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## A literature review of palm leaf manuscript conservation—Part 1: a historic overview, leaf preparation, materials and media, palm leaf manuscripts at the British Library and the common types of damage

### Abstract

The closure of the British Library during the 2020–2021 Covid-19 pandemic allowed the conservation department to undertake a treatment review of the conservation of palm leaf manuscripts in order to make better-informed decisions about the treatment of these complex objects. As part of the review a questionnaire was posted in 2020 to the Global Conservation Forum asking about the treatment of palm leaf manuscripts by others in the field. This two-part Literature Review uses the available literature and the survey results to address the wide range of issues inherent in the practical conservation of palm leaf materials. Part 1 includes an historic overview of palm leaf manuscripts and their production, leaf preparation methods, manuscript materials and media, palm leaf manuscripts at the British Library and the common types of damage found in such manuscripts. Part 2 details historic treatments and current conservation techniques as informed by our review and survey, as well as storage, religious and ethical issues, before concluding with our practical recommendations. The authors wish to share the collated information as widely as possible and help create greater continuity and consistency in palm leaf manuscript conservation by presenting our recommendations for best practice for conservators who treat these amazing objects.

### Keywords

palm leaf; boxing; long-term storage; conservation treatment; ethical conservation; traditional preservation methods

### Introduction and context of the review

The closure of the British Library (BL) during the 2020–2021 Covid-19 pandemic allowed the conservation department to undertake a treatment review of the conservation of palm leaf manuscripts to develop our knowledge in order to make better-informed decisions about the treatment of these complex objects. As part of the review a survey was posted to the Global Conservation Forum on the treatment of palm leaf manuscripts in August 2020.<sup>1</sup> This two-part review uses the available literature and the survey results to address the wide range of issues inherent in the practical conservation of palm leaf materials. Our goal is to share this information as widely as possible to help create greater continuity and consistency of

<sup>1</sup> 'The Treatment of Palm Leaf Manuscripts' survey as posted to the AIC Global Conservation Forum: <https://docs.google.com/forms/d/e/1FAIpQLSfuMtQB8HeUDABn47hc0O61liAdXZEjaUiZj87Df1YTvBX8mQ/viewform> (accessed 8 August 2022).

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treatments and improved practice among the relatively small numbers of conservators who treat these amazing objects.

Part 1 includes a historic overview of palm leaf manuscripts and their production, leaf preparation methods, manuscript materials and associated media, palm leaf manuscripts at the British Library, and the common types of damage found in palm leaf manuscripts. Part 2 will focus on historic treatments and current conservation techniques, and encompass boxing and storage, religious and ethical issues, and our recommendations for best practice.

There are four appendices: in Part 1 these include the survey findings, sources for further reading and an annotated bibliography (available on the BL Open Access Repository). In Part 2 there are two decision-making flowcharts, and our recommendations for best practice in handling, storage and treatments for conservators.

### Historic overview of palm leaves and the main types of palm leaf manuscript

Before the introduction of paper, palm leaf was one of the main writing supports used in South and Southeast Asian countries including: India, Nepal, Sri Lanka, Myanmar, Thailand, Indonesia and Cambodia. Therefore, it comes as no surprise that palm leaf manuscripts comprise a very diverse body of texts including, but not limited to, sacred religious scriptures, literature, music, history, medicine, mathematics and astronomy. For that reason, collections of palm leaf manuscripts are found not only in museums and libraries but also—especially in Asia—in monasteries, *granthagars* (manuscript storehouses) and private houses.<sup>2</sup>

It is debatable when palm leaves first began to be used as writing supports as there are almost no surviving manuscripts from before the tenth century, with the exception of one example preserved at Horyuji temple in Japan, dated to the sixth century.<sup>3</sup> However, written records as well as visual representations in other media such as sculpture point to the widespread use of palm leaf as a writing support long before that period. A fragment of text discovered in Central Asia from 2 CE is currently the oldest known and dated fragment of palm leaf in existence.<sup>4</sup> Dating itself poses a challenge in researching palm leaf manuscripts according to Anupam Sah, as many of them don't mention their authors, scribes or completion date in the text, and existing colophons often contain mistakes. Therefore, dating is often based on the style of text or script alone (Fig. 1).<sup>5</sup>

It seems that, when paper was introduced in South Asia around the tenth century, it very slowly began to replace palm leaf as the primary writing support. However, the cultural impact of palm leaves can be seen in the ornaments painted on some of the paper manuscripts, reminiscent of the holes punched in palm leaves for binding, despite their different structure and binding method. Palm leaf continued to be used widely until the nineteenth century, when the introduction of modern printing methods in mainland Southeast Asia resulted in the decline of its production during the nineteenth and twentieth centuries, as palm leaf manuscripts became largely replaced by bound or folded paper books.<sup>6</sup> These days, palm leaf is mostly used for artistic and ritualistic purposes.<sup>7</sup>

Made of an organic material prone to degradation, palm leaf manuscripts have been continuously recopied over the centuries as a way of preserving the text they bear. As such, extant early manuscripts are very scarce. The surviving examples attest to the longevity, continuity and the spread of the palm leaf tradition across the Asian continent.

Though the use of a generic term 'palm leaf' is widespread, especially in the English literature, vernacular names, often implying a particular variety of leaf, are commonly used across Asia. For example, variants include *Ola* in Sri Lanka, *Larn* in Thailand, *Lontar* (meaning palmyra) in Myanmar and

<sup>2</sup> Anupam Sah, 'Palm Leaf Manuscripts of The World: Material, Technology and Conservation', *Studies in Conservation* 47, Supp. 1: Reviews in Conservation 3 (2002): 15–24.

<sup>3</sup> Sah, 'Palm Leaf Manuscripts of The World', 16.

<sup>4</sup> Om Prakash Agrawal, *Conservation of Manuscripts and Painting of South Asia* (London: Butterworth Heinemann, 1984), 24.

<sup>5</sup> Sah, 'Palm Leaf Manuscripts of The World', 16.

<sup>6</sup> See Jana Igunma, *The Beauty of Palm Leaf Manuscripts (2): Northern Thai, Lao and Shan Traditions*, British Library Blog Post, 23 January 2015, <https://britishlibrary.typepad.co.uk/asian-and-african/2015/01/the-beauty-of-palm-leaf-manuscripts-2-northern-thai-lao-and-shan-traditions.html> (accessed 3 August 2022).

<sup>7</sup> Sah, 'Palm Leaf Manuscripts of The World', 16.



**Fig. 1** Prajnaparamita stotra, tenth century, eastern India, Mahayana Buddhism text, Sanskrit, Pala-Bengali- Nepali scripts, MS Add.1464 from Cambridge University Library. Image by Sarah Welch.

8 Sah, 'Palm Leaf Manuscripts of The World', 17.

9 Agrawal, *Conservation of Manuscripts*, 25.

10 Agrawal, *Conservation of Manuscripts*, 25.

11 Agrawal, *Conservation of Manuscripts*, 25.

12 Agrawal, *Conservation of Manuscripts*, 26.

13 Sah, 'Palm Leaf Manuscripts of The World', 17.

Indonesia, and *Tala*, *Sritala* or *Karalika* in different parts of India.<sup>8</sup> While there are numerous varieties of palm trees, three have been most widely used as writing supports: *Borassus flabellifer linn* (palmyra palm), *Corypha umbraculifera linn* (talipot palm, fan palm) and *Corypha taliera Roxb.*<sup>9</sup>

**1 *Borassus flabellifer linn*, palmyra or toddy palm (Sanskrit name: *Tal*; Hindu: *Tar*)**

The palmyra palm grows in many parts of India, Myanmar and Sri Lanka. It is native to Africa and needs a drier climate. The trees grow up to 15–20m and the leaf stalks grow to around 1m in height. The leaves are initially flexible, but this flexibility decreases over time. The leaves from the palmyra palm are thicker and coarser compared to those of the talipot. The leaves also appear to be more prone to insect attack than those of the talipot variety.<sup>10</sup>

**2 *Corypha umbraculifera linn*, talipot or fan palm (Sanskrit name: *Karalika*, *Sritalam*, *Tali*)**

The talipot palm grows in the forests of Sri Lanka, Myanmar—where it is known as *gebang*—Thailand, Malaysia and South India. It needs a wet climate, and the trees can grow up to 20–25m. The leaves from the talipot are used for making things like fans, mats and umbrellas. The leaves remain flexible and supple for a long period of time and are smoother than those of the palmyra palm.<sup>11</sup>

**3 *Corypha taliera Roxb***

This palm grows in Bengal and some coastal areas of Tamilnadu in India. The trees grow up to 10m tall. The leaves are thick and not very flexible, and more prone to insect attack.<sup>12</sup>

The leaves vary between different varieties of palms in shape, length, thickness and colour, but further research into structure and chemical composition (e.g. presence of essential oils) and the differences between palm varieties and regions is necessary in order to determine the roles they play in leaves' resilience, longevity and resistance to biological attacks.<sup>13</sup>

#### **Preparation, seasoning and production of palm leaves**

Once harvested—usually during the dry season—palm leaves require additional processing or 'seasoning' in order to make them fit for writing

on for manuscripts.<sup>14</sup> Several processing methods are used and these vary according to the leaf type, custom and region. Palm leaves treated in such ways are relatively robust and have been known to last as long as 500–600 years even in the humid, tropical climate of Southeast Asia.<sup>15</sup> Variations in seasoning according to country include the following.

