

Shagreen. The history and conservation of decorative ray skin in furniture

■ Cathy Silverman

Introduction

This study will explore the use of ray skin shagreen in the decoration of furniture. The small number of studies exploring the decorative use of ray skin have tended to examine the material together with shark skin (also known as shagreen), focusing on a particular geographic region or era.¹ The focus of this study has been narrowed, instead, according to object type. The paper will begin by charting the global history of ray skin on furniture, before discussing how ray skin could be considered to have been used in imitation of other materials – namely a type of Persian donkey hide and a Japanese decorative lacquer technique – and how it, in turn,

Figure 1 *Pastinachus sephen* (cowtail stingray). Several synonyms – *Dasyatis sephen*, *Hypolophus sephen*, *Raja sephen* – for this species of the *Dasyatidae* family have been mentioned in connection with ray skin shagreen.



has been imitated. Finally, three conservation techniques for recreating missing ray skin denticles will be described.

What is shagreen?

Rays are a type of cartilaginous fish, related to sharks. Their dorso-ventrally flattened bodies allow them to conceal themselves on the ocean floor (figure 1). Rather than the flat scales one might expect a fish to have, their skin is covered with projections known as placoid scales or dermal denticles. The structure of these denticles is very much like vertebrate teeth; there is a central pulpy cavity supplied with blood vessels, surrounded by a layer of dentine. The outermost layer is composed of vitrodentine, a largely inorganic, enamel-like material. Consequently, they are remarkably hard – hard and rough enough that ray skin used to be used as a rasp for woodworking,² and continues to be used in Japan to grate wasabi.

Ray skin was traditionally prepared by soaking the skin in warm water for several days, scraping off the flesh, and drying it.³ The resulting material is stiff but flexible, particularly so when wet. As well as being durable and waterproof, an interesting aesthetic is created by the arrangement of the close-set denticles, which are largest down the centre of the back and gradually diminish in size towards the edges (figure 2).

There are many different species of ray, and it is extremely difficult to identify the species once the skin has been removed and cut up. However, it is likely that most of the European objects described in this paper use skins of species of the *Dasyatidae* family – commonly known as whiptail stingrays – which live in the tropical waters of the Indo-Pacific.⁴ Several different species are known to have been used in Japanese weaponry;⁵ it is probable that the same range of species was used on furniture produced in Japan.

Ray or shark?

Both ray and shark skin are referred to as shagreen. In Europe the two materials have often been used in a similar manner to cover the same types of objects.

Figure 2 Ray skin shagreen (dyed green).

To complicate matters further, ray skin objects in museum collections and auction catalogues are frequently mislabeled as shark skin and vice versa. Ray and shark skin are easily distinguishable. Ray skin is thicker and has larger, rounder and bonier denticles, compared to the small rhombic denticles of shark skin (figure 3). The scales of the ray are closely set in a more random arrangement. The scales are not obviously directional. Shark scales are arranged in regular rows separated by furrows and point in the direction of the tail.

History of ray skin in furniture

Japanese-Portuguese trade

Ray skin has been used in Asia since at least the thirteenth century, notably in Japanese weaponry – Its grainy and water-resistant surface providing grip to hilts and decoration to scabbards (figure 4) – and Chinese Qing dynasty composite bows (figure 5). However, there is no evidence that it was used in Asia at this time to decorate furniture for their domestic market.

The earliest known examples of furniture decorated with ray skin were in fact produced in Japan, but were made for the European market. These objects were first imported to Europe by Portuguese traders in the late sixteenth century.

At this time the Portuguese were bringing large quantities of lacquerware from Japan to Europe. This early export lacquerware is known as *namban*, a term meaning Southern barbarian, applied by the Japanese to all foreigners except the Chinese and Koreans. The lacquer workshops tailored their production to meet the demands of western traders. Furnishings were made in shapes that would have been familiar to Europeans and the lacquer decoration was often of inferior quality to objects made for Japanese consumption. A small percentage of these objects incorporated shagreen.⁶

Furniture decorated with lacquer and shagreen panels in this period included large rectangular coffers with domed lids, probably made to hold clothing and bedding (figure 6), a type of cabinet with a drop front and inset drawers (figure 7),⁷ and smaller chests with flat hinged lids and a drawer at the base (figure 8).⁸ On these objects the ray skin was embedded in lacquer (a technique known as *same-nuri*). Sometimes the denticles were left intact, the skin being attached to the substrate and the lacquer applied on top; more often the skins were soaked in hot water and left to decay so that the denticles could be extracted, cleaned, and sprinkled



Figure 3 Left – shark skin-covered case, England, 18th century. Right – ray skin-covered case, England, eighteenth century.



