

*The Conservation of Asian Lacquer*





# *The Conservation of Asian Lacquer*

Case Studies at the Asian Art Museum of San Francisco

By Jane L. Williams



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whose mission is to lead a diverse global audience  
in discovering the unique material, aesthetic, and  
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## I *Lacquer: The Conservation Challenge*

DONNA STRAHAN

Asian lacquer, also known by its Japanese name, *urushi*, is found throughout Asia. Lacquer is produced from the sap of various trees of the genera *Toxicodendron* (formerly *Rhus*) and *Melanorrhoea*. It has been used since ancient times and continues to be made today. The earliest lacquers identified thus far were produced in China around 4000 BCE. Artifacts coated with lacquer or in which lacquer is used as an adhesive are produced in China, Japan, Korea, Thailand, Burma, Cambodia, Laos and Vietnam.

The Asian Art Museum of San Francisco has a superb collection of over 500 lacquer objects from throughout Asia and the collection is particularly strong in objects of Japanese and Chinese origin. Besides objects predominately made of lacquer, many of the museum's Southeast Asian copper alloy sculptures use lacquer as an adhesive for gilding and inlay.

Traditional lacquer objects pose a particular conservation challenge. Being an organic resin, lacquer may suffer serious physical damage. Generally speaking, newly cured lacquer is unaffected by most acids and alkalis, most organic solvents and water and it is impervious to insect attack. But exposure to ultraviolet radiation and temperature extremes cause the deterioration of lacquer, breaking down chemical bonds and causing irreversible discoloration. While newly-made lacquer surfaces are usually insoluble, degraded surfaces can be extremely

soluble, making them very difficult to clean without removing some of the original lacquer surface. The solubility of lacquer varies depending upon the type of lacquer used, method of application, age, and exposure to light. Also the conservation of lacquer objects must address the problems of their substrates, which may include wood, cloth, metal, or clay. Many lacquers suffer from the ravages of time and mishandling. The problems range from flaking lacquer surfaces, crumbling substrates and light damage, to corroded base metals, inappropriate restorations, poor environment conditions and physical damage. For these reasons, lacquer conservation is often challenging and labor-intensive.

Asian methods of lacquer restoration traditionally use lacquer for consolidation, fills and surface coatings. Applied by skilled hands, this material can improve the appearance and is very compatible with the original lacquer. But lacquer is toxic, causing a severe rash unless the user has built up immunity. The tree is related to poison ivy, producing a similar contact dermatitis that easily spreads. Even after years of exposure immunity is not certain. It is also difficult to work with and requires extensive training. The disappearance of wild lacquer trees in some areas through deforestation is making the sources for high quality lacquer unreliable. Moreover once lacquer has set (under high humidity conditions) it is insoluble and cannot be easily removed. Mistakes cannot be

undone. Over time the newly applied lacquer ages differently than the original lacquer, appearing different in color. Western methods of lacquer treatment traditionally use waxes and other synthetic materials for consolidation, fills and surface coatings. While complete removal of any consolidant remains more an ideal than a practical possibility, these materials generally remain soluble in solvents, are more reversible than lacquer which can only be removed by mechanical means.

The conservation department identified the need to refine their approach to the treatment of lacquers. Until recently there have been few publications that describe a methodology for lacquer treatments. Additionally, there are no lacquer specialists in the United States and only a few object conservators applying current Western conservation approaches to lacquer treatment problems. The Eastern techniques that have been used do not address the issues of toxicity and irreversibility, and are limited by their difficulty and availability.

Thus when a comprehensive survey of the museum's entire collection funded by the Getty Grant Program identified the lacquer objects as being in need of conservation, the conservation department saw the need to investigate approaches to lacquer preservation. The conservation staff decided this need would best be addressed through a workshop with an international group of lacquer specialists. Dialogue on lacquer treatment procedures would have wide application, not only within the field of Asian art, but in 18<sup>th</sup> and 19<sup>th</sup> century European art, where Asian lacquerware has been incorporated into various decorative arts objects.

