THE TECHNOLOGY AND CONSERVATION TREATMENT OF A NINETEENTH CENTURY ENGLISH "PAPIER-MACHE" CHAIR

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During a hundred year period between the mid-eighteenth and nineteenth centuries, a major industry flourished in England which had its origins in both architectural ornamentation and japanned tinware. The development of japanned papier-mâché led to an unparalleled trade that resulted in the manufacture of many articles of furniture. A chair typifying these developments was analyzed and treated by the Conservation Analytical Laboratory, Smithsonian Institution. Since so little has been printed on the treatment of japanned papier-mâché, this report was prepared to review both the technology leading to the production of the chair and recommendations for the repair of such artifacts.[1] An understanding of the chair's technology aided in the formulation of its final treatment.

INTRODUCTION

A chair belonging to the Cooper-Hewitt Museum, Smithsonian Institution, was sent to the Conservation Analytical Laboratory for treatment (Fig., l). It is a spoon-backed chair with scalloped edges and is dated c. 1844.[2] It has been described as black lacquered or japanned papier-mâché with mother-of-pearl inlay.[3] These terms, which are imprecise, will be clarified in the body of this report. The paperboard upper portion is supported by wooden legs and seat rails. The black coating, which appears to be directly on the paper and wood with no ground, is decorated on the front with gilding and mother-of-pearl, and on the back with bronze paint. These areas have a tinted glaze, which is used for shading on the gilding and bronze paint, and provides a base for linear detailing on the pearl. Very fine black lines indicate flower petals, bird feathers, leaf veins, etc. Although the chair was in fairly good condition, there was a deformation and large loss in the uppermost scallop. Some of the pearl was missing, areas of gilding had been severely abraded, and the varnish had discolored. The black coating on the paper substrate had a web-like craquelure pattern, while the finish on the wooden base showed cracks parallel to the grain of the wood.

In conjunction with the treatment, the following study was undertaken to identify major developments in the technology of both papier-mâché and japanning, pertinent to the manufacture of this chair.

TECHNOLOGY

The designation of papier-mâché for the chair is somewhat misleading. "Papier-mâché" is a term which has been applied to innumerable three-dimensional objects having a paper core. The description is confusing, since not only is it spelled many ways (the French papier-mâché, Anglicized to papier-mâché, papier-mâché, etc), but it also is used for two very different forms of paper. While the term literally means masticated paper, it is often used to describe objects made of adhered paper sheets.[4] This ambiguity of usage can cause misrepresentations in identification and dating of an object, reflects little understanding of the technology of molded papers, and could be detrimental to the conservation treatment and subsequent care of the piece. The problem is exacerbated by various synonyms and diverse formulae. An

Japanned "Papier-Mache" Chair, English, c. 1844.
Property of the Cooper-Hewitt Museum, Smithsonian Institution.
Before Treatment. An upholstered slip seat required no treatment.

historical overview serves to clarify terms sometimes used interchangeably, while tracing the technological development of papier-mâché from a composite of simple components created in the ancient Orient to an extremely hard and water-resistant material, workable enough to be turned on a lathe and strong enough to build an entire vi1lage.[5] For the purposes of the present report, the term papier-mâché will be used genericai1y.

The origin of papier-mâché is at least as ancient as the invention of paper itself. Paper was developed in China during the Han Dynasty, c. 202 B.C.- 220 A.D.,[6] and it is consequently not surprising that the earliest use of paper to make three-dimensional objects occurred there. Artifacts such as helmets and pot lids, which have been attributed to this dynasty, were made of what has been described as papier-mache.[7] Pasteboard also had its origins in the ancient East and early examples exist from Tibet. One of the oldest surviving artifacts made of this lightweight but strong material is a falcon's coffin from Persia, [8] and it is interesting to note that even today papier-mâché is recommended for coffins, albeit for humans, as outlined in a recent American patent.[9]

The first commercial pasteboard was produced in Europe around lS80, and European recipes for making papier-mâché date to the mid-1600's.[10] However, innovations in their respective technologies didn't undergo much development in the West until the early 18th century. In England the commercial application of papier-mâché seems to have been preceded by a similar material used for ornamental attachments on architecture and furniture. During the early part of the century, a revolution in architectural ornamentation eliminated the necessity of carving plaster or wood in situ through development of an inexpensive material that could be made in a mold and applied when convenient. While the initial composition consisted of inorganic and resinous solids mixed with binder and referred to as "compo",[11] a later version, called fibrous slab, combined plaster with vegetable matter such as hay, straw, nettles and bark. Eventually the plaster was replaced completely by fibers and other organic material including leaves of pineapple, aloe, and cacao plants; peat and bog asphodel; horse dung; and fibers of hemp, flax, and cane. Such material was recommended, and apparently used, for houses, bridges, and railroad wheels, among other things.[12] Slab appears to have been replaced by papier-mâché as an architectural material in the mid-18th century by one of its chief manufacturers, a Mr. Wilton. He supposedly employed two French women who chewed paper; hence the French origin of the term.[13]

This pre-machine method of macerating pulp is said to have developed in France in 1740 and was promoted in England by paperhangers interested in extending their expertise to ceiling decoration. It was also referred to as paper stucco and pasteboard stuccoe.[14] Wilton's recipe was applied not only to architecture but also to mirror frames and chair "knees". As a ceiling ornament, paper stucco fell into disuse with the advent of stamped tinware.