Figure 4 Wakizashi sword, Japan, 15th century. Steel, ray skin, lacquer, silk, iron. Bowers Museum, Santa Ana, California.

Figure 5 Portrait of the Imperial Bodyguard Zhanyinbao, unidentified artist, China, 1760. Ink and color on silk. Metropolitan Museum of Art, New York.





Figure 6 Namban-style lacquered coffer, Japan c. 1600. Lacquer, wood, mother-of-pearl, ray skin denticles, gilded metal mounts. Ashmolean Museum, University of Oxford.



Figure 7 Namban-style lacquered chest, Japan, early seventeenth century. Lacquer, wood, mother-of-pearl, ray skin denticles. Private collection. Courtesy of Sotheby's, Paris.



Figure 8 Namban-style lacquered cabinet, Japan, c. 1600. Lacquered wood inlaid with mother-of-pearl and ray skin denticles. Private collection. Courtesy of Aguttes auction house.

on the surface of the wet lacquer (*samegawa-nuri* or *togidashi same-nuri*).⁹ This allowed large areas to be covered with an even pattern, and without seams between the skins. Whether applied as skins or sprinkled denticles, the scales and lacquer were ground and polished to achieve a smooth, uniform surface. The ray skin was not usually dyed, and was often used in combination with mother-of-pearl cut into geometric shapes and gold decoration, painted onto the black lacquer ground.¹⁰

Japanese-Dutch trade

The Dutch – who superseded the Portuguese as the dominant European naval power trading with Japan in the early seventeenth century – also imported furniture decorated with shagreen and lacquer. The Dutch word for ray skin (*rochevellen*) first appears in the shipping lists of the Dutch East India Company around 1634, when the Dutch resumed large-scale trade with Japan following a five year ban.¹¹ On December 31, 1635, the Dutch ship *Wassenaer* brought ninety-four pieces of lacquer furniture from Japan to Batavia, including ‘eight cabinets with side doors in ray skin and lacquerwork throughout’.¹² The same year, a shipment of 416 lacquer objects, including ‘149 cabinets both large and small, clad with ray skin and lacquer ovals’ was sent from Dutch trading post Deshima to Hirado and presumably later on to Europe.¹³

Dutch influence saw a tendency towards a reduction in the use of mother-of-pearl and a move away from stylized floral and geometric decoration towards more realistic pictorial scenes, often enclosed in cartouches.¹⁴ The drawer in the base of lidded chests was seen less frequently, twin doors gradually replaced the drop front, and cabinets were often placed on Dutch-manufactured stands. Sometimes cabinets had no decoration other than panels of lacquered ray skin. An example of such a cabinet can be seen in Impey and Jörg (ill. 288).¹⁵ On that object the central dorsal line of larger denticles can be seen running vertically down the centre of each panel, indicating that the shagreen was applied as skin rather than detached sprinkled denticles.

The cabinet on stand shown in figure 9 is typical of the type of drop-front chest with drawers inside imported by the Portuguese. The base was probably specially commissioned to support the chest. It incorporates the turned oak legs of a piece of furniture made in Holland, but has stretchers made from woods local to Japan and must have been lacquered



Figure 9 Cabinet on stand. Cabinet - Japan, c. 1600-1630; stand - Japan, incorporating elements from a Dutch table, 1625-1650. Lacquer, wood, ray skin denticles, mother-of-pearl, gilt copper mounts. Peabody Essex Museum, Salem.



Figure 10 Cabinet on stand, Dutch, c. 1700-1705, incorporating elements from earlier Japanese chests. Oak, walnut and purplewood veneer, lacquer, ray skin denticles. Rijksmuseum, Amsterdam.

there. The denticles have been carefully sorted by size and are larger on the front than the back.¹⁶

The import of shagreen-covered chests seems to have ceased in the 1640s. This could have been as a result of changing fashions, or diminishing profitability for European trading companies due to increased competition from Chinese merchants. The cabinet on stand in figure 10 has been dated to 1700-1705. In this example the panels have been removed from an outmoded chest and incorporated by the Dutch cabinetmaker into something much more European in outline.

