144.

18 *Churchill War Rooms Guidebook* (IWM, 2011).



Fig. 4 Detail of the area of the North Sea Map pierced by hundreds of pinholes. Image copyright Z. Wyszomirska-Noga.

19 S. Staniforth and K. Lithgow, 'When Conservator Meets Architect and Engineer', in *Conservation of Historic Buildings and their Contents. Addressing the Conflicts*, ed. D. Watt and B. Colston (Routledge, 2003), 67, 70–73.

amongst the objects such as desks, chairs and plan chests, screened from the museum visitors by a glass wall, surrounded by wax figures and the eerie sounds of the WWII secret office in action.<sup>19</sup>

During the first stage of the work, two main objectives were identified to be achieved through the conservation treatment: the stabilization and consolidation of the powdery, fragile areas pierced the most intensely by pins during the room's use in the 1940s; and the removal of the thick layer of dirt in the lower border area. Parallel to these conservation issues two main challenges were noticed: the maps' paper appeared to be very susceptible to staining, which reduced consolidant options, and also that dry cleaning was not very effective in terms of restoring legibility of the lower border of the maps. It has to be highlighted that the aim of the conservation treatment was to preserve and stabilize the maps *in situ*, while retaining their unique, archival, complex character.

In Figure 4, details of the areas of the North Sea Map pierced by hundreds, if not thousands, of pinholes plotting the movement of the convoys across the North Atlantic are apparent. As mentioned before, each layer of the map was used until it was too damaged by the holes and then another layer was put on top. This resulted in a fragile area of multiple layers of friable damaged paper that stood out physically from the flat surface of the rest of the map. *Funori* was applied with soft goat's hair brushes and then gentle pressure was applied through Bondina® using a Teflon® spatula, and then dried with blotting paper. This was done several times in each location, depending on condition. This had the effect of consolidating the fragile friable layers of the map, and the ability of *funori* to penetrate many layers helped to reduce the physical deformation of those areas.

One of the other main issues with the map was the dirt that was concentrated on the lower border. There was a significant accumulation of surface dirt from the period of the war that was exacerbated by historic mopping and polishing of the floor that, in effect, consolidated the dirt further. When traditional dry surface cleaning methods were tested, they did not shift this waxy ingrained layer. The surface was sensitive to water. There were other considerations in the environment as well: the ventilation was limited and there was no access to secondary ventilation. The public continued to visit the museum and were just on the other side of the glass wall that was completely airtight. Thus, it was hoped that non-toxic materials could be used. Luckily, localized tests showed warm *funori* to be an effective method



**Fig. 5** Result of cleaning the ingrained dirt of the lower border with *funori* solution. Image copyright Z. Wyszomirska-Noga.

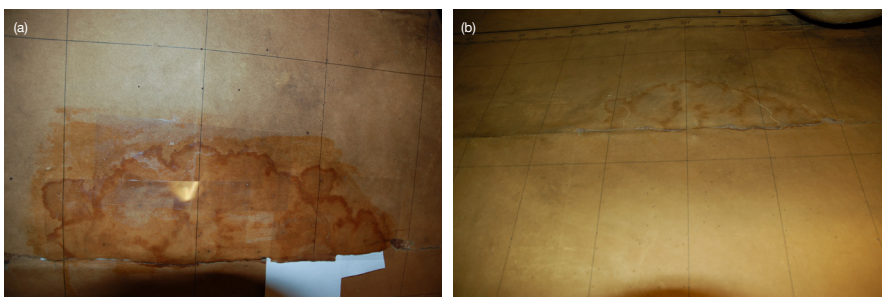
of reducing the dirt (Fig. 5). The *funori* penetrated the layers of dirt and allowed them to be removed. It was applied locally, left to work for a couple of minutes and then removed gently with cotton wool. The area was then dried using blotters and Bondina® to protect the surface. It was important to wait for the area to dry between applications, as over cleaning the lower boarder would result in it not matching the rest of the map. Further waiting between applications decreased the possibility of abrading the surface. In this way, legibility was restored to the bottom of the map.

### 3 Stain removal

There was an extensive water stain present on the upper-left-hand side of the North Sea Map. This stain was quite recent, caused by water flow during a Treasury roof leak.