The survey ranked the lacquers according to conservation priority. The lacquers in the worst condition were very diverse. Twenty-two were selected for study and treatment. They came from China, Japan and Korea and range in date

from the 3rd century BCE to the 19th century CE. They included a wide range of objects: screens, boxes, trays, furniture, sculpture, armor.

The museum next organized a three-day international workshop to focus on the particular conservation problems of these lacquers. Seven experts from Asia, Europe and North America, were invited to participate in January 2000 to represent both Asian and Western perspectives on lacquer conservation. The participants were Helena Jaeschke (England), Shosai Kitamura (Japan), Lan Zhang (China), Frank Minney (England), Jane Norman (United States), Barbara Piert-Borgers (Germany), and Marianne Webb (Canada), along with the project conservator Jane Williams and Asian Art Museum conservators Donna Strahan and Mark Fenn.

Helena F. Jaeschke received her BSc in Archaeology and Conservation from the University College, Cardiff, UK, and has undertaken postgraduate studies in the deterioration and conservation of Asian lacquer objects at the Institute of Archaeology, London. The author of several articles on lacquer analysis and treatment, Ms. Jaeschke maintains a private conservation practice that serves museums in both the UK and abroad.

Shosai Kitamura studied lacquer at the National University of Art and Music, Tokyo. He joined his father in the family lacquer restoration business in 1966, and presently maintains a workshop at the Nara National Museum, where he conserves lacquer objects for the museum and many temples and shrines. Mr. Kitamura has worked on many objects designated National Treasures and Important Cultural Properties. In 1985 he was a participant in the *Urushi* Study Group organized by the Getty Conservation Institute. Mr. Kitamura was named a Living National Treasure for his lacquer work in June, 1999.

Lan Zhang is the Director of the Lu Hsun

Museum in Shanghai. At the time of the workshop he was the Vice Director of the Research Laboratory for Conservation and Archaeology at the Shanghai Museum. He was educated at the Shanghai Institute of Arts and Crafts and the Shanghai Foreign Language Institute. He completed advanced course work in conservation at Fudan University. Mr. Zhang's published articles include *Investigation of Technology of Lacquer Making in the Song Dynasty* and *The Conservation of Lacquerware in China*. Mr. Zhang is a member of ICOM's Working Group on Lacquer.

Frank Minney was a conservator at The British Museum for more than thirty years. He is now a visiting professor at the Tokyo National University of Fine Arts and Music. With the introduction of material specialization at The British Museum, Mr. Minney became responsible for the conservation of lacquer and ivory. Mr. Minney's articles on lacquer conservation have appeared in *The Conservator*, *Studies in Conservation*, and *The Dictionary of Materials and Techniques in the Decorative Arts*.

Jane Norman is the Exhibitions Conservator for the Smithsonian Institution's Freer Gallery of Art and the Arthur M. Sackler Gallery, which together comprise the National Museum of Asian Art for the United States. Ms. Norman received her B.A. in Anthropology and M.A. in Special Studies in Ethnographic and Archaeological Conservation from George Washington University. As a practicing objects conservator with a specialization in East Asian lacquer she has collaborated with lacquer specialists in Japan and China, lectured and published articles on lacquer conservation.

Barbara Piert-Borgers received her conservation training in furniture and objects at the Museum of Applied Arts in Cologne, Germany. As a conservator at the East Asian Art Museum in Cologne she specialized in Buddhist sculpture and Asian lacquer. Ms. Piert-Borgers maintains

a private conservation practice in Cologne. She has traveled extensively to study Asian lacquer techniques and conservation, including a 1999 visit to the J. Paul Getty Museum to examine lacquered furniture.

Marianne Webb has been Decorative Arts Conservator at the Royal Ontario Museum since 1982. Ms. Webb holds a B.A. in Fine Arts from the University of Toronto and a Diploma in Art Conservation Techniques from Sir Sanford Fleming College. Ms. Webb was the coordinator of ICOM's Working Group on Lacquer. Over the past ten years she has presented papers on lacquer conservation at international conferences and meetings. She is the author of numerous articles on lacquer conservation, as well as the book *Lacquer: Technology and Conservation – A Comprehensive Guide to the Technology and Conservation of Asian and European Lacquer*.