### 1 South India

Fresh palm leaves are dried in the shade and rubbed with gingili oil to make them smooth.<sup>16</sup>

### 2 South India, eastern India and Odisha

Tender palm leaves are hung and smoked for several days (typically in a kitchen) after which any surface deposits are wiped off so that the leaves are ready for writing.<sup>17</sup> In Odisha there are some further variants including where:

- (a) tender palm leaves are smoked for a few days, and then rubbed with turmeric paste. The turmeric paste contains the roots of the shrub *Curcuma longa*, which have been boiled in earthen pots and dried in the sun, mixed with water;
- (b) the palm leaves are dried in the sun and buried for 10–15 days under pond mud or silt, after which they are cleaned and dried and maybe rubbed with turmeric paste;
- (c) the mature palm leaves are boiled in water, making the leaves thin and soft, after which they are cleaned with a soft cloth and turmeric paste is applied.<sup>18</sup>

### 3 Sri Lanka

Fresh palm leaves are boiled in water or limewater for a few hours and dried in the shade.<sup>19</sup> They are also sometimes boiled interspersed with pineapple leaves, then washed, fumigated and burnished.

### 4 Myanmar

Using methods similar to Sri Lanka and India, palm leaves are boiled and once the black secretions have been removed, the leaves are weighed down to dry and burnished.<sup>20</sup>

### 5 Bali

Bundles of leaves are dried in the sun, then soaked in water for 3–4 days, rubbed clean in the water, dried again in the sun, cut to size and boiled for 8 hours in a herbal solution, then gently cleaned in water with a cloth, and laid out to dry in the sun. After being wiped with a cloth, they are pressed repeatedly and finally polished with a cloth.<sup>21</sup>

### 6 Thailand

Processing in Thailand is considerably different to other countries and regions. While palm leaves can be typically found in nearly all Thai forests, it is the golden leaf from the Lopburi region that is preferred. After being cut the leaves are dried in the shade, the midrib removed with a sharp blade and the leaves then cut to uniform size. Bundles of leaves are then placed in a kiln for 24 hours, causing a black oil to exude from the edges. The oil is wiped off, the leaf held over a fire for a few minutes before finally being polished with hot sand.<sup>22</sup>

### Leaf colouring and coatings

Leaf colouring and coatings as part of processing are typically only found in Thailand and Myanmar. For other regions, the extent of leaf colouring and coating is generally limited to rubbing in turmeric paste to create a slight yellow hue, alongside its assumed insect-repellent properties. In contrast,

14 Sah, 'Palm Leaf Manuscripts of The World', 17.

15 Cf. Jana Igunma, 'The Beautiful Art of Tai Palm Leaf Manuscripts', *South-east Asia Library Group Newsletter* 46 (December 2014): 36.

16 Agrawal, *Conservation of Manuscripts*, 27.

17 Agrawal, *Conservation of Manuscripts*, 27.

18 Agrawal, *Conservation of Manuscripts*, 27–8.

19 Agrawal, *Conservation of Manuscripts*, 28.

20 Noed F. Singer, 'Palm Leaf Manuscripts of Myanmar (Burma)' p. 12, blog post, <https://www.burmese-buddhas.com/palm-leaf-manuscripts-of-myanmar.pdf> (accessed 3 August 2022).

21 Ann Kumar and John McGlynn, eds, *Illuminations: The Writing Traditions of Indonesia* (Jakarta: Weatherhill, 1996), 136–7.

22 Agrawal, *Conservation of Manuscripts*, 28–9; Bhoi Panchanan, 'Scribe as Metaphor: Patterns of Processing and Writing Palm Leaf Manuscripts', *Indian Anthropologist* 40, no. 1 (January–June 2010): 82.



**Fig. 2** Thai palm leaf manuscript with incised text, black lacquered wooden covers painted in gold with scrolling foliage, leaves with gilded edges and central band of vermillion, first half of the nineteenth century. Shown with metal stylus and decorative wrapper. Image: Wellcome Trust.

**23** Agrawal, *Conservation of Manuscripts*, 31.

**24** Sah, 'Palm Leaf Manuscripts of The World', 17.

**25** Sah, 'Palm Leaf Manuscripts of The World', 18.

**26** Cf. for example, D. Udaya Kumar et al., 'Traditional Writing System in Southern India—Palm Leaf Manuscripts', *Design Thoughts*, Industrial Design Centre (IDC) at the Indian Institute of Technology (IIT Bombay), July 2009, 3, <http://www.idc.iitb.ac.in/resources/dt-july-2009/Palm.pdf> (accessed 3 August 2022).

there are several types of colouring found in Thailand: the leaf can be dyed red, black or blue or lacquered with red or black. In some cases leaves can be fully gilded with gold or only have their edges decorated with lacquer, gilding or both. These all serve as a means of protecting the edges of the leaves. Lacquer coatings can also be found in Myanmar, where they are typically amber coloured.<sup>23</sup> However, there are few comparative studies that explain the reasons behind some of these treatments and it has been suggested by some authors that physical deterioration of palm leaves may actually stem from some of these traditional preparation methods.<sup>24</sup>

### Materials of palm leaf manuscripts (boards, cords and more ...)

There are different formats for palm leaf manuscripts, with the most common one being the 'bundle', where a number of similarly sized folios are bound between two wooden panels.<sup>25</sup>

#### 1 Format and size

The manuscripts are most often found in elongated horizontal format due to the natural long and narrow shape of the leaves (Fig. 2). The length of palm leaf manuscripts can vary from 15 to 60cm and with a width between 3 and 12cm. The dimensions depend on the available sizes of the leaves as well as regional variations.<sup>26</sup> For example, according to curators at the British Library, Burmese manuscripts tend to be much larger than Javanese manuscripts. In nearly every country, there are different sizes of manuscripts and different formats of use, such as, for example, a different number of holes and different ways of stringing through holes. Manuscripts are also stored differently. Finally, while most manuscripts

are typically rectangular some have been cut into 'novelty' shapes such as fish, a fan, beads and so on.<sup>27</sup>

When the leaves are ready after initial processing, they are cut to size and, if not done previously, the leaf midribs are removed.<sup>28</sup> There are occasions where the rib is retained with the centre of the leaf folded and only the outside of the leaf used to write on.<sup>29</sup>

The trimmed leaves are put into bundles, varying from just a few leaves to hundreds, but are usually small with a height of under 10cm. In some cases, two or more leaves are stitched together at the edges to make a broader surface for writing.<sup>30</sup>

## 2 Boards

Bundles are typically stored between two wooden boards (or panels) which are slightly larger than the leaves. The wooden boards can be left blank but they are often carved, gilded, lacquered, or decorated with ivory and mother-of-pearl or contain painted illustrations, especially for those with religious texts.<sup>31</sup> A red or black lacquer is a popular material to apply to covers; it also provides protection against water and humidity, as well as being a good background for gold leaf or paint application, or even in some cases for shell inlay. Bamboo strips or boards, which are cut to the size of the manuscript leaves, are popular covers in Lanna and Laos and among the Shan of Myanmar.<sup>32</sup>

In Thailand and Laos there were two common methods of applying gold designs to lacquer. One technique—popular in Thailand and some parts of Laos—involves applying several coats of black lacquer to the wooden board. The lacquer is a resin produced by a tree in the *sumac* family growing in mainland Southeast Asia. The drawing is then traced, and the areas which should remain black are covered in all their smallest details with a painted layer of liquid natural rubber. Once the rubber is dry, a thin coat of lacquer is applied to the board, and when nearly dry, gold leaf is applied over the whole surface of the panel. After about 20 hours the board is rinsed with water to detach the rubber paint in order to let the remaining gold design appear in all its beauty (Fig. 3). This art is called *lai rot nam* in Thai—meaning designs washed with water. A second simpler method, popular in northern Thailand and Laos, is to use stencils to apply gold leaf or gold paint onto the surface of the wooden or bamboo covers.

Another method of decorating the wooden boards was to coat them with black lacquer and then use a stylus to incise floral ornaments once the lacquer was dry. After this, red lacquer was rubbed on the incisions to create a vibrant red and black design. This technique may have been imported into northern Thailand and Laos from Myanmar, where it is an extremely popular method of decorating wood.<sup>33</sup>

## 3 Cords and wrappers

Holes are punched through the leaves and boards. Their placement can differ, mainly due to size and regional variation of the leaves, with a hole in the centre if the leaf is small, at either end, or sometimes because of size, two or more holes are punched through each leaf.<sup>34</sup> These holes enable a cord to pass through so that it can be tied around the manuscript to secure it (Fig. 4). The bundles are usually wrapped in cloth in order to protect the manuscript from dust and dirt, and then bound to keep secure. Traditionally the cloth wrappers were coloured, either red or yellow (possibly using vermilion and orpiment as noted below), as these were believed to have strong insect-repellent properties (Fig. 5). In Lanna, Laos and among the Shan there are also examples of bamboo strips woven into cotton cloth.<sup>35</sup>

27 Agrawal, *Conservation of Manuscripts*, 34.

28 Kumar et al., 'Traditional Writing System in Southern India', 3.

29 T. A. Davis and Dennis V. Johnson, 'Current Utilization and Further Development of the Palmyra Palm (*Borassus Flabellifer* L, Arecaceae) in Tamil Nadu State, India', *Economic Botany* 41, no. 2 (1987): 247–66.

30 Agrawal, *Conservation of Manuscripts*, 34.

31 Cf. Agrawal, *Conservation of Manuscripts*, 34, 36; Yana van Dyke, 'Sacred Leaves: The Conservation and Exhibition of Early Buddhist Manuscripts on Palm Leaves', *The Book and Paper Group Annual* 28 (2009): 87.