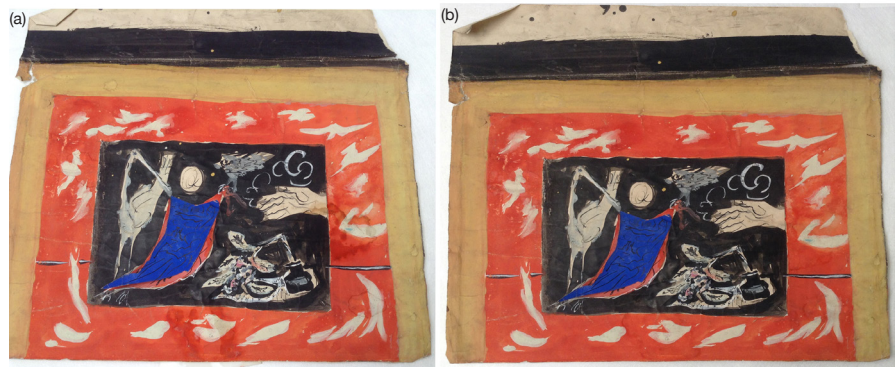
Following previous observations during the consolidation of various objects, such as the wallpapers mentioned above, it seemed expedient to try and combine the penetrating properties of *funori* with the capillary action initiated by blotting paper. It was possible to work comfortably with blotting paper pieces applied from the verso side of the map because the area alongside the stain was widely torn.

A solution of *funori* (2% w/v) was applied to the stained area, blotters on top of Melinex® pieces were placed beneath the stained paper layer and the treated area was covered with polythene layer and left to allow the treatment to work (Fig. 6, a). The blotting paper pieces were changed



**Fig. 6** Reducing the water stain using *funori* poultices applied from the reverse, where access was possible alongside the torn area. Fragment of the North Sea Map during (a) and after (b) treatment. Image copyright Z. Wyszomirska-Noga.





**Fig. 7** Early twentieth-century British gouache, private collection. Before (a) and after treatment (b), showing water damage sustained in a fire. Image copyright J. Harrold.

several times. (In that case, Melinex® was used as a barrier between the wet blotters and the wooden wall.) After a satisfying reduction of the stain was observed, the excess *funori* was gently removed from the map's surface, and appropriate repair of the torn area was completed, followed by flattening and drying using blotting paper and Teflon® spatulas.

Another example of localized stain removal can be found in an early twentieth-century British gouache from a private collection.<sup>20</sup> The gouache had sustained water damage in a home fire and visible tidelines had formed in some places on the image (Fig. 7). The gouache was extremely sensitive to water, and once humidified the surface could not be touched. The machine-made paper was thin and weak, and was already distorted from the thick layer of water-based paint as well as from the water damage. A flat bond was not achievable on suction without humidifying it more than was possible with the limitations of the medium. It also did not seem possible to pass anything through the paper from the recto. It was decided to test *funori* as a possible cleaning agent in an adapted form of blotter washing. The gouache was humidified over Gore-Tex® in a chamber, and the stain removal method was tested on the discoloration on the margin that was not visible when the image was framed. A solution of 1% to 2% w/v *funori* was prepared and then was applied to the verso of the stains and to small pieces of blotter that were placed under the stain. Initially, a piece of non-woven polyester was placed between the object and the blotter, but the contact was not good enough, so the blotter was applied directly to the verso of the gouache. After 2 to 3 minutes some discoloration was apparent on the blotter. The process was repeated and significant discoloration was removed. It was kept in a humidity chamber to stop it from drying out and sticking throughout.

A different type of stained object was a contemporary pastel painting by Tom Phillips (Fig. 8). The delicate pastel layer was not fixed; the painting was water damaged and kept rolled in storage. There were several yellow stains visible alongside the artwork's edges, in most of these cases they were interfering with the original pastel's lines, disturbing the perception of the original design. Because of the delicate nature of painted layer, localized treatment was taken under consideration.

*Funori* was gently, locally applied on the artwork's surface; the aim was to cover places where the white paper was not painted by pastel but obscured with yellow stain line. It was done to avoid the embedding of media into the paper substrate.<sup>21</sup>

Treatment was completed on a low-pressure vacuum table with blotting-paper pieces changed several times under the treated area.

<sup>20</sup> Work carried out on behalf of Plowden and Smith Ltd.