Ray skin furniture produced in Europe – seventeenth and eighteenth century

Later in the seventeenth century, ray skin was shipped to Europe as a raw material, where it began to be used by local craftsmen.¹⁷ For some decades in the seventeenth century, ray skins were an important commodity for the Dutch East India Company. Having recognized the value of ray skin in Japan, trading posts were set up in modern Thailand and on India's Coromandel Coast to procure the skins. Between 1633 and 1663, exports from the Thailand office to Japan included nearly half a million ray skins.¹⁸ The Japanese were extremely sensitive to the quality of skins. One document describes over 8000 ray skins from a shipment of 9000 being rejected.¹⁹ Although it appears that the Dutch procured the skins mainly for trade within Asia, such incidents may account for the occasional reports we find of shipments to Europe – for example, in 1661



Figure 11 Tea caddy, England, late eighteenth century. Wood, silver, ray skin. Private collection.

Figure 12 Microscope. Optical elements by Claude Simeon Passemant (1702-1769), France, c. 1750. Gilt bronze, ray skin (tinted), parchment with gold tooling, steel, brass, mahogany, mirror glass, glass. Metropolitan Museum of Art, New York.





Figure 13 Trade card of John Folgham, shagreen case maker, England, c. 1760. Paper. The British Museum, London.



Figure 14b Interior of the cabinet.

the *Hollantsche Mercurius* reported the arrival in Holland of 900 ray skins.²⁰

A second likely source for the skins is the British East India Company. In 1799, Bernard Germain de Lacépède, the well-known ichthyologist, having identified the unprepared skins in the stores of wholesale dealers in Paris as the skin of ‘la raie sephen’, was informed that the hides were imported into France from England, but that the origin of the skins was unknown.²¹ The British East India Company was well positioned to purchase skins in India and China and records twice list the import of shagreen skins from 1682-1694,²² as well as the

purchase of 400 shagreens in Canton from 1724-27.²³ Although the records have yet to be properly explored, the earlier reports of imported shagreen may explain the source of raw material for late seventeenth-century English shagreen furniture as seen in figure 14.

The use of ray skin in objects made in Holland and England dates from around the mid-seventeenth century. The French started using the material some decades later, from around 1730. The Dutch were fairly limited in their output. In France and England, ray skin was more widely used – though primarily to cover small objects and cases rather than furniture per se. The material was also a popular covering for microscopes and other scientific instruments, its texture presumably aiding precise adjustment.

The extent of the trade in England is demonstrated by the existence of the recognized profession of shagreen casemaker from the first half of eighteenth century.^{24, 25} The trade card of shagreen casemaker John Folgham (figure 13) lists an array of cases and objects covered with shagreen, fish skin and blue or green dog skin. Willemssen suggests that, since ‘dogskin’ almost certainly refers to dogfish (a type of shark) skin, the separate mention of ‘fishskin’ must be taken to mean the only other fishskin which was used, that of ray.²⁶ The trade card lists fish skin and mahogany knife cases and shaving and writing desks are listed, suggesting several types of ray skin furniture from this period have not survived.



Figure 14a Cabinet on stand. Wood, ray skin, rosewood veneer. England, c. 1685. Private collection. Courtesy of Sotheby's, New York.

An unusual surviving example of a piece of furniture made in Europe is a cabinet on stand from England from the late seventeenth century (figures 14a, b).²⁷ It has a rosewood interior and is covered entirely with shagreen. The eye holes – which have been patched – and the tapering end of the tails are clearly visible on the doors.

In eighteenth-century France the status of shagreen objects was elevated by Madame de Pompadour, who bought many green polished shagreen-covered objects from the craftsman Jean-Claude Galuchat.²⁸ Galuchat became a sort of ‘brand name’ in France for shagreen, by which it is still known today. Again, the term is used to describe both ray and shark skin. The former is sometimes described as ‘galuchat à gros grains’, the latter as ‘à petits grains’.