32 Igunma, *The Beauty of Palm Leaf Manuscripts* (2).

33 Jana Igunma and San San May, *Buddhism Illuminated: Manuscript Art from Southeast Asia* (London: British Library, 2018), 38.

34 Agrawal, *Conservation of Manuscripts*, 34.

35 Igunma, *The Beauty of Palm Leaf Manuscripts* (2).



**Fig. 3** Covers belonging to a Thai royal edition of the *Paññāsa Jātaka*, British Library, Or 12524. The wooden covers are decorated with black lacquer and gilded plant forms, nineteenth century.



**Fig. 4** Upper image: British Library Indian palm leaf manuscript of sacred Tamil hymns (*Tēvāram*) from the eighteenth century, Or. 12212, tied with a loop and wooden pointer (or dowel). The cord is secured with a knot under the bottom board so it can be loosened for reading and turning the leaves without losing the cord. The main function of the pointer is to follow along the lines while reading (reciting); keeping the cord in place with the loop is a secondary function. Lower image: wooden title indicator for palm leaf manuscript (*bai lan*) with gold leaf, Or. 16555 from Northern Thailand (Lānnā), nineteenth century.

<sup>36</sup> Igunma and May, *Buddhism Illuminated*.

British Library curator Jana Igunma states that some palm leaf manuscripts have textile wrappers which are often in very poor condition and historically replaced rather than retained.<sup>36</sup> Such replacement is a traditional practice in Buddhist communities. However, the original wrapper is an integral part of the manuscript, which in the Buddhist tradition adds meritorious value to the religious scripture. Usually, believers commission the wrapper or make it as a religious offering. The original wrapper also gives information on the origin and historical use of the manuscript and should always be preserved.





**Fig. 5** Upper image: British Library palm leaf manuscript Or. 12212 in its calico, cotton wrapper. The original wrapper is probably lost. Lower image: original two-layered cotton wrapper for British Library manuscript Or. 1044, *Sārasaṅgaha* from Thailand, nineteenth century. The inner layer made from red handwoven cotton, outer layer made from blue printed cotton with floral design and broken cotton cord .

As with wrappers, the cords or strings on a manuscript vary in size, colour, material (silk or cotton being most common) and style depending on the manufacturer of the manuscript and the regional or local style. For example, some cords have ornaments such as beads and others are intertwined with human hair which, in the case of one Thai example from the BL collection, belonged to the manuscript's female patron. Indonesian manuscripts often have Chinese coins called *kepeng* (with a central hole) as string ornaments, but may also have glass beads or buttons.<sup>37</sup> Furthermore, some Burmese manuscripts have hand-woven *sazigyo* or binding ribbons made from silk or cotton thread. Like manuscripts and their wrappers, *sazigyo* are commissioned to gain merit as the manuscripts are often donated to a Buddhist monastery or temple.<sup>38</sup>

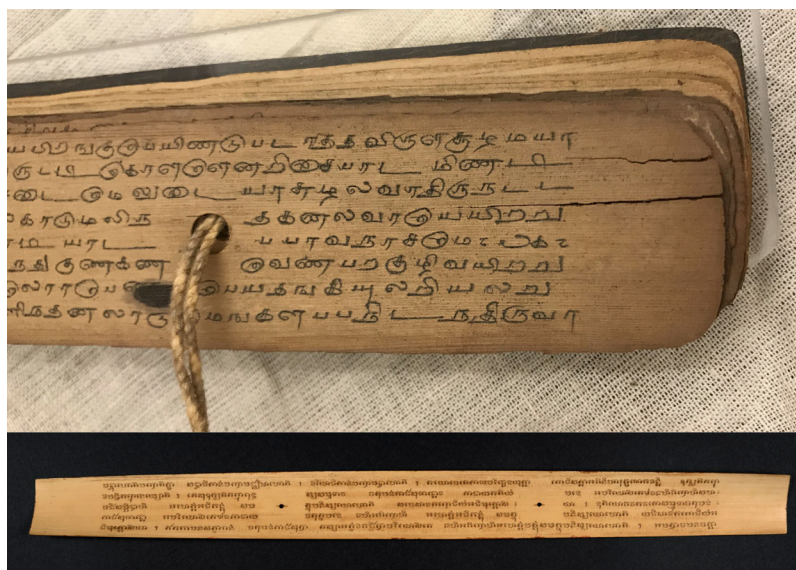
For identification purposes, a slip of palm leaf, ivory, bamboo or wood, labelled with the manuscript title and foliation, often called a 'title indicator', can be placed over the cover of the manuscript.<sup>39</sup> In the Burmese and Thai traditions, these title indicators vary from plain to elaborately carved in various shapes (see Fig. 4). Some of their signs or labels were carved in dagger shapes and contained the titles, number of leaves and

<sup>37</sup> Cf. for example, Dick van Der Meij, 'Indonesian Manuscripts from the Islands of Java, Madura, Bali and Lombok', in *Handbook of Oriental Studies Section 3: Southeast Asia*, Vol. 24 (Leiden: Brill, 2017), 158.

<sup>38</sup> Annabel Gallop et al., 'More than a Book: A New Display of Southeast Asian Manuscripts', *African and Asian Studies Blog*, The British Library, 14 March 2016, <https://blogs.bl.uk/asian-and-african/2016/03/more-than-a->

[book-a-new-display-of-southeast-asian-manuscripts.html](#) (accessed 3 August 2022).

39 Agrawal, *Conservation of Manuscripts*, 34, 36.



**Fig. 6** Upper image: British Library manuscript Or. 12212 in Tamil script with incised and blackened text. Lower image: British Library Thai palm leaf manuscript, *Sarasāṅgha*, Or. 1044 with incised text, nineteenth century.

40 Igunma and May, *Buddhism Illuminated*, 14.

other information such as the donor of the manuscript.<sup>40</sup> Igunma and San San May explain that the title indicators (or *gabyidan* in Burmese) are also referred to as 'wooden pointers' and can be used to follow along the lines when reading. The main characteristic that distinguishes a title indicator from a wooden pointer is the inscriptions to identify the manuscript as shown in the Tamil example in Fig. 4.

The structure of palm leaf manuscripts means the leaves are read from left to right, top to bottom, lifted and turned to place one leaf over another. The openness of the format of the binding structure has meant that the text block can be leafed through more easily without causing physical damage to the leaves. However, the format has also led to text blocks being found mixed, missing and out of order and, in addition, covers have become separated from their original text blocks.<sup>41</sup>

41 Cf. van Dyke, 'Sacred Leaves', 87.

### Inks, pigments and other media

The text written on palm leaf manuscripts was most commonly created using two different methods. Texts were either first incised using a stylus and then written on or written directly onto the surface of the leaf with a pen or brush. The species of palm leaf used for the production of a manuscript informed the writing technique applied, as different species proved to be more suited for one technique or the other. Anupam Sah reasons that the palmyra type was rarely surface written because it was darker and waxier than the talipot, thus less able to absorb media.<sup>42</sup> The range of media applied to palm leaves reflects regional variations and availability of materials, as well as aspects such as the status and subject matter of manuscripts. Finally, the long-term condition of a manuscript is affected by the application method, which also informed traditional preservation measures and subsequent conservation approaches.

42 Sah, 'Palm Leaf Manuscripts of The World', 21.

#### 1 Incised text

Incised text was produced using a pointed metal, bone or hard wooden stylus (see Fig. 2). Sah notes that in Sri Lanka where a metal stylus is used, beginners start with a blunt stylus and then progress to using a

decorated and well-balanced sharp stylus usually 25–35cm long. The incisions were then inked or treated in some other way (see Fig. 6). The most common media used was soot (carbon black) combined with a binder of either plant juice, resin or oil, which was wiped or rubbed across the text. Excess media would then be wiped off with a dry cloth or rice husk to ensure that only areas where the incisions were made would be stained. In Thailand, sand was also used after wiping with a cloth to absorb any remaining excess media.<sup>43</sup>

Regional examples of media variations include soot combined with Dummala and Kakuna oils in Sri Lanka,<sup>44</sup> turmeric powder, soot and citronella or gingili oil in India,<sup>45</sup> and the use of red ink, indigo and vermilion in Thailand.<sup>46</sup> Other materials identified include bean plant juice, pulverised burnt candlenut and coconut oil,<sup>47</sup> gum arabic and wood oil.<sup>48</sup>

In his research, David Jacobs found that there was a lack of awareness that some incised manuscripts were never intended to be inked with carbon black, but were initially treated with plant juice, with the text being made visible when desired through the application of water or by rubbing with fresh leaves. Dr S. Jayabarathi similarly mentions the application of turmeric powder followed by water for reading,<sup>49</sup> and Yeni Budi Rachman details a traditional Javanese method of applying candlenut powder to highlight the text.<sup>50</sup> This lack of understanding of the intended appearance of some manuscripts has led to the perception that ink has been lost, and led to the practice of re-inking, a technique that has also been applied for those that were originally inked. In his notes on the India Office Library and Records (IOLR) studio, Jacobs described how, in the twentieth century at the British Library, carbon black ink powder would be mixed with camphor oil and rubbed into incised text that looked faded or bare, and the same treatment is also referred to by Alfred Crowley.<sup>51</sup> Anupam Sah discusses how re-inking is applied when binders in the inks have weakened with the subsequent loss of pigment particles, but argues that this practice limits the ability to use media for dating and that the risks and benefits of re-inking versus consolidation should be further considered: '... is the purpose only to render the incisions visible or is it also to preserve the "original" ink particles?'.<sup>52</sup> It is often perceived that certain substances used for media were selected for their insecticide properties, but Sah also argues that this is something that is taken for granted in the literature and there is scope for further research.<sup>53</sup>

## 2 Surface written text

Surface writing was applied directly to the surface of an oiled palm leaf with either a reed, bamboo pen or brush (Fig. 7). Janay Laudat describes how the oiled, smooth surface of the leaf allowed the ink to flow, while preventing it from penetrating or staining unwanted areas.<sup>54</sup> As with incised leaves, the most common media used for writing was carbon black mixed with a binder and the rolled manuscripts with clay seals from Nepal are one of the best examples of surface written text.<sup>55</sup>

Surface writing can be vulnerable to abrasion and loss. Yana van Dyke has stated that the ink used is generally chemically stable, but 'inherently susceptible to microscopic instability or losses due to mechanical abrasion in the stack'.<sup>56</sup> This vulnerability often leads to surface written (or painted) manuscripts needing to be consolidated or conserved at a later date.