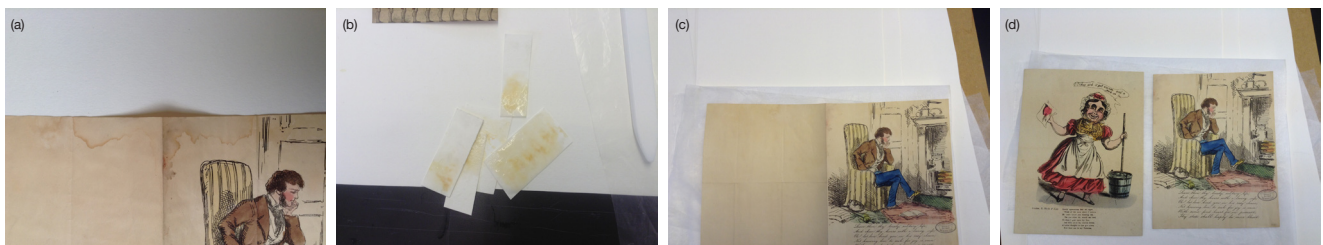
<sup>21</sup> Joanna M. Kosek, 'Washing Paper in Conservation', in Gerhard Banick and Irene Bruckle, *Paper and Water. A Guide for Conservators* (Routledge, 2011), 317, 333.



**Fig. 8** Fragments of water-stained contemporary pastel painting by Tom Phillips, private collection. Before and after stain removal. Image copyright Z. Wyszomirska-Noga.

The vacuum table enabled the treated areas to be dried gently without causing paper distortion and without applying additional pressure on the delicate painted layer.

A final example of a stain removal is a nineteenth-century Valentine’s card that was damaged in the devastating fire that destroyed the Cuming Museum in Southwark in London in March 2013 (Fig. 9). The card is printed with applied hand colour, which had already run in the water used to extinguish the fire. There were strong tidelines caused at the same time, revealing that there was significant discoloration in the paper. The fugitivity of the colour meant that a localized treatment was to be sought to remove some of the soluble degradation products concentrated in the tidelines. The card was humidified and then 1% *funori* w/v in water was applied to blotters and applied to the verso of the stain for several minutes. Non-woven polyester was used as a release layer. The discoloration can be observed in the used blotters. The process was repeated several times and then the card was allowed to dry to ensure the area had not been over-cleaned.



**Fig. 9** Nineteenth-century printed Valentine’s card with hand colour. It formed part of a temporary exhibition at the Cuming Museum, Southwark, and was damaged in the fire of March 2013. The image shows the piece before (a) and after (c, d) stain reduction. The discoloration that has been drawn out can be seen in the blotting paper (b). Image copyright J. Harrold.

#### 4 Reducing distortion and local flattening

In treatment, particularly of contemporary art, *funori* has also been found to be useful to humidify objects in order to flatten or reshape localized areas. This has been particularly useful in complex works where localized treatment was the only possible option.

*As time goes by*, Howard Hodgkin's aquatint, with carborundum and hand painting, mounted on an aluminium frame, was in excellent condition but needed some minor repairs to its edges. It is very large modern work (overall 243.8 x 609.6 cm) consisting of five sheets of Moulin de Gué paper. The artwork was mounted onto five aluminium panels that were smaller than the sections of the artworks, so that about 10 mm of the artwork edges were outside the panel. This caused problems in transport and storage: some of the edges were creased, torn or deformed. A treatment was required that was time-efficient, safe, localized and non-invasive.

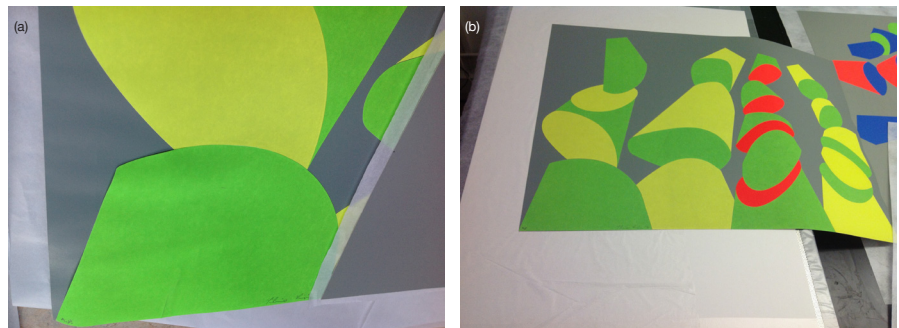
The paper was thick and not very strongly sized; although it absorbed a lot of moisture, it was not able to dry quickly. It was not possible to humidify a larger area or the whole of the artwork, so there was a significant danger of causing a staining during localized treatment.