Craftsmen in Europe used the skins intact, rather than removing and sprinkling the scales. The denticles were usually ground down and the skin was often dyed. It is possible that colored paper may sometimes have been placed behind the thinned translucent skin, as has been found with shark skin examples.²⁹ Green was very popular but pink and other colors are also seen. In France, the sheen of the ray polished ray skin was often enhanced with an application of vernis Martin.

Ray skin furniture produced in Europe – nineteenth century

There was a significant lull in the use of shagreen in Europe through the nineteenth century. Gaston Derys, a French historian writing in 1926, wrote about the bedroom of Napoleon III at the Chateau de Tuileries being decorated entirely in shagreen. He describes how it took craftsmen three years to prepare and apply the skins. Unfortunately, the orders and receipts associated with this probably disappeared in a fire, and modern scholars have been unable to find any other documents to corroborate the information he gives.³⁰

However, shagreen was being used in Korea at this time. The ray skin was cut into shapes, dyed in bright colors and applied to the lacquered wood to form elaborate designs. Often used in combination with mother-of-pearl and brass wire and sometimes tortoiseshell, common decorative motifs include flowers, leaves and phoenixes. Low tables, treasure cabinets (*kap-kae-suri*), boxes and folding screens were all decorated in this way.³¹ The example seen in figure 15 is thought to have been used in the women’s quarters of an upper class



Figure 15 Treasure cabinet (*kap-kae-suri*), Korea, early twentieth century. Lacquer, wood, mother-of-pearl, tortoiseshell, ray skin, brass wire inlay, brass mounts. Metropolitan Museum of Art, New York.



Figure 16 Commode, designed by André Groult, executed by Chanaux & Pelletier France, c. 1926-1928. Shagreen, mahogany, marble, amazonite, silvered bronze. Private collection. Courtesy of Sotheby’s, New York.

Figure 17 Design for a lady’s bedroom, André Groult, France, 1925. Musée Des Arts Décoratifs, Paris.





Figure 18 Namban-style lacquered coffer, Japan, c. 1640 (on a later Rococo giltwood stand). Wood, lacquer, mother-of-pearl, silver nashiji, gilt copper mounts. Private collection. Photo courtesy of Peter Mühlbauer.



Figure 19 Namban-style lacquered coffer, Japan, early seventeenth century. Lacquer, mother-of-pearl, brass mounts. Private collection. Photo courtesy of Christie's, Paris.



Figure 20 Shoe, Persia, seventeenth century. Embossed donkey or ass hide. Bata Shoe Museum, Toronto.

Figure 21 Tea caddy, stamped Jennens & Bettridge, England, nineteenth century. Papier maché, faux shagreen. Private collection.



household. The cabinets open to reveal drawers of differing sizes.

Ray skin furniture produced in Europe - twentieth century

The word shagreen evokes above all the furniture of the Art Deco period in Paris. This style is characterized by fine craftsmanship and the use of rare and expensive materials. Art Deco designers known for employing shagreen include Jean Michel Frank, André Groult, Paul Iribe and Clément Rousseau. Rousseau and Iribe are credited with reintroducing shagreen to Parisian workshops.³² These designers made great use of its flexibility, stretching it over the curves of their furniture. They sometimes used the central ridge of larger scales to emphasize geometric elements of their design, or made a feature of the restrictions imposed by the relatively small size of the skins, by arranging them in a mosaic or tile pattern.

John Paul Cooper (1869-1933) and Omar Ramsden (1873-1939) of the Arts and Crafts Movement in Britain are also particularly noted for their use of shagreen in combination with precious metals and stones, making boxes and caskets as well as jewelry.

Imitating makie?

The use of sprinkled denticles embedded in lacquer is a form of decoration found predominantly on Japanese objects produced for export. Ray skin used on objects made for the Japanese domestic market tends to be applied as skins. This may in part be explained by the relatively large scale of the objects being produced for export – removing the denticles from the skins would have allowed large continuous surfaces to be decorated with an even pattern and without disruptive seams.