The Institute of Museum and Library Services, the National Endowment for the Arts and the Getty Grant Program funded a two year position for a conservator to treat the objects after the workshop. The Getty Grant Program also provided funds for the three day workshop, photography, analytical tests, treatment materials and pre-production work on the post-treatment manuscript.

Each workshop participant received advance copies of exiting condition reports and photographs of the twenty-two lacquers with the highest conservation priority. When possible similar objects were grouped together so that the participants could compare their technology and deterioration. Each participant was asked to focus on a select group of lacquers within the twenty-two, so that the participants could configure their presentations to specific examples. The groups were: screens, sculpture, a helmet, boxes, trays, and furniture. The aim was to encourage the presentation and discussion of different viewpoints on the conservation of the

same objects. The participants only had a few days at the workshop to determine and discuss their treatment proposals and philosophies. The objects were available for examination throughout the workshop. They could only work with the information that was provided to them, which was not always balanced. For instance some objects had X-radiographs and extensive treatment histories while others only had photographs and no prior records. Some were considered treasures of the collection, while others had received little prior curatorial attention. A roundtable discussion followed the participants' individual presentations on their focus objects. Several participants demonstrated examples of certain lacquer and conservation techniques. Of course they all drew on their own experiences, which made the discussions quite lively and interesting.

This brief concentrated immersion in the difficulties of lacquer preservation allowed all members of the workshop to discuss, analyze and compare the many different treatment philosophies. Both stark contrasts and great similarities were exposed and considered. The division among conservators began to melt with each side seeing possible applications for previously unacceptable methods. During the ensuing treatments some of these compromises began to develop and expand into use. From these discussions emerged treatment proposals which borrowed freely from both traditions to address the needs of each individual object. The workshop enabled the museum to draw from the existing body of knowledge on lacquer treatment in both Asia and the West, and to develop an approach which is both sound from a conservation perspective and consistent with curatorial requirements.

The workshop was the spring board for the treatment direction. In preparation for the im-