After tests, a *funori* solution was applied to the verso, used alongside a blotter to create capillary pressure to gently flatten and consolidate distorted, delicate areas, whilst drying additional pressure was applied with hands, Teflon® spatula, bulldog clips and board. In this case, *funori*'s penetrating properties proved to be useful, as it relaxed and flattened treated areas relatively quickly without using an excessive amount of water.

The other unusual, interesting example of the contemporary artwork where Japanese adhesive was used as an agent helping with flattening was a water-damaged 1970s collage entitled *Koan-cuts* by Lillian Lijn. The collage was created with self-adhesive paper off-cuts on grey silkscreened paper (Fig. 10).

The artwork was very susceptible to water stains. The silkscreened support was distorted; high humidity also resulted in the disintegration of the self-adhesive paper's glue and separation of the collage's layers as well.

After several tests, *funori* was used, chosen for its matte appearance, as well as its penetrating and consolidating properties. A warm solution (0.5%) was applied to damaged, distorted areas with brush, using tissue as a protective layer to avoid any signs of brushstrokes. It relaxed the distorted layers, allowing the re-adherence of lifted fragments of self-adhesive paper, making it possible to dry and flatten the artwork in its original shape, without any creases or stains.



**Fig. 10** *Funori* adhesive was used as a humidifying agent, helping to flatten a water-damaged 1970s collage entitled *Koan-cuts* by Lillian Lijn. The collage was created with self-adhesive paper off-cuts on grey silkscreened paper. The silkscreened support was distorted and the artwork was very susceptible to water stains. Image copyright Z. Wyszomirska-Noga.

## Conclusion

The polysaccharide *funori*, used in Japanese conservation for centuries, has, in recent decades, become more and more common in Western practice. Initially encountered by the authors as an effective consolidant for matte friable paint layers, the characteristics and working properties of this seaweed extract have made it a suitable treatment option in a variety of circumstances, including cleaning, stain removal and the reduction of distortion. It proved to be an effective tool for a wide range of applications on papers from different periods, on various media and, most interestingly, it appeared to be very efficient and useful when used on complicated, multi-layered objects.

When encountering new products, despite all the excitement, we have been very careful and verified available research and information. During that time more new products have entered the market, research has progressed, more information has become available. Our preparation methods have become more refined, and it is important to point out that the use of *funori* has always been tested and compared with other methods before any treatment proceeded. The authors are looking forward to any new research into subject of *funorans*, especially research focused on *funori* use in paper conservation.

## Abstract

The polysaccharide *funori*, used in Japan for centuries, has, in recent decades, become more common in Western paper conservation. The authors have been using *funori* in conservation practice since 2008 and in this discussion, a variety of Western objects, both contemporary and historic, that have been worked on over the last seven years, have been chosen to show how the characteristics and working properties of *funori* have suited some circumstances, and to demonstrate some of the range of possible uses for it as one of a number of treatment options when approaching a suitable object. Initially encountered as a consolidant for matte surfaces, the use of the material has broadened to other circumstances as well, including cleaning, stain removal and the reduction of distortion. Successful treatments on a variety of objects, including charcoal drawings, watercolours, pastels, distemper-primed wallpaper and contemporary art on paper, are discussed. Particularly interesting was its effectiveness in treating the complex, multi-layered maps found in the Churchill War Rooms, that were treated in 2012. This project allowed the authors to employ *funori* to clean and remove stains as well as to consolidate fragile layers of paper. In this case *funori* stabilized degraded and deformed areas of the maps without staining the delicate surface. It also succeeded in cleaning the heavy dirt layer on the lower border restoring legibility to this part of the map.

## Biographies

Jillian Harrold completed a PhD in the History of Art, after which she studied paper conservation at Camberwell College of Arts and graduated with an MA in 2010. Since graduating she has been working as a freelance paper conservator in London. She has worked in both the private and public sectors for a variety of clients including UCL Special Collections, UCL Art Museum, Imperial War Museum and Noga Conservation. Since 2013 she has also been working as the paper conservator for Plowden and Smith. Zofia Wyszomirska-Noga MA, ACR graduated in 2003 from Nicolaus Copernicus University in Torun, Poland where she gained an MA in Conservation and Restoration of Paper and Leather. Since 2004 she has been working in London as a freelance paper conservator, and worked as the senior paper conservator for Plowden and Smith Ltd between 2005 and 2013. She is accredited by Icon and works in both the private and public sector as Noga Conservation.

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