At about the same time, during the mid-18th century, a japanner of tinware, John Baskerville, experimented with paper panels, a derivative of pasteboard, as a base for japan ware. [15] Japan ware was an English imitation of Oriental lacquer. True lacquer comes from the resin of a tree of the sumac family indigenous to the Orient, and in the East this resin dries quickly upon exposure to sunlight. It was applied to a base of wood or leather, or occasionally paper. Since the lacquer did not set properly in the English climate, its effect had to be duplicated by various varnishes in a process referred to as "japanning".[16] An example was "tar varnish" or "Jewish pitch", which was a mixture of asphaltum, amber, linseed oil

and rosin in turpentine. This might be covered, for added protection or higher gloss, by an alcohol based "spirit varnish", or a copal resin in linseed oil.[17] Because these materials dried slowly, the japanners hastened the process with frequent "stovings". Since the exposure to heat would crack and warp wood, other bases were sought. Tinned iron was successful, but paper provided a cheaper and lighter alternative. While recipes for using paper pulp are extant, the variations in density and homogeneity of this substrate provided a poor surface for varnishing.[18]

In the late 18th century, Baskerville's apprentice, Henry Clay, succeeded in his predecessor's endeavor to develop an appropriate paper support by patenting a method of making hand-pressed or hand-smoothed paper panels which were heat-resistant.[19] Ten sheets of unsized rag paper were pasted on both sides with a mixture of cooked glue and flour. They were then pressed into a metal mold and smoothed to remove air bubbles. The edges were trimmed and the sheets were drenched with linseed oil for waterproofing and the ensemble was dried at 100°F.[20] The result was a rigid material which could be worked like wood. The use of paper panels came to be known as the "best" papier-mâché as opposed to the "common" papier-mâché made from pulp.

In the early 19th century, there was a shift from the time-consuming process of hand-pressing individual sheets into a mold to the manufacture of paper maker's panels or blanks which could be sold to furniture makers and were well suited for trays. [21] However, hand-smoothed panels continued to be preferred by japanners since they were smoother and more solid than the papermaker's panels. The firm of Jennens and Bettridge, which purchased Clay's old shop in 1816, made thicker panels by layering 120 sheets together at a time, enabling production of larger and stronger items, such as the Smithsonian chair.[22] However, these could take days to dry, or required even more stovings. In 1847 Theodore Hyla Jennens was issued a patent that marked the next major development in the papier-mâché industry. [23] He developed a technique whereby dry panels could be softened with steam to enable manipulation into a heated metal mold. A counter mold was then screwed into position and the steam-molded panels were dried by heat. The result was a hard, pre-shaped product of even thickness. By reducing the number of steps and amount of time required to mold furniture, Jennens revolutionized the process and opened the door to mass-production.

The firm of Jennens and Bettridge also improved methods of japanning and decoration that are pertinent to the Smithsonian chair. In 1825 they received a patent for improvements in the process of mother-of-pearl decoration. Their process by-passed the need for skilled craftsmen to inlay decoration. The pearl pieces were ground and polished by workers to a thickness of 0.2-0.4 mm. These thin sheets of material were then stenciled with asphaltum and dipped in hydrochloric acid. The acid dissolved all the shell not protected by the asphaltum, leaving pearl pieces corresponding in size and shape to the stencil pattern. The pieces were adhered to the prepared japanned surface immediately after the object was varnished, using the tacky varnish as the adhesive. The areas of decoration were then repeatedly coated with varnish and polished until the surface was completely smooth, giving the appearance of intricate inlay by craftsmen of consummate skill.[24] What appears to most 20th century eyes to be excellent craftsmanship is in reality a labor saving method of decorating industrially mass-produced objects. Gilding and painting were often applied after the pearl. "Bright" gold was applied principally by water gilding an area larger than the intended figure, and the pattern was then stopped out by asphaltum painted on with very fine brushes. The excess gold was washed away with cotton mops, and the asphaltum was removed by

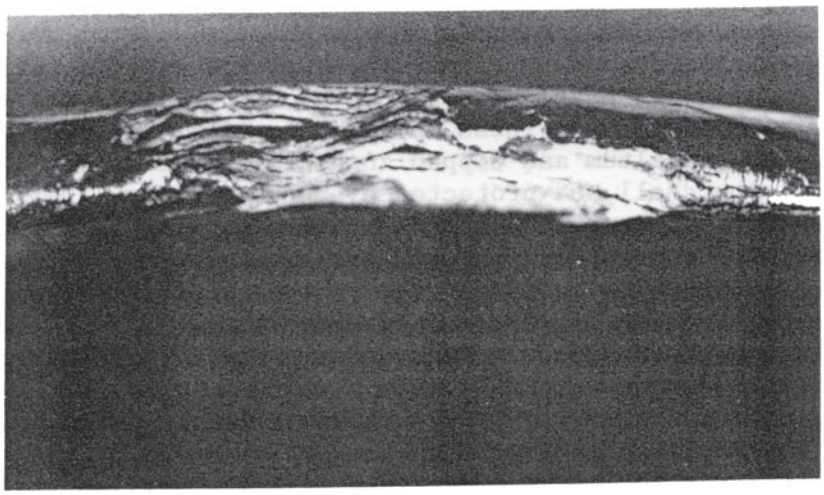


Fig. 2 Uppermost scallop.
Damaged hand-pressed paper core, showing layered structure, red, gesso-like repair and black overpaint.
Before Treatment.