It is also clear from a text written by a Kyoto dealer of same (ray skin) in 1777, describing the characteristics and value of different types of ray skin, that many of the markers of quality are related to the natural arrangement and distribution of the denticles within the skin.³³

Christine Guth argues that this technique may have been developed to mimic more cheaply the aesthetic of the traditional Japanese lacquer technique called *nashiji* - in which gold and silver flakes were sprinkled onto the wet lacquer surface. It is possible that the denticles of poorer quality skins and waste from skins used for the decoration of weaponry may have been used. Each samurai sword required the skin of one ray to create the distinctive ridged line of larger

denticles running vertically down the centre of the hilt, so only a relatively small part of the skin would have been used in their production.³⁴

Three examples of lacquer coffers made for export demonstrate how Japanese craftsmen experimented with different sprinkled materials: silver flakes (figure 18); mother-of-pearl flakes (figure 19), and ray skin denticles (figure 6). The overall effect in each case is quite similar. Guth explains that European consumers might have been more willing to accept a variant style since their expectations were not based on an extended familiarity with lacquer or ray skin.

Imitating embossed leather?

A second way in which shagreen could be interpreted as an imitation of another material is revealed through an examination of the etymology of the word. Confusingly, in addition to shark and ray skin, there is a third material referred to as shagreen: a type of untanned horse or donkey leather from Persia into which seeds were pressed to produce an embossed texture. This was often dyed green and used to make footwear (figure 20).

Although it is often suggested that the term shagreen derived from the French word 'chagrin', drawing a link between its definition of irritation and the fish skin's abrasive quality, it seems more likely that it comes from the Persian 'saghari' or Turkish 'sagri' - words for the embossed donkey or ass leather - and was only later applied to shark and ray skin.³⁵ Persian leather goods were circulating in Europe well before trade with East Asia was established, and we know from the diaries of European travelers that they were familiar with the embossed leather.³⁶

It is unclear whether the same term was deliberately or inadvertently applied to the two types of fish skin. It could be that the adoption of the term, and even the practice of dyeing it green was a deliberate way to associate the fish skin with an already popular, similarly textured material. However, the green color could also have been in imitation of the Chinese treatment of ray skin on bows.

Faux shagreen

A faux shagreen-covered tea caddy bearing the stamp of Jennens and Bettridge (figure 21), the preeminent British manufacturer of papier mâché wares (operational from around 1815 to 1864), suggests that shagreen was being imitated as early as the nineteenth century. Sometimes made from printed and varnished papers, early plastics,³⁷



Figure 22 A section of ray skin ground, polished and dyed.



Figure 23 Additional color variation was added using acrylics and watercolour.



Figure 24 A silicon putty mould was used to cast individual resin scales.



Figure 25 Before treatment, showing missing denticles.



Figure 26 After treatment.



Figure 27 Before treatment.



vinyl or embossed mammal leather, many mass-produced early twentieth-century items also imitate shagreen. Today's faux shagreen tends to be cast in resin and, despite lacking the translucency and subtle variation of the real skin, is quite convincing. It is sometimes even used on high end furniture.

Conservation case study – creating fills for ray skin
One problem encountered in the conservation of shagreen objects is the loss of denticles as the material becomes more brittle with age. There are several reasons why one might not wish to use ray skin to patch these areas. Firstly, there are ethical concerns. The trade in exotic skins is governed by CITES (the Convention on International Trade in Endangered Species of Wild Flora and Fauna). Shagreen currently falls into Appendix 2, which covers species not necessarily threatened with extinction. It is therefore legal and relatively easy to source shagreen. There is also an assumption that because rays are farmed as a food source in South East Asia that the skins are a sustainable by-product.³⁸ However, farming does not always relieve pressure on wild populations. A recent report from the International Union for Conservation of Nature suggests that a quarter of sharks and rays are threatened with extinction.³⁹

Another reason to find an alternative to actual ray skin for fills is that it can be very difficult to match the skins, both in terms of denticle size, color (including its propensity to absorb dyes) and translucency, particularly as shagreen can generally only be sourced through the internet, so the skins cannot be examined in person before buying. Thirdly, it may not make economic sense to purchase a whole ray skin to replace a small number of missing scales.

Three different techniques were used to create fills for a shagreen handled walking cane.

For the larger area a piece of ray skin was used. This was ground down with an orbital sander, and sanded with increasingly fine grits of sandpaper until a smooth finish was achieved. The skin was then colored using Selladerm dyes, and some variation added using acrylics (figures 22 and 23).