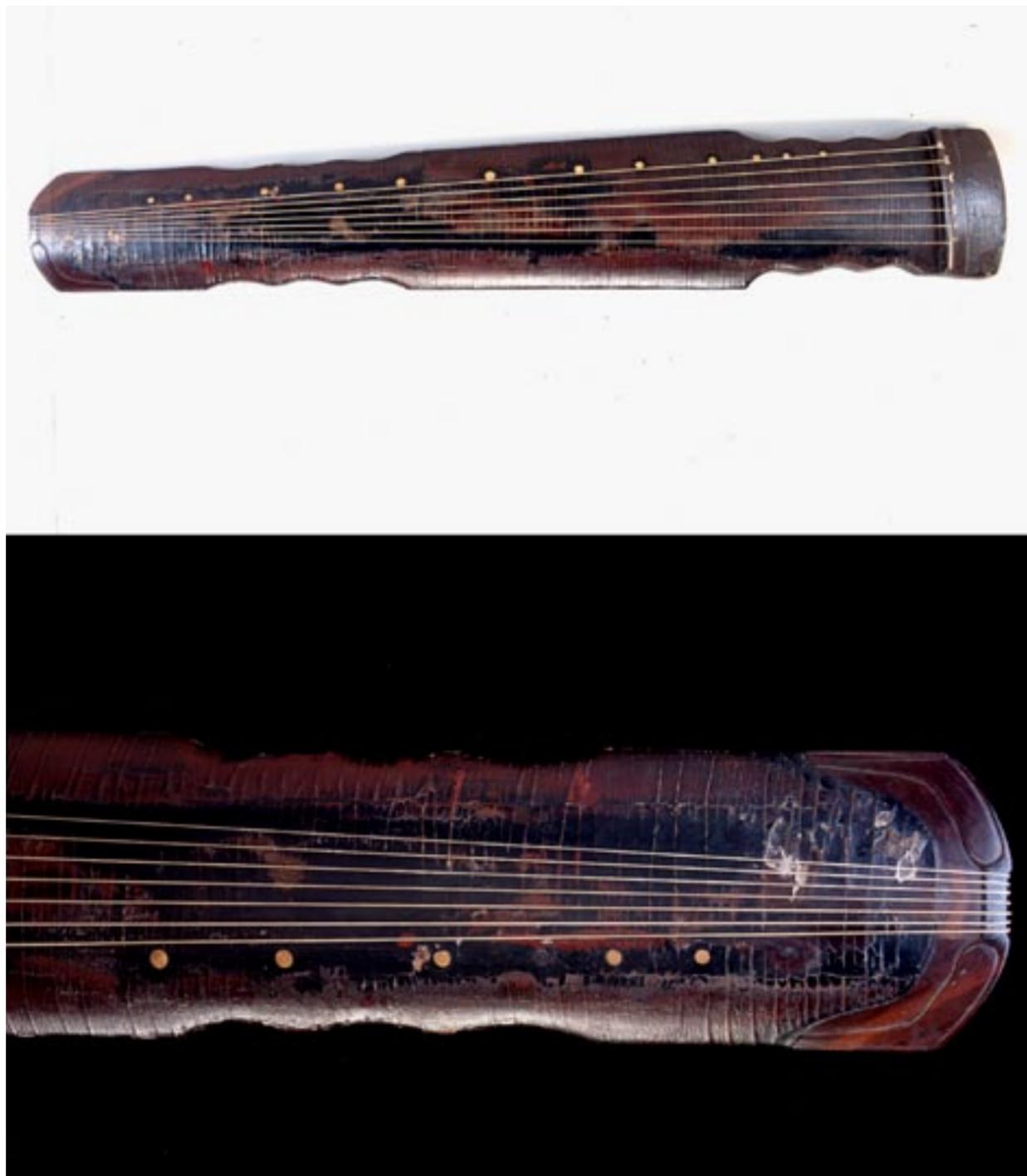
pending move of the museum from Golden Gate Park to San Francisco's Civic Center, project conservator Jane Williams prioritized the treatment of the twenty-two objects. She spent the next two years treating those objects which needed stabilization to move safely and those which had been chosen for the opening exhibit in the new building. The one year break which followed during which the actual move of the museum was accomplished was expected to be an unenviable postponement of the project, but it turned out to be a blessing. Putting the project aside and returning to it later gave us a fresh look and almost always brought new answers to tough questions. Following the move Jane spent another six months completing the analysis and treatments and preparing the manuscript of this book.

The value of the technical studies alone was enormous. During the actual treatment process analysis and further study often revealed new information about fabrication methods, past history and present condition. The powers of the naked eye were expanded by microscopy and X-radiography. The use of the binocular microscope and ultraviolet light aided the examination of surface details. Pigments and lacquer cross-sections were studied using fluorescent and polarized-light microscopy. Kate Duffy at Williamstown Art Conservation Center carried out the bulk of the outside analytical testing for the project. James Martin, Orion Analytical, analyzed the samples from the Chinese screen. Other experts were used for specialized types of analysis.

It was no surprise that fragile lacquer objects should suffer damage over their life span of several hundred years or more. The surprise was in discovering how much each object had been altered. Every object in the project was found to have received some past treatment. The analyti-

cal work provided additional insights into the materials and structures which helped explain existing problems and ensured the implementation of the best possible treatment procedures. This new information often changed the conservation method originally proposed. All of this information underlined the incredibly complex nature of lacquer artifacts.

The format of the project can be used as a model for the discussion and development of conservation treatments in other areas. This project has set the direction for the approach of other parts of the collection in which the museum's conservation staff currently lacks expertise. The major treatment issues were stability, aesthetics, reversibility and materials compatibility. The permanence of *urushi* and the difficulty of obtaining, working with it has limited its use by Western conservators. This project has demonstrated that comparable results can be achieved with other materials. It also proved that the amount of time originally estimated to study and treat the objects was not enough. No object was ultimately found to be as it initially appeared and quick evaluations often did not provide a true picture of the object, its history or problems.