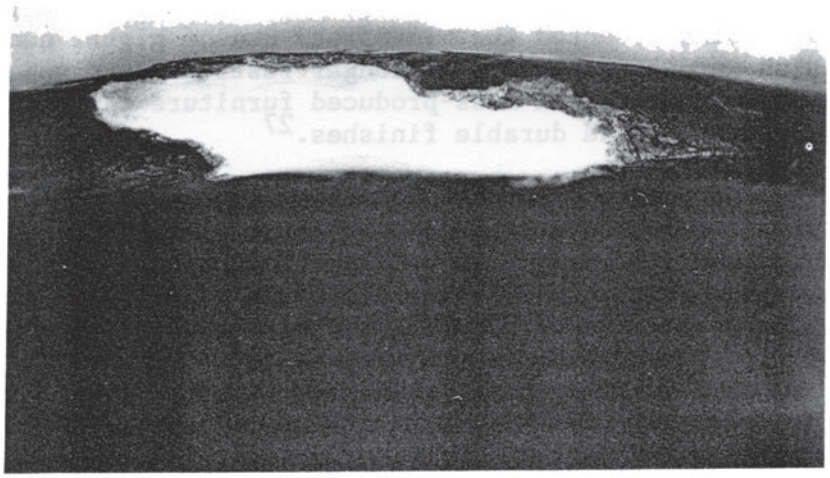


Fig. 3. Loss filled with insert of layered Oriental tissue adhered with wheat starch paste.
During Treatment.

turpentine, exposing the desired pattern.[25] The final step was "sprigging" or delineating details such as feathers or flower petals.[26]

By the mid-19th century, the technology of varnishes was also undergoing dramatic changes that fostered increased and more standardized "assembly line" production of japanned furniture. Alcohol based spirit varnishes were gradually being augmented with or replaced by fixed oil varnishes that were easier to use and far more durable. The industrial processing of resins promoted the widespread use of higher quality coatings, which were consequently no longer restricted to expensive furniture. As a result, even mass-produced furniture could be finished with highly decorative and durable finishes.[27]

Ironically, Jennens and Bettridge's achievements in the mid-19th century were followed within several years by a decline in the demand for japanned furniture in England. As decoration became more bizarre and garish, objects evolved into more elaborate and impractical forms, moving from the simple trays and snuff boxes of early days to the piano cases and bedroom set shown in the Great Exhibition of 1851. Such over-popularization eventually destroyed the novelty of the material, and, coupled with a change in clothing fashions which necessitated heavier furniture, led to the demise of the firm in 1864.[28]

TREATMENT

Examination of the Smithsonian chair by the staff of the Conservation Analytical Laboratory (CAL) indicated that it typifies the English tradition. CAL scientists undertook infrared spectrographic analysis of the coating materials, and preliminary results suggest that the black layer may be an ester resin such as pine pitch, and the varnish may consist of jalap and scammony, findings which are consistent with the period. The Cooper-Hewitt Museum requested treatment of the chair by the Furniture Conservation Laboratory, and since it is a composite object, it became the focus of a joint project with the Paper Laboratory. The treatment, as outlined below, involved primarily the repair and inpainting of the damaged scallop, the replacement of the shell decoration, and the consolidation of the surface varnish.

The loss in the paper support in the uppermost scallop was approximately two inches long and one inch deep, and revealed the layered structure of the paper core (Fig. 2). The area surrounding the loss had a rigid, red crust which was identified by IR spectroscopy as gypsum mixed with an ester resin. This appeared to be a fill by a previous restorer, and was overpainted.[29] The contour of the rigid red material did not correspond to that of the original scallop, and it is unclear whether this was a design mistake by a restorer or whether it had been deformed by a subsequent blow or impact that might have dislodged the rest of the repair, leaving the present loss. There is a concentric ring of cracks radiating from what would have been the point of impact. Part of the loss in the paper support had been filled with mashed paper or pulp. Although this was quite hard, it was easily removed with toluene. The original paper core was analyzed by fiber microscopy and found to be a stable combination of long-fibered rag with distinctive blue threads running throughout.[30] The adhesive inter layer was identified as starch by testing with potassium iodide iodine solution, and it tested negative to protein, i.e. glue, with ninhydrin solution. Ultraviolet and infrared illumination revealed extensive surface differences in the area.