## 3 Illustration and decoration

Palm leaf manuscripts can contain illustrations (or paintings) as well as text (see Fig. 1), which are similarly either painted directly on the leaf surface or incised then coloured. For example, Igunma states that the majority of Thai

43 Anupam Sah, 'Puskola Pothi: Palm Leaf Manuscripts of Sri Lanka', *Studies in Conservation* 47, supp. 2 (2002): 14; Montgomery Schuyler Jr, 'Notes on the Making of Palm-Leaf Manuscripts in Siam', *Journal of the American Oriental Society* 29 (1908): 282.

44 Cf. for example, David Jacobs, 'Workshop Notes of The Conservation and Stabilization of Palm Leaf Manuscripts', South Asia Library Group, Newsletter 40, December 2010, 26.

45 Susan Ghosh, Arnab Mahajan, and Swapna Banerjee, 'Palm Leaf Manuscript Conservation, The Process of Seasoning', *International Journal of Information Movement* 2, no. 2 (2017): 123.

46 Janay Laudat, 'South Asian Heritage Month Collection Close Up: Preserving Palm Leaf—A Sacred Manuscript Tradition', blog post, The John Rylands Library, Manchester, August 2020, <https://rylandscollections.com/2020/08/03/south-asian-heritage-month-collection-close-up-preserving-palm-leaf-a-sacred-manuscript-tradition/> (accessed 3 August 2022).

47 Jacobs, 'Workshop Notes', 25.

48 Laudat, 'South Asian Heritage Month'.

49 S. Jayabarathi, 'Palm Leaf Writing by the Ancient Tamils', video, May 2015, <https://www.youtube.com/watch?v=vxxGbSsYDx8> (accessed 3 August 2022).

50 Yeni Budi Rachman, 'Palm Leaf Manuscripts from Royal Surakarta, Indonesia: Deterioration Phenomena and Care Practices', *Restaurator—International Journal for The Preservation of Library and Archival Materials* 39, no. 4 (2018): 238.

51 Alfred Crowley, 'Repair and Conservation of Palm Leaf Manuscripts', *Restaurator—International Journal for The Preservation of Library and Archival Materials* 1 no. 2 (1969): 106–7.

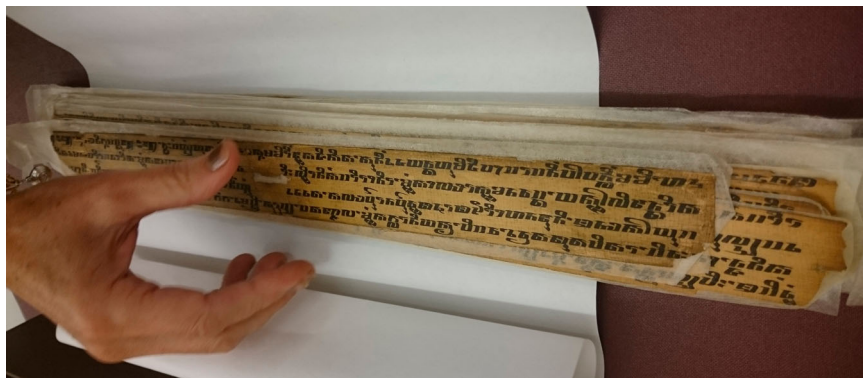
52 Sah, 'Palm Leaf Manuscripts of The World', 21.

53 Sah, 'Palm Leaf Manuscripts of The World', 19.

54 Laudat, 'South Asian Heritage Month'.

55 Cf. for example, Naoko Takagi, Yoriko Chudo, and Reiko Maeda, 'Conservation of Digitisation of Rolled Palm Leaf Manuscripts in Nepal', Paper Conservators Asia Unlimited, blog post November 2005, <https://www.asianart.com/articles/tamsuks/> (accessed 3 August 2022).

56 van Dyke, 'Sacred Leaves', 87.



**Fig. 7** British Library Javanese gebang manuscript, made from the talipot or fan palm, MSS Jav 105 with surface written text, previously laminated to prevent further ink loss with leaves blocking (sticking together), fifteenth–sixteenth century.



**Fig. 8** British Library Burmese palm leaf manuscript, Or. 12010 J with lacquered leaves. Outer leaves painted with silver pigment and black lacquered designs of lotuses in roundels, showing damage to lacquer with beige underlayer visible, in Pali script, nineteenth century.

57 Igunma, *The Beautiful Art of Thai Palm Leaf*, 37.

58 Sah, 'Palm Leaf Manuscripts of The World', 18.

59 van Dyke, 'Sacred Leaves', 89.

60 van Dyke, 'Sacred Leaves', 88; Deepakshi Sharma et al., 'Pigment Analysis of Palm Leaf Manuscripts of India', *Current Science* 118, no. 2 (2020): 285.

manuscripts are composed of text only, but those that contain illustrations are either blackened like the text or coloured with red or brown lacquer solution.<sup>57</sup> Sah describes how illustrations were either incised or surface drawn, with the incised lines then filled with gum tempera paint (Fig. 8).<sup>58</sup> From a case study of 45 Indian manuscripts, van Dyke found that the images were formed by thickly applied opaque paint applied directly to the leaf surface with no preparation layer or ground. The adhesion of the paint layer to the leaf was usually found to be strong, but that flaking and friable paint layers could be attributed to poor adhesion, desiccation of the binder, abrasion and stress caused when the leaves were turned.<sup>59</sup>

Various researchers have aimed to identify the pigments employed in palm leaf media. Both van Dyke and Deepakshi Sharma et al., identified carbon black, blue derived from indigo, yellow from orpiment, red from vermilion or cinnabar, white from calcium carbonate or China clay, and green from a mixture of indigo and orpiment.<sup>60</sup> Orpiment, which contains arsenic, was sometimes used as it was thought to have insect-repellent qualities. In another study, Sharma et al. confirmed the presence of starch paste and pectin as binders in the paint layer of an illustrated



**Fig. 9** Upper image: ornate top board with mother-of-pearl shell inlay, from British Library palm leaf manuscript Or. 16077 in Pali from Northern Thailand, nineteenth century. Lower image: British Library palm leaf manuscript with red lacquer and gilt decoration in Pali script, *Kammavācā*, Or. 12010a, Burmese, nineteenth century.

Indian manuscript,<sup>61</sup> and in their pigment study concluded that colours were prepared by mixing primary pigments with locally available gum or adhesive.<sup>62</sup>

Jacobs summarised the materials used for media as:

- Lamp black mixed with wood apple gum (resembles gum arabic in properties)
- Vermillion as a red pigment from ground cinnabar (iron oxide), known in India as *Hingula*
- Red lead mixed with plant gum (gum arabic)
- Red ochre mixed with plant gum
- White made from burnt conch and oyster shells powdered and mixed with plant gum
- Yellow made from orpiment and realgar, both arsenic sulfide minerals
- Yellow prepared from an adhesive made out of wood apple mixed with turmeric powder
- Blue made from the ground juice of indigo plant leaves mixed with plant gum
- Green made from a mixture of indigo and orpiment with plant gum
- Green made from ground bean leaves, mixed with plant gum.<sup>63</sup>

The leaves of a palm manuscript can be more heavily decorated with lacquer, gold leaf, gold paint, inlaid mother-of-pearl (Fig. 9), mirror glass, crystals or precious stones.<sup>64</sup> The leaves of Burmese 'Kammavaca' manuscripts were lacquered and gilded, sometimes with added pigment for colour.<sup>65</sup> Anupam Sah suggests that the use of lacquer is one of the factors that distinguishes the manuscripts of Thailand and Myanmar from those of other regions.<sup>66</sup> Furthermore, the boards for these manuscripts were commonly made from wood and occasionally decorated with materials such as mother-of-pearl, gold leaf, gold paint or lacquer. Igunma states that 'mother-of-pearl inlay was a very popular method of wood decoration in central Thailand, but it was also adopted in Lanna and Laos due to close cultural relationships and exchange or transfer of Buddhist scriptures'.<sup>67</sup> Boards could also be made from other materials such as metal or ivory, which could also be highly decorative.

#### 4 Oiling

Varnish or oil may also be present as a layer or within the leaf. For instance, Om Prakash Agrawal reports that shellac was used as a popular protective

**61** Deepakshi Sharma, Manager Rjdeo Singh, and Bhushan Dighe, 'Chromatographic Study on Traditional Natural Preservatives Used for Palm Leaf Manuscripts in India', *Restaurator—International Journal for The Preservation of Library and Archival Materials* 39, no. 4 (2018): 259.