## 2 *Philosophy and Approaches to Lacquer Conservation*

**T**his chapter provides an introduction to the considerations that conservators use to guide them in treating lacquer objects. The workshop participants were asked to describe the philosophy that underlies their approach to lacquer conservation before going on to discuss the treatment of specific objects. Their general statements, except for that by Marianne Webb, follow. Webb's discussion pertains specifically to the conservation of Chinese lacquer screens and is therefore included at the beginning of that chapter.

These approaches helped guide the discussion during the workshop as each object was examined. The participants were also asked to make recommendations for the treatment of specific objects, incorporating examples of treatments and decision making from their own experience. Jane Williams' discussion and findings follow this chapter. Finally the case studies detail the participants' observations of and recommendations for the objects along with Williams' actual treatments

D.S.

HELENA JAESCHKE

An item in a museum collection is valued not merely for its appearance but also for the information it contains. This may be, for example, scientific, historic, or technical. Every stage of the object's existence, from its creation to the moment it comes to the conservator for treatment has had an effect and in many cases has left detectable evidence.<sup>1</sup> This evidence may be of

varying importance and may be viewed differently in different times. The task of the conservator, however, remains the same: to preserve as much as possible of the evidence of the object, to enable others to see and interpret the object, and to ameliorate or prevent as much damage and deterioration as possible.

It is a further responsibility of the conservator to make sure that the changes made to the object during treatment can be clearly identified, not just from the documentation, but more importantly from the object itself. This may be vital in the future if the object and its documentation become separated. It is essential that both the object and any treatments be thoroughly documented throughout the conservation processes. It is also expected that any treatment proposed is tested thoroughly before being applied to the object and that the conservator remain observant and alert, ready to halt or modify the treatment if required. Samples of materials used and samples of the residues of treatment should be retained, clearly labeled.

The treatments undertaken by restorers can form a valuable part of the history of an object and may be seen as adding to the worth of the object. Many restorers, past and present, are highly skilled artisans whose craftsmanship may match or even surpass that of the original maker. The methods and materials they use are often similar to or developed from those of the

*Opposite page: Fig. 2.01 (top) and 2.02 (detail, bottom). Qin (zither), China, Tang dynasty (618–906). Restored with urushi many times; on examination the restorations are clearly different colors, red, brown, and black. Such restorations are considered by qin experts to be evidence of this zither's high value throughout its history. Courtesy, Freer Gallery of Art and Arthur M. Sackler Gallery, Smithsonian Institution, Washington, DC, F1915.00.*

original manufacture and are worthy of similar respect. For a conservator like myself, trained to archaeological standards, the use of such materials and methods is, however, seldom permissible. A conservator chooses materials that are as stable and inert as possible, so that future reactions within the material or between the material and the treated object are minimized. Many materials used in restoration techniques are of natural origin, such as plant resins, waxes, and adhesives derived from animals. These often have a natural aging process that can be measured in decades rather than centuries. They may change in color, in size, in strength, or in solubility and may even deteriorate to form other compounds, some of which can damage the materials of which the object is made. In addition, the restorer's methods may repeat processes used during the manufacture of the item, making it difficult to distinguish between the original and later repairs. Some types of restoration require the removal of damaged original material and the replacement of an entire area with new materials that match the original as closely as possible, both visually and chemically. The conservator, in contrast, attempts to undertake the minimum of interference to the object and to use treatments that, wherever possible, may be reversed or removed in the future. There are limits to this, but it is a principle that is not lightly set aside. The conservator considers not only what might be added to an object, such as a consolidant, adhesive, or coating, but also what might be removed by a treatment, such as a deteriorated surface layer, an earlier, inept repair, or a damaged area of decoration.

The first difficulty for the conservator, therefore, when treating museum objects, is to set the balance between conservation and restoration. Is it appropriate, given the stage that the object has reached, to continue with the kinds of restora-

tion treatments it may have received in the past? Is it suitable at this stage to undertake remedial work that will permanently change some aspect of the object? The desires of the current generation who wish to see the object as close to its perfect state as possible must be matched with the expectations of future generations for whom this heritage is to be preserved and who may wish to see it as it exists now, without further modifications.