Published recommendations for the repair of papier-mâché range from building up with sheets of cotton paper stabilized with a gelatin solution, to applying pins as a fence on which to hold a mixture of

whiting and plaster of Paris or wood putty, to filling with tinted beeswax.[31] Due to the size of the loss, its position in a vulnerable spot, and the nature of the surrounding paper, it was decided to use a system of paper sheets to fill it.[32] By inserting the sheets into the partially delaminated panel core, a strong but completely compatible and readily reversible fill could be made. Further, it was decided to make the insert by duplicating as much as possible the original process of hand-smoothing sheets into a mold. This would assure the appropriate thickness, edge shape, compression and surface characteristics for finishing. A mold was made of the most similar edge, and sheets of high quality oriental tissue were coated with dilute reagent grade wheat starch paste, pressed into it and baked at about 100°F until dry. The baked molded paper was then carved to fill different levels of the loss, adhered in the interstices with more paste, and dried in place under polyester web, thin blotters and soft weights. This produced a strong repair which was consistent with the nature of the original core but which could be easily distinguished and removed if necessary at a later date (Fig. 3).

The curator requested that the original form of the scallop be simulated by covering over the damaged area. To insure good adhesion, the overpaint was removed with reagent grade alcohol, exposing the porous red gypsum material. Layered paper was then adhered to this with starch paste, filling in the missing contour. The contour was left slightly shallow of the original surface to allow for an isolating layer of 5% Acryloid B-67 in toluene, followed by an application of acrylic gesso to match the original surface contour and provide a base for inpainting. Inpainting was done with acrylic paints in toluene followed by a localized seal coat of B-67 in toluene.

The front side of the chair was decorated with mother-of-pearl, and approximately 40 pieces of inlay were missing (Fig. 4). The term “inlay” is inaccurate, because, although the mother-of-pearl appears to be set into the surface, it is actually affixed to it. In addition the material used on this chair is probably not mother-of-pearl but decorative shell similar to abalone. However, for the purposes of this discussion the word “pearl” will be used generically. The curator expressed a strong preference for replacing the missing decoration, since the chair was part of a collection interpreted for its design significance. Of the pearl pieces missing from the chair, almost all were from the knees of the front legs and the front seat rail. The areas of loss provided evidence that the procedures patented by Jennens and Bettridge in 1825 had indeed been used, since the grinding patterns from the back of the original pearl were imprinted in a varnish adhesive over the black coating. The recesses where losses had occurred were cleaned and smoothed with dental tools where the substrate itself had been damaged. Rubbings were taken to indicate the shape of the more complex losses. These rubbings were glued to prepared abalone shell with hot hide glue. The outline indicated by the rubbing was cut out using a jeweler’s saw. Shell of the same thinness as the original proved to be impossible to work by hand, so thicker pieces ($\geq$0.5 mm) were used. The paper pattern was removed by soaking the pieces in warm water, and final trimming was executed with fine rifflers and needle files.

The first attempt to glue the inlays into the recesses with hot hide glue, a traditional adhesive for woodworkers, proved to be unsuccessful. Since the new inlays projected from the surface by approximately 0.2 mm they had to be trimmed flush with the surrounding material. The heat generated by filing the inlays with rifflers was sufficient to cause the adhesive, which is extremely thermoplastic, to fail. This prompted a switch to Jade 403 PVA emulsion adhesive. This adhesive was entirely satisfactory in holding the inlay stable through the trimming process (Fig. 5).

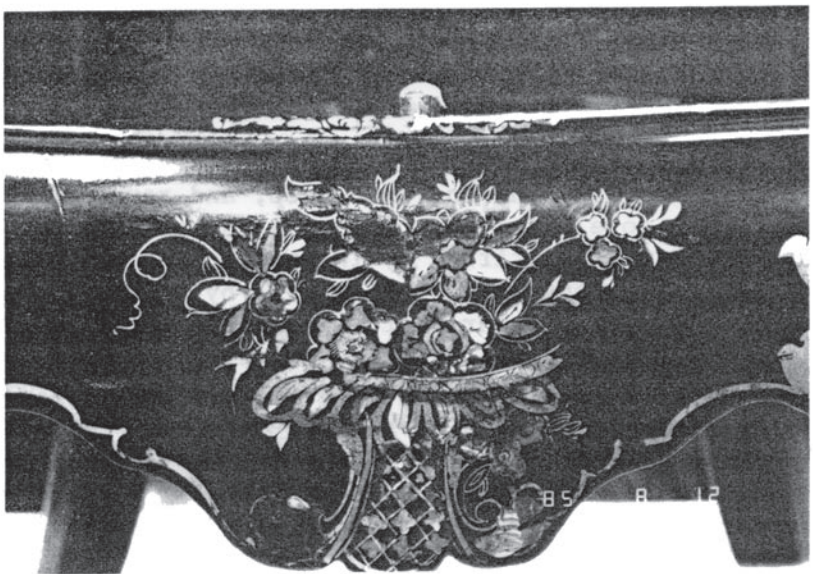


Fig. 4. Front seat rail.
Detail of missing mother-of-pearl. Before Treatment.