**62** Sharma et al., 'Pigment Analysis of Palm Leaf Manuscripts of India', 287.

**63** Cf. Jacobs, 'Workshop Notes', 25.

**64** Igunma, *The Beautiful Art of Thai Palm Leaf*, 40.

**65** Melanie Nief, Wolfgang Baatz, and Sigrid Eyb-Green, 'Kammavacas: Lacquered and Gilt Palm Leaf Manuscripts from Burma. Analysis of Materials and Techniques in the Context of a Conservation Case Study', *The Journal of Paper Conservation* 11, no. 3 (2010): 19.

**66** Sah, 'Palm Leaf Manuscripts of The World', 18.

**67** Igunma, *The Beautiful Art of Thai Palm Leaf*, 41.

68 Agrawal, *Conservation of Manuscripts*, 58.

69 Susan Gawlowicz, 'Imaging Technology Restores 700-Year-Old Sacred Hindu Text', Rochester Institute of Technology website, News, 18 September 2006, <https://www.rit.edu/news/imaging-technology-restores-700-year-old-sacred-hindu-text> (accessed 3 August 2022).

70 See, for example, D. G. Suryawanshi, M. V. Nair, and P. M. Sinha, 'Improving the Flexibility of Palm Leaf', *Restaurator* 13, no. 1 (1992): 37–46; Sah, 'Palm Leaf Manuscripts of The World', 19; Jacobs, 'Workshop Notes', 29; Ghosh, Mahajan, and Banerjee, 'Palm Leaf Manuscript Conservation', 123; Rachman, 'Palm Leaf Manuscripts from Royal Surakarta', 238; Sharma, 'Chromatographic Study on Traditional Natural Preservative', 252–3.

coating in India,<sup>68</sup> and Susan Gawlowicz at Rochester Institute of Technology concluded that the leaves in her study had aged dark brown as a result of 'time and a misguided application of oil', which was obscuring the text.<sup>69</sup> Other authors reference the application of different oils to impart flexibility or as insecticides, relating to treatment by both indigenous communities and conservators.<sup>70</sup>

### Palm leaf manuscripts at the British Library

The India Office Library and Records (IOLR) collection of palm leaf manuscripts, now part of the British Library's vast Asian and African Collections, is extensive. Many of the manuscripts were stored in less than ideal conditions before coming to the library but since their arrival many have only rarely been opened and received little or no care. When they arrived in the collection some manuscripts were very fragile with weak and brittle leaves and/or leaves stuck together from mould or past treatments (blocking). However, some were also in good condition with text intact and ornate pigments or lacquered covers.

Like many other collections, the most common types of damage for palm included brittleness, mechanical damage, insect damage, staining, splitting of the surface layer and cleavage (separation of the upper from the lower surface). Since the 1970s, the manuscripts have been treated in various ways and by different studios, first at the British Museum and then the British Library after its creation in 1973, starting with the India Office Library and Records conservation studios.

#### 1 IOLR treatments, 1970–1990

Often the first stage of treatment for manuscripts with incised text was to fumigate the unopened manuscripts with thymol vapours to stop and/or prevent mould growth. Once fumigated the manuscript was left to air, before being surface cleaned with a soft brush in a fume cupboard.

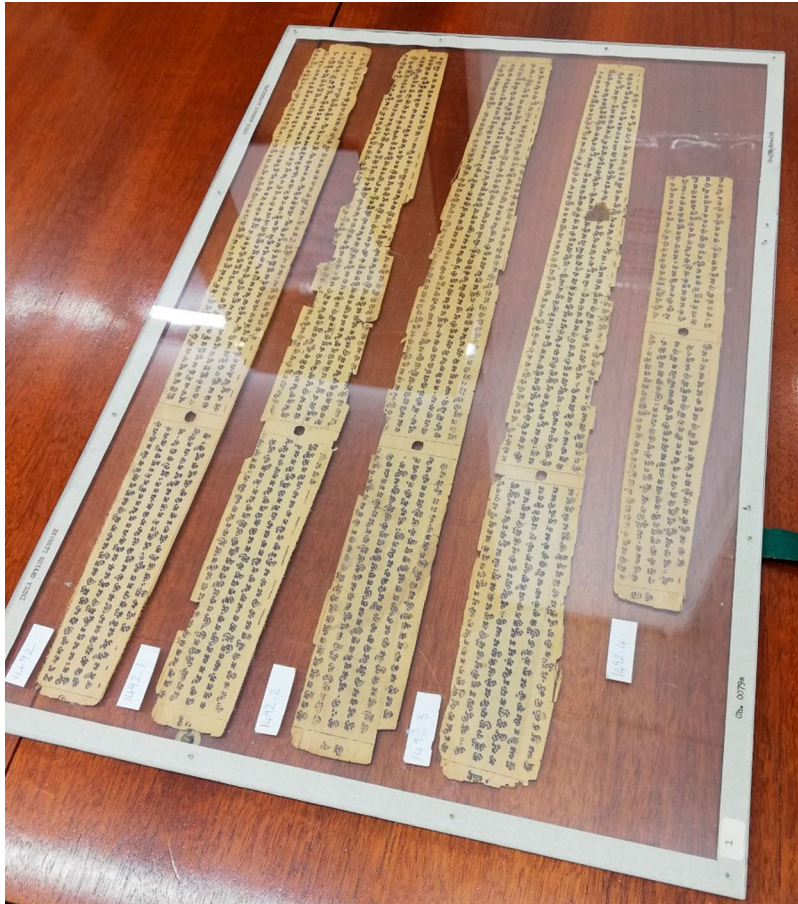
The next step was to introduce some flexibility into each leaf with an application of camphor oil. Where the incised and inked text had faded, or if it had never been inked, a carbon black ink powder would be mixed with the camphor oil and rubbed into the incised text. Excess ink was then wiped away with a cotton cloth.

During this period, it was not known that some of the palm leaf manuscripts were never intended to be inked. As discussed, some palm leaf manuscripts were incised so a bean plant or berry juice and aromatic oil could be rubbed into the incised palm leaf, before oil or a little water would be rubbed onto the leaf to make the text visible.

If there was no obvious physical damage the manuscripts were wrapped in a plain cotton cloth and sometimes boxed. Traditionally a yellow or red dyed silk cloth was used to wrap the manuscript. The dye in the cloth was also thought to prevent insect attack. More important texts were wrapped and kept in sandalwood boxes.

#### 2 IOLR conservation studio (1970–1990)

Sewing was the traditional method used to repair damaged palm leaf manuscripts in Asia. In contrast, in the IOLR conservation studio several repair methods were used to attach loose fragments, repairs and infills using various adhesives such as polyvinyl acetate (PVA), polyvinyl alcohol (PVOH) and other wood adhesives. Losses were replaced with toned Japanese tissue using PVA and methyl cellulose. Conservators did not build up layers of tissue to match the exact thickness of the palm leaf, instead the repairs were kept slightly thinner and lighter, so as not to stress the repaired edge. Watercolours and cloth dyes were used to tone the tissue. Local pulp application was also used to infill insect lacunae, consist-



**Fig. 10** British Library palm leaf manuscript IOL San 1492 written in Sanskrit, housed between perspex sheets.

ing of paper pulp toned with watercolour. It is probable that the IOLR studio did not use the method developed in the OMPB (Oriental Manuscripts and Printed Books) studio of infilling losses in the manuscript with new palm leaf material.

### *2a Encapsulation*

Various materials were used to encapsulate palm leaf manuscripts, some with greater success than others. Materials used included glass, cellulose acetate, perspex (Fig. 10) and polyester films, such as Melinex® pockets or sleeves with the edges sewn or spot welded in place.

### *2b Fragments*

Fragments were often stored in Melinex® to avoid loss and further damage. However, this may not always have been the best choice for heavily damaged or brittle fragments, as Melinex® is very flexible and may have allowed too much movement in some cases.

## **3 Oriental Manuscripts and Printed Books studio at the British Library (OMPB)**

As solvents can have a desiccating effect on palm leaves, water on cotton swabs was generally used for cleaning in the OMPB studio. However, ethyl alcohol (ethanol) was used for cleaning leaves that weren't incised,

avoiding the text or pigmented areas, and any old repairs made with tape were removed and cleaned of residues using acetone where necessary.

Infills were carried out using pieces of new palm leaf with ethylene-vinyl acetate (EVA) or using *sa* paper, a thick type of Thai mulberry (*kozo*) fibre paper, with EVA and methyl cellulose. Often repairs wouldn't adhere to oily palm leaves, so the surface oil needed to be removed first using a small amount of ethanol on a cotton swab.

### 3a Repairs with new palm leaf

Once the infill area was ready, a new piece of palm leaf was carefully cut out using a tracing made on Melinex® to get the exact shape. The repair piece would be cut slightly larger than the original, so that it could overlap on the verso by about 2mm. The new palm leaf was then pared and applied with a small amount of EVA on the overlapping edge. The method of attaching new palm leaf infills with EVA is described in detail by David Jacobs.<sup>71</sup>

71 Jacobs, 'Workshop Notes'.

### 3b Repairs with Japanese papers

Tears were repaired in the OMPB studio using 100% Japanese *kozo* papers of different weights or thick *sa* paper for larger losses. The papers were toned with Cartasol K dyes in various shades.<sup>72</sup> The dyes (now produced by Archroma) have been used in the British Library for many years and have shown good colour fastness and stability. The repairs were adhered with a water-soluble mixture of a small amount of soluble EVA and methyl cellulose.