No treatment is ever final. The object will continue to react to its environment and even the best conservator cannot hope to halt the effects of the second law of thermodynamics. Every object needs to be monitored and examined regularly, so that problems can be detected at an early stage and steps taken to minimize their effects.

SHOSAI KITAMURA

*Translated from the Japanese by Yoshiko Kakudo*

Because Japanese restoration techniques are linked inseparably with research on ancient practices, the treatment of precious cultural properties provides an invaluable opportunity to learn about the original construction methods and any later restorations. Technical study makes it possible to replicate the ancient practices. In Japan many modern lacquer artists have become fine restorers, the work providing them an opportunity to use their lacquering skills.

The approach to the restoration of lacquer objects in Japan depends on the nature of the object to be treated. Traditional lacquer-making techniques and materials are preferred over other natural or synthetic materials. Because of their value as source materials for the study of art, history, religion and science, designated cultural properties (*bunkazai*) are treated simply to

stabilize them in their current condition. In Japan, national laws prohibit restorers from making changes to cultural properties. When changes are unavoidable in treatment, a special report is required. If the object's original appearance needs to be seen, a replica is made. The process of making a replica is valuable for researching and understanding classical techniques and for preserving such traditional techniques and materials.

Other historical objects (*denseihin*) that are part of private collections are normally repaired with the same materials and techniques that were used to make the object originally. Objects that are not stable, are missing structural parts, or are not aesthetically harmonious may be restored, but only to the extent that the original form and decoration can be reliably determined; all such restorations are documented in photographs and diagrams. If it proves impossible to repair an object with lacquer, other suitable natural or synthetic materials may be selected. Another material might be used to consolidate shell inlay, for example, when the dark color of *urushi* would make the shell appear bluer than the original, untreated inlay. Modern synthetic materials are also often used to treat recently excavated archaeological lacquer objects to prevent their becoming distorted by dehydration.

FRANK MINNEY

East Asian lacquerware made using *urushi* resins differs both chemically and technically from those made in other parts of the world and their conservation presents particular problems. Methods of construction vary from country to country and from region to region within a country. Consequently a wide range of materials and types of damage can be encountered.

Damage to *urushi* lacquerware generally falls into one or more of four categories:

- 1 Physical damage, including breakage and dirt caused by mistreatment
- 2 Damage caused by the failure of components due to faulty manufacture
- 3 Poor previous conservation or restoration
- 4 Environmental damage caused by storage or display in unsuitable conditions

Before the treatment requirements can be assessed, a fundamental understanding of the construction of the object is necessary. Only then can one determine a suitable treatment and specify the materials and methods to be used. Whenever possible I prefer to use materials that are the same or similar to those of the object. This means treating *urushi* coatings and *shitaji* with *urushi*-based materials and where an *urushi* coating has been applied over a different base, or *doro shitaji*, treating that with a suitable non-*urushi* material.

European conservation techniques using modern synthetic materials are generally effective for stabilizing and restoring damaged Asian lacquerware, but there are several types of damage that cannot be corrected adequately using these. For example, if a flaking and cupped lacquer coating has become brittle, it can be very difficult to secure or readhere without causing supplementary breaks in the lacquer flakes. If the flaking and cupping has been caused by disruption of the *shitaji* or foundation layers, satisfactory stabilization may be impossible. Japan has a tradition of lacquerware conservation that uses *urushi*-based materials and traditional Japanese techniques can often overcome such problems.

Techniques that use *urushi*-based materials are effectively irreversible but, practitioners argue, the techniques are used within a centuries-

old tradition and the materials are completely compatible with both the object and any conservation materials that may subsequently be used within that tradition. Practitioners also claim that the argument for the use of modern synthetics, that of reversibility, is ill founded, having been built on a framework of theoretical chemistry and artificial accelerated aging tests, rather than on real knowledge from long-term experience. They argue further that the aspect of compatibility of conservation material to object is rarely considered.