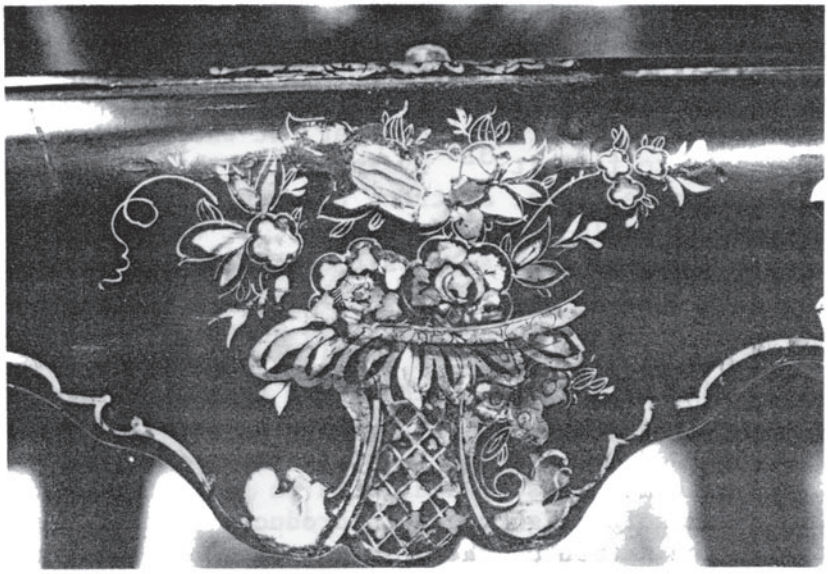


Fig. 5. Area after cleaning and mother-of-pearl inserts.
During Treatment. Before inpainting.

Following the completion of the inlays and the replacement of the paper losses on the back, the chair was sprayed with a coat of Acryloid B-67 5% in toluene. There were two reasons for the application of this surface coating. First was the need for consolidation of the entire original surface, which had an overall craquelure with minor cleavage. Although the cleavage accompanying the cracking was negligible, the surface varnish was extremely friable. This varnish had discolored, obscuring much of the decoration underneath it. However, since the varnish itself contained much decorative detail, the curator chose to preserve it. This required the use of a surface consolidant, and previous treatments of japanned papier-mâché objects with an Acryloid as a consolidant have been successful.[33] The second reason for application of this coating was to provide an isolating layer to form a base for application of gold leaf.

Following the isolating layer, gold leaf was applied to the areas of gilding loss. Hastings Synthetic Varnish size was used with Hastings 23K Gold Leaf. Glaze layers of B-67 5% in petroleum benzine tinted with earth colors yielded a visual compatibility between the new gilding and the old. This medium was chosen because of concern that a B-67/toluene solution might attack and swell the varnish size under the new gold leaf. The entire surface was then given a protective coat of B-67 5% in benzine.

CONCLUSION

Knowledge of the historical and technological context of the chair served as a stimulus to devising a new approach to the repair of papier-mâché. It was possible to modify the original method of manufacture to create a successful blending of traditional techniques and current conservation practices.

It is interesting to note that while this project focused on the past developments of papier-mâché, there are dozens of contemporary patents which are logical extensions of preceding paper fabrication technologies, as exemplified in this chair.[34] The technology of the past is directly linked to the present, and can provide some understanding for the future conservation of contemporary three-dimensional paper objects.[35]

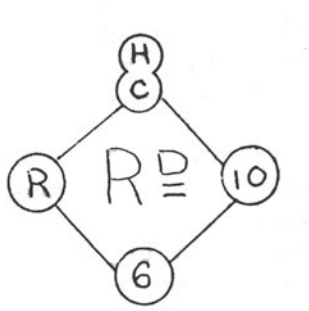
FOOTNOTES

1. References on the treatment of japanned papier-mâché include: Walter Angst, "Papier Mâché Table by Jennens and Bettridge;" Shirley Spaulding DeVoe, English Papier-Mâché of the Georgian and Victorian Periods, pp. 183-5; and Gillian Moir, "The Care of Papier Mâché," p. 58. The latter two references have brief suggestions for care and repair of papier-mâché which do not necessarily conform with current conservation practices.

References on the treatment of papier-mâché in general include: YU. A. Ruzavin, "Preservation of papier-mâché of architectural monuments in Central Asia," pp. 55-9; and Katherine Singley, "Conservation of a Painted Papier Mâché Anatomical Model," p. 149

References on the treatment of japan ware: John H. Hill, "The History and Technique of Japanning and Restoration of the PIMM Highboy," pp. 59-84.

2. The chair is stamped with the initials "TR" on the inside seat, and has a registration mark on the back of the seat illustrated in the drawing below. The mark has not yet been identified, but the RD may stand for registered; the encircled R may stand for the month of August, and the letters at the top are in



the position reserved for the year, i.e. C may stand for 1844. H may stand for 1842, but is in the place where Roman numerals usually appear, indicating a class, such as II for wood. The 6 may indicate a parcel number, which could be traced through the British Public Record, Chancellary Lane, London, WC2. Registration marks were issued from 1842-1883 (R. and T. Kovel, Know Your Antiques, New York, Crown Publishers, 1967). It is worth speculating whether the HC might not stand for Henry Clay.