72 Cartasol K are cationic, direct dyes developed especially for toning wood-free pulp paper.

If a large part of the leaf was missing, a piece of thick *kozo* or *sa* paper would be carefully torn or water-cut to match the missing area. The infill was then applied, slightly overlapping the edge of the leaf with the repair paper on the verso. When dry, it was supported on both sides of the infill by Japanese tissue in the manner described above. Loose leaf fragments were secured the same way. The cracks, vertical folds and creases were also supported with thin Japanese paper from the verso.

## 4 British Library conservation studio treatments 2005–present

Repair methods continued to evolve in the British Library conservation studios in the 2000s. Cascamite—a urea formaldehyde resin—was a wood glue used in the conservation studios in the early 2000s to attach new pieces of palm leaf as infills for damaged leaves. This technique was used for thick palmyra leaf manuscripts, with varying levels of success and they were attached flush, edge-to-edge, and done in the fume cupboard. Cascamite is no longer used as it's irreversible as well as toxic. Other wood glues such as Araldite epoxy resin were previously used to repair wooden boards, and Paraloid B-72 (in acetone) was used to consolidate wood. Otherwise, manuscripts without boards were often given new support boards made of acid free mount board, cut slightly bigger than the manuscript to protect the edges before wrapping in calico and boxing.

More recently palm leaf conservation at the British Library has seen conservators returning to use toned Japanese papers of various weights for tear repairs and infills due to their stability and reversibility (Fig. 11). Depending on the thickness and type of manuscript, wheat starch paste and methyl cellulose have been used as adhesives in more recent work, with isinglass or fish glue sometimes used for lacquered items. Due to its ease and convenience, fish glue was used rather than isinglass in some cases; but further research and investigation is needed for an accurate comparison with isinglass.

### Common types of damage

The common types of damage, as described in the available literature, highlight both historical and continuing types of damage found in palm





**Fig. 11** Infills being applied to a palm leaf manuscript with wheat starch paste by building up layers of Japanese paper to reach the desired thickness.

leaf collections today. There are inherent defects in the organic structure of palm leaves and when combined with environmental factors, constant handling and improper storage, all can greatly affect the deterioration of palm leaf manuscripts.

### 1 Inherent defects

The palm leaf is an organic product prone to natural ageing and deterioration. The chief constituent of the palm leaf is cellulose, which on ageing loses suppleness and becomes fragile and embrittled. As Julia Poirier has recently written, 'degradation agents inherent to the palm leaf, such as the lignin content, lead to the palm's tendency to become rigid and lose flexibility, therefore becoming prone to brittleness over time'.<sup>73</sup> The substances used in the manufacturing process of palm leaves can also have a damaging effect on the structure with, for example, the resinous oils that are applied to retain suppleness eventually evaporating and reducing the flexibility of the leaves.

### 2 Environmental factors

This structural deterioration is exacerbated by environmental factors, namely light, heat and moisture and fluctuations in these elements. Damage occurs as planar distortions (or cockling), splitting (longitudinal cracks in the surface layer) and cleavage (the surface layer separating from the inner layer).

By far the most prevalent damage found in palm leaf collections is from insects which appear as tiny bore holes penetrating the structure or tunnels (losses across the surface). The insects responsible are mostly termites, cockroaches, silverfish and booklice. Rodent damage (rats and mice) in the form of gnawing marks and losses along the edges is less common, as is fungal attack, where a greenish to black mould can infest and discolour the leaves.

Staining is a common occurrence on palm leaves, mostly from the accumulation of dust and dirt (which can also be abrasive) and less commonly from insect excreta. Contact with water or other liquids can cause staining and can often lead to blocking (where leaves stick to one another) and mould growth.

Other environmental factors that cause significant damage to palm leaves are from the oxidation of cellulose and acidic gases present in the

<sup>73</sup> Cf. for example, Julia Poirier, 'Delaminating and Fraying Fibres: Developing an Advanced Treatment Approach for the Conservation of a 12th Century Palm Leaf Manuscript', Chester Beatty blog post, March 2020, <https://chesterbeatty.ie/conservation/delaminating-and-fraying-fibres> (accessed 3 August 2022).



**Fig. 12** Close-up of damage to a cord hole on a Tamil manuscript revealing the fractured inner layers of the leaf created by the binding cord, British Library manuscript Mss Tamil 171, India, nineteenth century.

atmosphere. Not to be confused with the natural browning of the leaves as they dry out, this type of discolouration appears as yellowing or blackening, often found along edges or where exposed when cover boards are missing. The historical re-oiling or protective varnishing of leaves can also produce discolouration.

### 3 Handling

Poor handling can result in localised delamination, fraying, breakages and loss. Frequent opening of the manuscript leaves can lead to a widening of the holes in the binding structure, as they are damaged by the repeated friction of the cords when opening or of pages being turned (Fig. 12). van Dyke suggests that 'fraying, delamination, and splitting of the structure are to be expected around the binding holes and from the edges; tears are much less common'.<sup>74</sup> Further mechanical damage is caused by a traditional binding method that involves winding the threaded cord around the edges of the manuscript which can cause breakage to leaf edges.<sup>75</sup>

Old and inappropriate repairs and treatments can also cause irreparable damage to palm leaves with, for example, Sellotape being employed as a repair method in the past. The use of palm leaf manuscripts as objects of worship and daily prayers mean they are often subjected to an environment containing burning candles and/or incense and are susceptible to staining from any soot particles.

### 4 Improper storage

Improper storage and housing can have an adverse effect on the preservation of palm leaves. Flood, fire, infestation or other climatic disasters can devastate collections. As described, traditionally manuscripts were wrapped in a cloth and bound with cord but they can be found stored in bespoke wooden boxes or suspended on racks. More commonly they are shelved and stacked in piles in local repositories and this stacking can cause breakages.

If not kept in a museum-like environment, the physical protection of manuscripts can be less than ideal and conditions within buildings can offer minimal protection from the elements and nature. Differing climatic conditions can make palm leaves more susceptible to degradation—such as planar distortion from excess humidity—whereas a controlled environment can improve their longevity.

<sup>74</sup> van Dyke, 'Sacred Leaves', 88.

<sup>75</sup> Jacobs, 'Workshop Notes', 26.

## 5 Media

The range of media applied to palm leaves is commonly described as unstable because the surface of the leaf is not very absorbent and any ink, for example, remains on the surface and is prone to physical loss or flaking. Abrasion from the stacking of leaves can lead to the surface written text becoming very faint over time. The organic binder in the ink also has a tendency to degrade and cause flaking and powdering.

Both surface and incised inks can be lost through fading (light damage) and oxidation. Staining and discolouration of the support can make the text illegible, and any distortion of the support can cause partial or complete loss of the text.

Repeated handling of palm leaves, particularly illustrated manuscripts with liquid gold decorations and where letters appear raised, can lead to abrasion and scratches of the painted or written surface.

## 6 Boards

The mostly wooden (occasionally metal or ivory) protective cover boards are an integral part of a palm leaf manuscript. They provide an additional layer of physical protection against the elements. Wooden objects, being porous in nature, often require coating with a surface protection as well as ornamentation. As detailed, boards are often decorated with inlays (mirror glass, mother-of-pearl), or painted and varnished, gilded (gold leaf) or lacquered or a combination of these. These decorative elements are often prone to loss, flaking, separation, deterioration or damage mostly from environmental factors and poor handling.

The structural deterioration of wood is somewhat similar to that of palm leaves, and is exacerbated by environmental factors, the most pronounced being from the fluctuations in temperature and humidity. Damage occurs as shrinkage and expansion, warping and splitting, all of which can disturb and distort the surface coatings and ornamentation. Damage from light can cause a change of colour (fading or discolouration) and a change in texture or finish with, for example, varnished boards appearing to have an opaque coating. Wood is also prone to attack from insects, rodents, mould including fungi in common with the palm leaf support.

The repeated handling of the boards can cause abrasion and loss of the surface treatment. Boards can be separated or lost from the manuscript after the untying of the binding cords, leaving the palm leaf support vulnerable and without protection. This loss can lead to the misplacement of the title indicator (if present) and invariably disassociation of the object. Often broken wooden boards were simply replaced with new boards as was traditional practice in Buddhist communities.

## 7 Cords

The binding cords—often cotton but traditionally a braided silk in South East Asia—are used to string palm leaves together and are commonly wrapped around the cover boards in order to secure the manuscript. Silk and cotton, being organic materials, are prone to natural ageing and deterioration. This deterioration can lead to embrittlement causing the fibres to split, fray and ultimately break.

Silk is particularly sensitive to environmental degradation with light being a major cause of damage, particularly because of UV radiation. Exposure to UV can cause yellowing, weakening of the fibres and significantly contributes to fading of dyes and colourants. Heat and moisture, and fluctuations in these elements, contribute further to the physical decay of silk fibres, if already extant from things like insect damage such as from clothes moths and carpet beetles. Insect damage appears as tiny holes or losses or residual webs and insect casings. Water damage can

cause the bleeding of dyes and the accumulation of mould deposits which can lead to staining.

As with the boards, repeated handling can cause stress to the silk fibres from turning the palm leaf folios when being read. This strain on the binding cords, as when wrapped around the covers, can cause severe breakages to the cords (as well as to the leaves). If the binding cords are removed, leaving the support unbound, this can lead to a disordering of the folios. Handling can also impart oils and acids from the skin which can lead to ingrained dirt or staining.

Due to the causes of damage inherent to the organic nature of palm leaves, and other materials that comprise palm leaf manuscripts, it is vital that they are handled and stored properly to deter any further damage.

### Conclusions

Palm leaf manuscripts and paintings represent a complex range of objects with a huge variety of types and sizes, physical characteristics, and local traditions with strong regional variation. These variations are heavily influenced by the types of palm trees the leaves are made from, which dictates the size and type of leaf that can be used to create these objects.