In areas where just one or two denticles were missing, a mould was created from silicone putty to replicate individual denticles in synthetic resin (figure 24). Hxtal NYL-1 epoxy coloured with Orasol dyes was used to cast denticles, adding colloidal silica to modify the opacity. This was extremely time consuming, so in other areas a technique was adapted from one used in leather conservation. Layers of

Figure 28 After treatment.

Japanese tissue paper coloured with Selladern dyes were built up with polyvinyl acetate. By tearing the tissue paper a very soft and unobtrusive edge can be created. The tissue paper also creates a slightly mottled, translucent effect which blends better than other fill materials. Watercolors and acrylic paints were used to replicate the pattern of surrounding scales. The fill materials were finally sealed with a coat of clear Paraloid B72, and the sheen modified slightly with microcrystalline wax. It should be noted that in this instance the ray skin had been ground and polished, and the area between the scales filled. On objects covered with textured ray skin, casting fills from a mould taken from the skin may be a more appropriate method.

Conclusion

Ray skin shagreen has a long history in the decoration of furniture. It may initially have been used by Japanese craftsmen as a cheaper alternative to sprinkled gold and silver, and later associated linguistically with an already popular, texturally similar material. However, ray skin was certainly also appreciated in its own right, earning notable periods of popularity in the eighteenth century and Art Deco period.

The material has continued to inspire designers from Wedgwood to Alexander McQueen, and many synthetic versions are now available. However, as discussed in the conservation case study, it is the very qualities that make it so appealing – Its natural variation in scale size and translucency, the pleasingly variegated color achieved through its uneven absorption of dye - the fact that no two pieces of skin are alike – that make it such a difficult material to convincingly imitate.

Cathy Silverman, conservator
Andrew W. Mellon Foundation Conservation
Fellow, Department of Objects Conservation
catherine.silverman@metmuseum.org
catsilverman@hotmail.com

Notes

¹ The research of Jean Perfettini, Mathieu Willemsen and Christine Guth is gratefully acknowledged. Willemsen describes the use of shagreen in Western Europe in seventeenth and eighteenth centuries. Perfettini pays particular attention to French makers from the eighteenth to twentieth centuries. Guth's excellent study explores the Portuguese trade in shagreen lacquerware from Japan as well as the use of ray skin

in Europe in the seventeenth and eighteenth centuries. J. Perfettini, *Le Galuchat, Un matériau mystérieux; une technique oubliée*, Editions Vial, 2016; M. Willemsen, 'Shagreen in Western Europe; its use and manufacture in the seventeenth and eighteenth centuries', *Apollo Magazine*, 1925, pp.35-38; C. Guth, 'Towards a Global History of Shagreen', in: *The Global Lives of Things – The Material Culture of Connections in the Early Modern World*, edited by A. Gerritsen and G. Riello, 2015, pp. 62-80.

² An extensive survey of the world-wide use of fish skin as an abrasive is given by L. Brühl, 'Fischhaut also Schleif und Gattungsmittel' in: *Die Rohstoffe des Tierreichs*, edited by W. Arndtand and E. Pax, 1929-1933, pp. 316-323.

³ H.L Joly and I. Hogitaro, *The Sword Book and The Book of Same*, privately printed, 1913. This is a translation of *Ko Hi Sei Gi* by Inaba Tsurio, published in Japan in 1785.

⁴ The most thorough effort to identify the species used by European craftsmen was conducted by W.H. Van Seters in his study of microscope coverings. In consultation with natural historians, Van Seters concluded that the skins were obtained from *Dasyatis* sp, with *Dasyatis sephen* probably being the most important species. It seems likely that other types of object produced in England at this time would have used the same material. W.H. Van Seters, "'Shagreen" on old microscopes', *Journal of Microscopy*, LXXI, 4, June 1951.

⁵ Joly and Hogitaro, 1913.

⁶ For a more comprehensive survey of namban lacquerware, see O. Impey and C. Jörg, *Japanese Export Lacquer 1580-1850*, Hotei Publishing, 2005 and O. Impey and T. Canepa, *After the Barbarians, an Exceptional Group of Namban Works of Art*, Jorge Welsh Books, 2003

⁷ Guth, p. 66.