A similar chair has been attributed to Jennens and Bettridge and is dated August 10, 1844 (Sarah Seymour, " Papier Mâché," p. 53). The inside of Seymour's chair back has an illustration of a bird bath, while the Smithsonian's has a fountain. Two other spoon-back chairs, each with a different flower decoration, are described by Gillian Walkling, " Papier Mâché," pp. 223, and Devoe, English Papier Mâché, p. 179. The Catalogue for the Crystal Palace Exhibition London 1851, p. 190, illustrates yet another similar chair, with what appears to be a wreath on the inside back, which it includes in "papier-mâché works by Mr. H. Clay." Henry Clay died in 1812, although Clay and Company continued until 1860 and exhibited under Henry Clay's name (Jane Toller, Papier Mâché Great Britain and America, p. 29).

3. The terms black lacquer, mother-of pearl inlay, and papier-mâché are generally used to describe this type of chair, as in the previous references.

4. Variations in spellings can be verified by surveying the titles on the numerous references, some of which are included in our bibliography. An attempt has been made to retain original spellings. Papier-mâché can be translated as "chewed paper" using the past participle of the French verb "mâcher." However, the word is defined as "papier mouille," or molded paper, in French dictionaries. It is generally believed that the word was coined by the English and not the French, as the Oxford Dictionary states that the term "is not of French origin" (Oxford University Press, 1971). American Dictionaries such as the American Heritage, generally define the term as "a material made from paper pulp or shreds of paper mixed with glue or paste..." (William Morris, ed. Boston, Houghton Mifflin Company, 1976). The definition seems to include sheets of papers only in old English trade dictionaries, such as Peter L. Simmonds' Dictionary of Trade Products, which defines "papier mâché" as "made in 2 ways; one consists of pasting together on a mould different thicknesses of paper; the other is by pressing into moulds the paper reduced to a pulp. The former produces the best quality, the latter inferior kinds. It is then sized, covered with lamp-black, varnish, and place in a heated oven" (London, 1863).

5. The Illustrated London News, August 6, 1853, ran a story with two illustrations about a papier-mâché village made by Mr. (Charles) Bielefeld for a Mr. Seymour who planned to take up residence in Australia. The portable village was "composed of ten houses, including a villa, with nine rooms, 12 feet high; a store-house, 80 feet long, with four dwelling-rooms (sitting-room, two bed-rooms and kitchen, with cooking apparatus); and houses of different sizes, of from two to six rooms…The material...is of a patent waterproof, papier-mâché... It consists of paper and rags, beautifully ground and reduced to pulp, which...become as hard as board." The village was set up, and survived a two-foot flood. A small house could be assemble in less than 4 hours. Devoe, English Papier-Mâché, p. 32.

6. "The oldest paper extant today is probably the specimens discovered in 1957 in Pachhiao... in a tomb dated no later than the period of Wu Ti (-140 to -87)[sic] of the former Han Dynasty" (Tsien Tsuen-Hsuin, Science and Civilization in China, p. 38). Tsien's chapter on "Paper and Printing" illustrates early samples, pp. 38-42. He is referring to the so-called "Baqiao paper," of hemp fibers, which served as wadding for an ancient mirror back. The dating and designation of "paper" are the source of great controversy based on lack of inscribed dates and of agreement as to what constitutes paper-making. At best the samples dated B.C. represent a rudimentary or "embryonic" form of paper, still appropriate as a precursor of papier-mâché. Other scholars such as Wang Juhua and Li Yuhua in "New Findings Confirm Paper's Origin," pp. 40-41 feel that the earliest true paper is the "Hantanpu paper" from Wuwei, Gansu Province of the Eastern Han Dynasty (150-200 A.D.), which has a coating of calcium, aluminum, and silica.

7. For early use of paper-mâché, see Edward F. Strange, Catalogue of Chinese Lacquers, p 2, and Devoe, English Papier-Mâché, p. 4. The pot lid shards are lacquered, which probably aided in waterproofing. They were attributed to the Han Dynasty by Ryuzo Torii, who found them in shell mounds of Manchuria's Kwantung Territory in Port Authur in 1910. However, there is a discrepancy of dates noted in the two references above. Strange places the pots to 206 B.C. - 25 A.D. while DeVoe quotes 206 AD.

8. Devoe, English Papier- Mâché, pp. 4-6.

9. Kollmann, H., et ale "Papier-mâché coffin and method of making it."

10. Few references could be found concerning European use of papier-mâché during the 16th and 17th centuries. The first commercial pasteboard, called "paste paper," was used in Germany, France and Italy in l580 (Dard Hunter, Papermaking: The History and Technology of an Ancient Art, p. 480). In the middle of the 17th century, Robert Boyle (1627-91) suggested soaking white paper in hot water and then mashing it up in his "Uses of Natural Things" (DeVoe, English Papier-Mâché, p. 12-15).