Some of our key findings from undertaking this review of the available literature have demonstrated the importance of understanding the region and culture that the manuscripts come from such that, due to their diversity, any decisions about their conservation must be taken on a case-by-case basis. Furthermore, good communication with curators and subject specialists is vital to understanding the manuscripts and their materiality. Other components of the manuscripts, such as boards, cords and wrappers, all have their own significance and should always be retained with the manuscript. We have also seen that some of the historic conservation treatments carried out at both the British Museum and the British Library, while done with good intentions, are no longer approved methods. A less interventive approach, with attention given to proper storage and handling, is more appropriate to prevent irreversible damage or loss.

The research carried out for this review has highlighted a lack of consistency in conserving, housing and repairing palm leaf manuscripts. This is a developing area of conservation, to which it is hoped this review will contribute. Please see the Appendix for survey results and the British Library blogs list. Our Annotated Bibliography and further results of the survey can be found on the BL Open Access Repository.<sup>76</sup>

The Palm Leaf Treatment review will continue with Part 2, which will focus on historic treatments and current conservation techniques, boxing and long-term storage, as well as religious and ethical issues, and our recommendations for best practice for conservators. The Appendix for Part 2 will also include two decision-making flowcharts—one for curators and another for conservators—that can be useful when assessing palm leaves and making treatment or housing decisions.

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### Appendix 1: Results of the conservation of palm leaf manuscripts survey

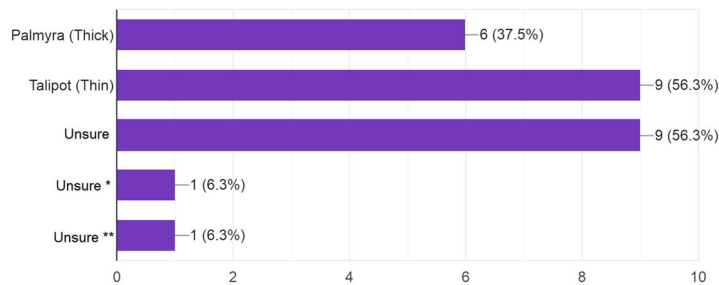
A survey on the treatment of palm leaf manuscripts was posted on the Global Conservation Forum (formerly the Conservation DistList) in August 2020 by the Palm Leaf Treatment Review team of conservators at the British Library. Graphs created using Google Forms.

76 <https://doi.org/10.23636/8hbd-xj49>  
(accessed 16 August 2022).

## Group responses

What type(s) of palm leaf?

16 responses

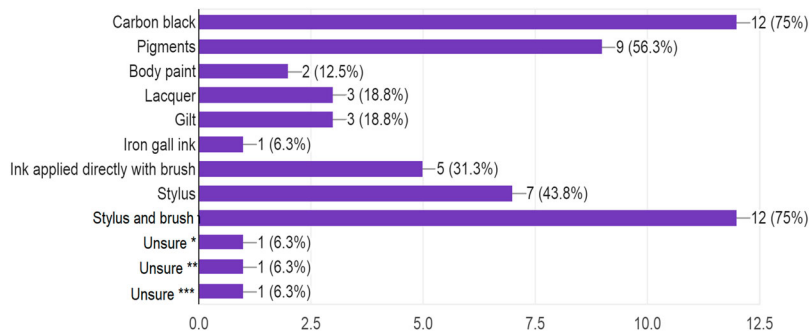


\*Most likely all are talipot, a fuller survey for identification needs to be completed.

\*\*I am not familiar with the above terms, we use the term Lontar when it concerns Indonesian palm leaves, and these do come in the thin, sometimes warped leaves, and also in very thick and sturdy leaves.

What media is present/How was the impression made on the palm leaf?

16 responses



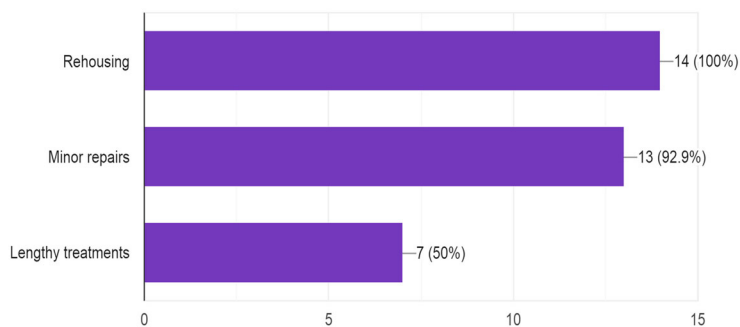
\*I'm not sure whether the above (stylus with ink applied with brush) is applicable—the ink may have been applied in a different manner—but we definitely have the combi stylus and ink.

\*\*Some manuscripts were applied with vegetable juice with lamp shoot.

\*\*\*Purportedly carbon black, but not sure.

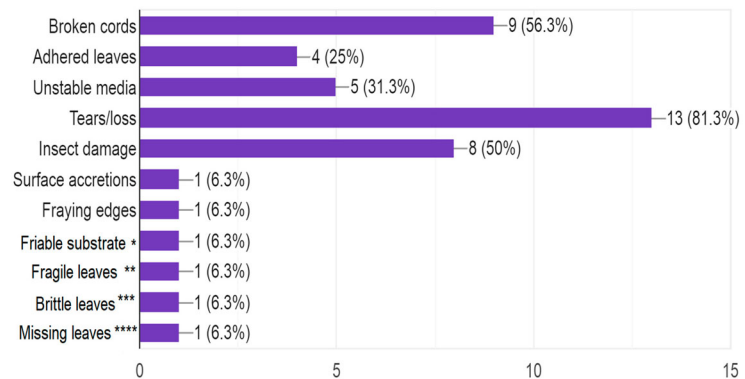
How do you treat your collection? What is your typical approach and general level of intervention?

14 responses



What is the most common type of damage present on your collection?

16 responses



\*Friable substrate of palm leaf.

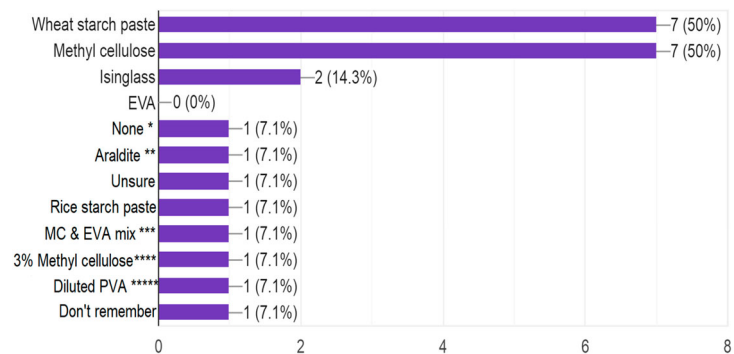
\*\*Fragile leaves with breakages and sometimes losses at back and front. Also warping (due to type of leaf) which is a problem when we need to digitise, and dust and some abrasion.

\*\*\*Brittle leaves, loss of lacquer and gilt decorations.

\*\*\*\*Missing leaves, dissociation, combined manuscripts in one box.

What adhesives do you use for palm leaves? If it is a combination of adhesives please specify which adhesives and at what percentage.

14 responses



\*I did not use any adhesive on my treatment.

\*\*Have also used Araldite and Cascamite wood glues for old method of board repair and palm infills.

\*\*\*In a few instances we have used a mixture of MC and EVA, ca. 50:50.

\*\*\*\*The percentage is generally adjusted from 3% methyl cellulose to create suitable flow/penetration. The same is for starch paste. In some cases, thicker adhesives are brushed out and dotted onto the area to be repaired in order to reduce moisture while making a repair. With adhesive use, we try to select an adhesive that is flexible and not stronger than the area to be repaired—we prefer that the repair fails rather than introduce new tensions and stresses to the work of art that can initiate damage.

\*\*\*\*\*Poly vinyl acetate emulsion in thin form.

## Appendix 2: List of British Library blogs, research and other information on palm leaf collections

### 1. Collection Care Blog

*Magic in Conservation—Using Leaf-Casting on Paper and Palm Leaves*, 10 October 2017, Iwona Jurkiewicz, <https://blogs.bl.uk/collectioncare/2017/10/magic-in-conservation-using-leaf-casting-a-mechanical-pulp-repair-technique-on-paper-and-palm-leaves-as-the-library-i.html>

## 2. Asian and African Studies Blog

*A Thai Royal Edition of Pannasa Jataka*, 5 June 2020, Jana Igunma and Henry Ginsburg, <https://blogs.bl.uk/asian-and-african/2020/06/a-thai-royal-edition-of-pannasa-jataka.html>

*Sir Hans Sloane's Old Javanese manuscript, Sloane 3480*, 20 June 2018, Ida Bagus Komang Sudarma, Wayan Jarrah Sastrawan, and Arlo Griffiths, <https://blogs.bl.uk/asian-and-african/2018/06/sir-hans-sloanes-old-javanese-manuscript-sloane-3480.html>

*Javanese Manuscripts in the Sloane Collection*, 19 June 2018, Annabel Teh Gallop, [https://blogs.bl.uk/asian-and-african/2018/06/javanese-manuscripts-in-the-sloane-collection.html?\\_ga=2.210299285.182101380.1528836642-768445457.1421359745](https://blogs.bl.uk/asian-and-african/2018/06/javanese-manuscripts-in-the-sloane-collection.html?_ga=2.210299285.182101380.1528836642-768445457.1421359745)