⁸ Impey and Jörg, p. 79.

⁹ C. Hagelskamp and P. van Duin, 'A Seventeenth-Century Dutch Cabinet Mounted with Export Lacquer', *The Rijksmuseum Bulletin*, 2012, pp. 317-341.

¹⁰ Impey and Jörg, p. 78.

¹¹ After the so-called Taiwan Incident of 1628, the Dutch Factory at Hirado was forbidden to trade for five years. Impey and Jörg, p. 83.

¹² J. van der Veen, 'East Indies shops in Amsterdam', in: *Asia in Amsterdam. The Culture of Luxury in the Golden Age*, edited by K.H. Corrigan, J. van Campen, F. Diercks and J.C. Blyberg, 2016, p. 156.

¹³ Hagelskamp and Van Duin, p. 330.

¹⁴ Impey and Jörg, p. 156.

¹⁵ Impey and Jörg, p. 140.
¹⁶ Van der Veen, p. 156.
¹⁷ Occasional pieces of European-made weaponry pre-dating this period incorporate ray skin. The so-called 'Sabre of Charlemagne' at Kunsthistorisches Museum in Vienna, for example, dates from the first half of the tenth century, and is thought to have been made in Hungary. Presumably the ray skin used on the handle of this sword and other early objects arrived in Europe by The Silk Road.
¹⁸ Guth, p. 75.
¹⁹ Guth, p. 75.
²⁰ Willemsen, p. 35.
²¹ Van Seters, p. 438.
²² India Office Records and Private Papers held at The British Library.
²³ The Diary and consultations of the council in China (1724-25 and 1726-27) from the India Office Records and Private Papers held at The British Library.
²⁴ The London Trademan explains that the shagreen casemaker 'is employed in making Shagreen Cases for Watches, Tweezers, &c. and Chests for Plate', listing educational requirements and salary expectations for masters and journeymen. R. Campbell (Esq.), The London Tradesman, 1757, p. 255.
²⁵ The National Archives at Kew contains seventeen wills and twelve insurance documents of shagreen case makers (one overlap) and two 'Bill and Answer' court documents referencing two further shagreen casemakers. These date from 1740 to 1830, although the vast majority are from the second half of the eighteenth century. Additionally, The London Magazine, Or, Gentleman's Monthly Intelligencer, XXXVI, January 1767, p. 148, lists the bankruptcy of shagreen casemaker Elizabeth Heath. Therefore, at least thirty-one – and probably many more - shagreen casemakers were working in England (primarily in London) in this period.
²⁶ Willemsen, p. 38.
²⁷ L. Synge, Mallett's: Great English Furniture, 1991, p. 25.
²⁸ Perfettini, p. 16.
²⁹ Willemsen, p. 37.
³⁰ Perfettini, p. 28.
³¹ The Asian Art Museum in San Francisco has several examples of nineteenth- and early twentieth-century Korean furniture decorated with ray skin.
³² Perfettini, p. 30.
³³ Joly and Hogitaro, 1913.

³⁴ Guth, p. 74.
³⁵ Van Seters, p. 433.
³⁶ Guth, p. 65.
³⁷ Examples of several items made in the 1930s from cellulose nitrate and cellulose acetate in imitation of ray skin can be seen in the collection of The Museum of Design in Plastics: www.modip.ac.uk.
³⁸ <https://www.theguardian.com/environment/2014/mar/23/is-it-ok-to-buy-bags-made-from-stingray-skin>.
³⁹ <http://voices.nationalgeographic.com/2014/01/24/shark-ray-biodiversity-oceans-conservation-endangered>.

Supplier list

- Micro-Mesh
 Scientific Instrument Services, Inc.
 1027 Old York Road
 Ringoes
 NJ 08551-1054
 USA
- Selladerm dyes
 The Leather Conservation Company
 University Campus
 Boughton Green Road
 Northampton
 NN2 2AN
 United Kingdom
- Orasol dyes, Paraloid B72, Hxtal
 NYL-1, polyvinyl acetate resin, Renaissance
 microcrystalline wax
 Museum Services Corporation
 385 Bridgepoint Way
 South St. Paul
 Minnesota 55075-2466
 USA