11. For an excellent discussion of "compo," see Jonathan Thornton, "'Compo': The History and Technology of 'Plastic' Compositions," pp. 113-126. From his discussion, it appears that recipes for "compo" did not usually include organic fibers. It is interesting that he discusses the firm of Jackson and Sons, who were also instrumental in the development of fibrous slab (George Dickinson, English Papier-Mâché, p. 5). Reputedly they also made papier-mâché after moving their factory to Rathbone Place, Oxford Street, London in 1780 (Jane Toller, Papier-Mâché in Great Britain and America, p. 35-6). This firm has also been given credit for carton pierre, a paper pulp panel used for coaches (Frederick Oughton, The Complete Manual of Wood Finishing, p. 174).

12. Dickinson, English Papier-Mâché, p. 4 and Toller, Papier-Mâché, pp. 15-16.

13. "The elder Mr. Wilton...was the person who employed people from France to work in the papier mâché manufactory which he established in Edward Street, Cavendish Square...his two women had chewed paper, buying cuttings from stationers and bookbinders and preparing the paper in that way...to keep the process secret in those days before it was mashed by machines," from a conversation between a Mr. Twigg and a Mrs. Joseph Nollekens (Devoe, English Papier-Mâché, pp. 3-4).

14. E.A. Entwisle, "Papier Mâché, Painted Paper and Print Rooms," pp. 72-3. He notes a recipe consisting of pulp mixed with whiting and glue.

15. Japanning on metal originated at the Pontypool Japan Works in Wales, founded in 1730 by Edward Allgood. In 1740, John Baskerville (1702-1775) opened a factory in Birmingham. Baskerville was also a printer of sorts who made his own paper and ink (Toller, Papier-Mâché, p. 25).

16. Devoe, English Papier-Mâché, pp. 87-8. There is considerable information on japanning. The first major work was John Stalker and George Parker, A Treatise of Japanning and Varnishing. Books currently in print describing methods duplicating japanning include Oughton, Complete Manual of Wood Finishing and Isabel O'Neill, The Art of the Painted Finish.

17. Other methods of japanning included using shellac loaded with dry pigment followed by French polishing; or applying several coats of asphaltum mixed with turpentine and linseed oil over a gesso ground, baking, then rubbing with pumice powder and oil-polishing (Moir, "Care of Papier Mâché," p. 57).

18. Various papier-mâché pulp recipes of the 18th century included J. Peele's 1732 recommendation to use slips of brown paper boiled in water and mashed with a stick while boiling; when pasty, the material would be beaten to a pulp in a mortar. Other recipes suggested mashed paper mixed with a binder of glue or gum arabic, with possible additions of flour, sawdust, and plaster. This pulp could be made into pasteboard by steam-kneading followed by rolling flat, or pressed into a hard-wood mold with a drainage hole in the center for excess water and paste. There was also a ceramic pulp which was a mixture of pulp, resin, glue, drying oil, and sugar of lead (DeVoe, English Papier-Mâché, p. 12-15,25 and 28). In the 1765 Complete Dictionary of Arts and Science a recipe promoted pulp mixed with glue,. chalk, and fine sand pressed into oiled boxwood, followed by baking and japanning (Toller, Papier-Mâché, p.17).

19. Clay, Henry, "Manufacture of Panels." Around 1765-70, another type of paper board was being utilized, possibly created from layers of posters and playbills which, after being layered one on top of the other on billboards, were removed by strippers and sold for wrapping, kindling, etc. (DeVoe, English Papier-Mâché, pp. 6-7). This was a precursor to cardboard, which wasn't actually patented until 1824 by John Dickinson (Hunter, Papermaking, p. 541). However, Clay's invention of 1772 was significant in that it resulted in a tough, heat-resistant material. The patent states that Clay had all rights to "Making, in Paper, High Varnished Pannels [sic] or Roofs for Coaches, and all Sorts of Wheel Carriages, and Sedan Chairs, Pannels [sic] for Rooms, Doors, and Cabbins [sic] of Ships, Cabinets, Bookcases, Screens, Chimney Pieces, Tables, Teatrays, and Waiters." This process involved "pasting several papers upon boards...[which are] put in a stove sufficiently hot to deprive them of their flexibility, and at the same time are rubbed over or dipped in oil or varnish, which so immediately drenches into them as to secure them from damps...they are capable of being sawed into different forms, and planed as wood then coated with colour and oils sufficient to make the surface even, and then japanned and high varnished."

Clay's exclusive rights lasted until 1802, at which time a succession of firms sprang up, including other Birmingham shops renowned for japanning papier-mâché such as Small and Son, Guest, Chopping and

Bill (1802-1816), Jennens and Bettridge (or Betteridge) (1816-1864), McCallum and Hodson (1846-1920). Alsager and Neville (1847-1887). and Woodward and Midgeley (1830-1857). In Wolverhampton, these included Benjamin and Charles Mander (1792-1840) and Henry Loveridge and Company (closed 1918). Devoe. English Papier-Mâché, pp. 35-80.

Clay's product was called paper-ware. but Jennens and Bettridge preferred to revive the old name. papier-mâché. Clay's paper, called "making" paper, came from two or three papermakers, and was supposedly greenish grey, thick, tough, from rags of old bags and sacks as well as cotton and linen. But "woolen rags were carefully excluded, for it was found that these perished in the stoving, causing dents and irregularities to appear in the body..." (Dickinson, English Papier-Mâché, p. 3 and 9).