*Buddhism Illuminated through Southeast Asian Manuscript Art (1)*, 8 June 2018, San San May, Jana Igunma, and Henry Ginsburg, <https://blogs.bl.uk/asian-and-african/2018/06/buddhism-illuminated-through-southeast-asian-manuscript-art-1.html>

*Kammavaca: Burmese Buddhist Ordination Manuscripts*, 17 February 2017, San San May, <https://blogs.bl.uk/asian-and-african/2017/02/kammavaca-burmese-buddhist-ordination-manuscripts.html>

*More than a Book: A New Display of Southeast Asian Manuscripts*, 14 March 2016, Annabel Gallop, San San May, Jana Igunma, and Sud Chonchirds, <https://blogs.bl.uk/asian-and-african/2016/03/more-than-a-book-a-new-display-of-southeast-asian-manuscripts.html>

*The Beauty of Palm Leaf Manuscripts (3): Storage and Preservation*, 6 February 2015, Jana Igunma and Henry Ginsburg, <https://blogs.bl.uk/asian-and-african/2015/02/the-beauty-of-palm-leaf-manuscripts-3-storage-and-preservation.html>

*The Beauty of Palm Leaf Manuscripts (2): Northern Thai, Lao and Shan Traditions*, 23 January 2015, Jana Igunma and Henry Ginsburg, <https://britishlibrary.typepad.co.uk/asian-and-african/2015/01/the-beauty-of-palm-leaf-manuscripts-2-northern-thai-lao-and-shan-traditions.html>

*The Beauty of Palm Leaf Manuscripts (1): Central Thailand*, 20 November 2014, Jana Igunma and Henry Ginsburg, <https://britishlibrary.typepad.co.uk/asian-and-african/2014/11/the-beauty-of-palm-leaf-manuscripts-1-central-thailand.html>

*A New Catalogue of Malay and Indonesian Manuscripts in British Collections*, 1 September 2014, Annabel Teh Gallop, <https://blogs.bl.uk/asian-and-african/2014/09/a-new-catalogue-of-malay-and-indonesian-manuscripts-in-british-collections.html>

*The Javanese Story of the Prophet Joseph*, 3 December 2013, Annabel Teh Gallop, <https://blogs.bl.uk/asian-and-african/2013/12/the-javanese-story-of-the-prophet-joseph.html>

## 3. Endangered Archives Blog

Fragile Palm Leaves Digitisation Initiative (EAP1150), June–July 2020, <https://eap.bl.uk/project/EAP1150>

Sanskrit and Malayalam Manuscripts from The Thrissur Monastic Complex (EAP1039), April–May 2020, <https://eap.bl.uk/project/eap1039>

Constituting a digital archive of Tamil agrarian history (1650–1950)—phase II (EAP689), May 2016–June 2016, <https://eap.bl.uk/project/EAP689>

## Cataloguing, digitisation, and preservation of ancient palm leaf and paper manuscripts archived in Chinmaya International Foundation (CIF) (EAP729), February 2016, <https://eap.bl.uk/project/eap729>

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### Résumé

« Une revue littéraire de la restauration des manuscrits sur feuilles de palmier: Partie 1: aperçu historique, préparation des feuilles, matériaux et media, manuscrits sur feuilles de palmier de la British Library et types d'altérations courantes »

La fermeture de la British Library lors de la pandémie de Covid-19 2020–2021 a permis au département de la restauration d'entreprendre un recensement des traitements de conservation des manuscrits sur feuilles de palmier afin de prendre des décisions plus éclairées sur le traitement de ces objets complexes. Dans le cadre du recensement, un questionnaire fut posté en 2020 sur le Forum international de la conservation comprenant des questions sur le traitement des manuscrits sur feuilles de palmier réalisé par d'autres personnes dans ce domaine. Cette revue de la littérature en deux parties exploite la littérature disponible et les résultats de l'enquête pour aborder le large éventail de problèmes inhérents à la conservation matérielle des matériaux en feuilles de palmier. La partie 1 comprend un aperçu historique des manuscrits sur feuilles de palmier et de leur fabrication, des méthodes de préparation des feuilles, des matériaux et medias dans les manuscrits, des manuscrits sur feuilles de palmier à la British Library et des types d'altérations courantes observées dans ces manuscrits. La partie 2 détaille les traitements anciens et les techniques de conservation actuelles tels qu'ils ressortent de l'examen et de l'enquête, ainsi que les questions de stockage, religieuses et éthiques, avant de conclure par les recommandations pratiques.\* Les auteurs souhaitent partager les informations rassemblées aussi largement que possible et aider à créer une plus grande continuité et cohérence dans la conservation des manuscrits sur feuilles de palmier en présentant leurs recommandations de bonnes pratiques pour les restaurateurs qui traitent ces objets étonnants.

### Zusammenfassung

„Eine Literaturübersicht über die Konservierung von Palmblattmanuskripten: Teil 1: Historischer Überblick, Blattvorbereitung, Materialien und Medien, Palmblattmanuskripte in der British Library und häufige Schadensarten“

Die Schließung der British Library während der Covid-19-Pandemie in den Jahren 2020–2021 ermöglichte es der Abteilung Bestandserhaltung, die Behandlung von Palmblattmanuskripten zu überprüfen, um fundiertere Entscheidungen über die Behandlung dieser komplexen Objekte treffen zu können. Im Rahmen dieser Überprüfung wurde 2020 ein Fragebogen an das Global Conservation Forum geschickt, in dem nach der Behandlung von Palmblattmanuskripten in anderen Sammlungen gefragt wurde. Diese zweiteilige Literaturübersicht nutzt die verfügbare Literatur und die Ergebnisse der Umfrage, um das breite Spektrum an Fragen zu behandeln, die

mit der Restaurierung von Palmblattmaterialien verbunden sind. Teil 1 enthält einen historischen Überblick über Palmblattmanuskripte und ihre Herstellung, Blattpräparationsmethoden, Manuskriptmaterialien und -medien, Palmblattmanuskripte in der British Library und die in solchen Manuskripten häufig vorkommenden Schadensarten. Teil 2 geht auf historische Behandlungsmethoden und aktuelle Restaurierungstechniken ein, die sich aus unserer Untersuchung und Umfrage ergeben haben, sowie auf die Lagerung, religiöse und ethische Fragen, bevor wir mit unseren praktischen Empfehlungen schließen.\* Die Autoren möchten die gesammelten Informationen so weit wie möglich verbreiten und dazu beitragen, mehr Kontinuität und Konsistenz bei der Restaurierung von Palmblatthandschriften zu schaffen, indem sie unsere Empfehlungen für bewährte Verfahren für Restauratoren, die diese erstaunlichen Objekte behandeln, vorstellen.

### Resumen

“Una revisión bibliográfica sobre la conservación de manuscritos de hoja de palma. Primera parte: descripción histórica, preparación de hojas, materiales y medios, manuscritos de hojas de palma en la Biblioteca Británica y tipos comunes de daños”

El cierre de la Biblioteca Británica durante la pandemia de Covid-19 de 2020 al 2021 permitió al departamento de conservación llevar a cabo una revisión de los tratamientos de conservación de los manuscritos en hoja de palma y así tomar decisiones más fundamentadas en relación con el tratamiento de estos complejos objetos. Como parte de la revisión, en 2020, se envió un cuestionario al Global Conservation Forum preguntando a otros conservadores sobre el tratamiento de los manuscritos de hojas de palma. Esta reseña bibliográfica en dos partes utiliza la literatura disponible y los resultados de la encuesta para abordar la amplia problemática de la conservación práctica de los materiales de hoja de palma. La primera parte incluye una descripción histórica de los manuscritos en hoja de palma y su producción, los métodos de preparación de la hoja, los materiales y medios del manuscrito, los manuscritos en hoja de palma en la Biblioteca Británica y los tipos de daños comunes a dichos manuscritos. La segunda parte detalla los tratamientos históricos y las técnicas de conservación actuales según lo informado por nuestra revisión y encuesta, así como cuestiones de almacenamiento, religiosas y éticas, antes de concluir con nuestras recomendaciones prácticas. Los autores desean compartir la información recopilada lo más ampliamente posible y presentar nuestras recomendaciones de mejores prácticas para los conservadores que tratan estos objetos fascinante para así ayudar a crear mayor continuidad y consistencia en la conservación de manuscritos de hoja de palma.

### 摘要

“有关保护棕榈叶手稿的文献回顾——第一部分：历史概述、叶子制备、材料和媒介、大英图书馆的棕榈叶手稿以及常见损伤类型”

大英图书馆在2020-2021年新冠疫情期间关闭，使得保存修复部可以对棕榈叶手稿的保护进行审查，以便在修护这类复杂藏品时做出更明智的决定。作为审查的一部分，2020年大英图书馆在全球保护论坛上发布了一份调查问卷，询问了该领域其他人对棕榈叶手稿的修护情况。这篇由两部分组成的文献综述使用了现有文献和调查结果，来探讨棕榈叶材料在保护实践中所涉及的广泛问题。第一部分包括对棕榈叶手稿及其制作的历史概述、叶子的制备方法、手稿材



料和媒介、大英图书馆的棕榈叶手稿，以及在此类手稿中发现的常见损伤类型。第二部分详细介绍了我们审查和调查所了解到的历史处理方法和当前保护技术，以及存储、宗教和伦理问题，最后提出了我们的实际建议。\* 作者希望尽可能广泛地分享这些整理过的信息，并通过向修护这些非凡物件的修复师建议我们的最佳做法，来帮助促成在棕榈叶手稿保护方面的连续性和一致性

### Biographies

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