20. Devoe, English Papier-Mâché, p.27.

21. Dickinson, English Papier-Mâché, p. 23-24.

22. Clay's shop was bought by Small and Sons in 1802. They sold it in 1816 to Jennens and Bettridge, who became japanners to George IV, William IV and Queen Victoria. Their paper came from Farnsworth. Their process of manufacture by 1854 has been described as follows: paper from linen rag, unsized to absorb paste, is pasted and pressed into the mold. Four or five sheets are applied and then allowed to dry in a stove or hot room. They are then rasped with a file to provide tooth for subsequent layers. When strong, the forms are cut from the mold and dipped in oil and then stoved again until hard and dry. It is then covered with fine lampblack mixed with tar varnish, then a second coat of tar varnish is applied and after drying, scraped with a plane to smooth the paper fibers. Between varnish coats it is rubbed with a pumice stone, until even. Polishing is done with pumice and rotten stone. After painting, it is dried in stoves and then polished again (Toller, Papier-Mâché, pp. 30-31).

23. Theodore Hyla Jennens, "Improved methods of manufacturing papier-mâché articles and a new and improved method of ornamenting papier-mâché articles applicable also for ornamenting purposes generally.

24. Dickinson. English Papier-Mâché, pp. 18-20, describes the patent and the industrial processes used for mother-of-pearl.

25. ibid., pp. 39-42.

26. DeVoe, English Papier-Mâché, pp. 115-117.

27. For a brief history of varnish manufacturing consult Decorative and Protective Finishes Vol. I., J.J. Matteillo, ed. Also see Thomas Brachert "Historische Klarlacke und Mobelpolituren." A more complete review of historic paint technology. particularly American, is contained in Decorative and Protective Finishes 1750-1850: Materials, Process, Craft, by Theodore Z. Penn.

28. Seymour. "Papier Mâché," p. 50. The shift in ladies clothing from the form-fitting Romantic Style to the extensive crinoline skirt of later periods necessitated sturdier furniture (Toller. Papier-Mâ-

ché, p. 23). However, the technology of 19th century papier-mâché had taken route abroad: English immigrants, some possibly from Jennens and Bettridge, brought the secrets of the "best" papier-mache techniques to the first of very few papier-mâché companies established in America, the Litchfield Manufacturing Company in Connecticut (Toller, Papier-Mâché, p. 99 and Devoe, English Papier-Mâché, pp, 15-22).

29. While there are descriptions of grounds of native red clay for japanning, the material around the repair on the chair did not appear elsewhere on the object. Removal of the material would have caused some damage and might have weakened the structure. Since it had remained stable, the decision was made to retain it.

30. Fibers examined under a Zeiss polarizing light stage microscope indicated that about 65% were morphologically characteristic of bast. Flax and cotton linters, dyed blue, made up another 15% each, and about 5% resembled ground soft wood fibers. An S-twist, multi-plied cotton thread was also present in the sample. This mix would suggest waste products such as old sacks and bags. However, it is interesting to note that the inventor of cardboard in 1824, John Dickinson, was famous for his "thread paper," developed in 1829 to discourage counterfeiting of stamps with the incorporation of threads of cotton, flax or silk. Mechanical wood pulp was not used in machine-made paper until the 1840's, and this may explain its minor presence in the sample. Staining with Floroglucinol tested negative for acidic lignin, and the fibers were long with good interlocking qualities, indicating that the paper core was relatively stable.

31. Ruzavin, "Preservation of papier-mache." DeVoe, English Papier-Mâché, pp. 184-5. Moir, "Care of Papier-Mache," p. 35. Moir also recommends mending with methylcellulose, starch paste or a PVA-base adhesive "such as Elmer's clear cement."

32. The position of the loss was in a vulnerable spot with respect to handling, and so a repair stronger than wax was desired. Mashed paper pulp or plaster, besides having a different surface and porosity than the original, would have required too much moisture for too long before setting, and this could have caused swelling of the laminate core or warping. In addition, they would not have had good, uniform adhesion. Finally, they would have had to have been smoothed before inpainting. The layered paper insert was applied almost dry and needed no additional smoothing. While the method selected might seem time-consuming, the actual hands-on time from mold-making to weighting the insert into the loss totaled three hours.

33. A papier mache table contemporary with this chair was treated at CAL in 1976 (Angst, CAL #2871). This table was recently examined and shows no adverse effects from the surface consolidation, despite being stored in an unregulated environment.

34. There are contemporary patents not only for coffins, but also mass-produced modular chairs, room-sized panels with radiant heating grids, and "torsion box" panels and structures capable of withstanding great stress. The basis of these is similar to that of 19th century objects; paper as a structural matrix with impregnated oils or resins providing great strength. The principal difference now is that the binders are no longer natural oils and resins but synthetics, generally modified cross-linking urea-form-

aldehyde resins. See for example Fritz B. Harris, "Instant Paper-Mache: in compressed form, containing plaster and a binder," Brit. Patent No. 3468414, 1969.

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