There is an element of truth here. Concern about the long-term reversibility of synthetics is, I think, justified. Supported by scientific evidence, we can be fairly sure that materials used in the Western tradition will remain reversible for some time, but we do not know for certain what will actually happen to these materials in the long term. Even if repairs made with modern materials prove to be stable for one or two hundred years, we cannot be sure that synthetics compatible with what will then be ancient conservation materials will be available in the distant future. It is probably true that little thought is given to the compatibility of the materials used. Furthermore, if the practicalities of actually reversing some reversible procedures, such as the consolidation of friable foundation layers with conservation-grade materials such as Paraloid B-72, is considered, it becomes apparent that true reversibility is not always possible. We are generally satisfied if the adhesives, consolidants, and surface coatings that we employ meet the criteria of modern conservation science.

The long-term scientific experimentation that is necessary to prove compatibility between *urushi* and synthetic repair materials is too time consuming, complex, and expensive. Furthermore, given the complex nature of *urushi* coatings, the wide range of techniques, the variety

of supports and the subtle differences among materials used by different craftsmen, can the question ever really be answered?

Part of the role of modern conservators is the development of the best methods of caring for the objects in their care. A knowledge gained of traditional techniques and materials widens the range of options available.

#### JANE NORMAN

Among the challenges of conserving works of art in a museum collection is that of finding the treatments that are most appropriate and can be done in the time available. Decisions often involve factors beyond the conservator's control—exhibition deadlines, limited scientific equipment, a shortage of funds—and are usually made in collaboration with the curatorial staff, whose expectations or interests may differ greatly from the conservator's. Nonetheless, there are usually several options for treatment; the conservator must weigh the choices with an open mind.

Before an object is considered, certain issues should be addressed:

The objectives and mission of the museum—Whether expressly stated or implied by their activities, museums often direct the way in which their objects should look or be conserved. Issues of restoration are especially subject to discussion, but even basic cleaning and repairs may involve collaboration with curators, especially for religious or spiritually endowed objects.

Reasons for treatment—Treatment decisions can be affected by plans for the object, typically, whether it is to be exhibited in the relative safe-keeping of the home museum or is to travel to other venues. The way an object will be exhibited may influence the choice of treatment, especially if it is not to be protected by a vitrine.

Schedules and due dates—Other conservation projects that will be in progress concurrently with the treatment under consideration must be taken into account.

Abilities, experience, and philosophical approaches—Conservators, guided by their training, cultural background, and experience, differ in their treatment choices. Principles of minimal intervention, reversibility, selection of inert and stable materials, priority of stabilization over cosmetic improvements, and good documentation may be more significant to some conservators than to others.

Cultural significance—An object's context within the culture in which it was made and used may affect treatment decisions.

These factors are especially relevant for lacquer treatments. The use of lacquer (*Rhus verniciflua*) for repairs and restoration has been a controversial subject within the conservation community for many years. Most conservators are firmly planted on one side or the other of this great philosophical divide. As in any type of repair, however, there are examples of both high and low quality. Some lacquer repairs have contributed to further damage and are difficult, if not impossible, to remove without doing greater harm. In other cases, the repair or restoration may still be viable but the color may differ from its surrounding original surface to a degree that becomes distracting. Sometimes, such additions of lacquer are considered valuable and signify the high regard afforded an object through its history (see figs. 1 and 2).<sup>2</sup>

The superior adhesive properties of lacquer may have little competition from synthetic counterparts, particularly when it is bonded to lacquer works of art. When used sparingly for reattaching lifted surfaces, lacquer is a very effective adhesive, albeit one that would be difficult if not impossible to remove. A minute layer

of new lacquer applied to an old lacquer surface (as in the Japanese technique known as *katame*) can make a physical as well as a visual improvement, but this, too, is an irreversible process.

Many conservators do not use lacquer to repair lacquer because the material is permanent, they lack expertise using it, and acceptable, alternative materials and methods for treatment are available. Conservators can select materials that are compatible and sympathetic with but not identical to the original materials. Restored areas may be detectable but, one hopes, not especially noticeable. Restorations are reversible and often intended to add support or protection as well as to improve physical appearance. In reviewing the five objects belonging to the Asian Art Museum that were presented for consideration, conservators have various options for successful treatments.

#### BARBARA PIERT-BORGERS

*Translated from the German by J. W. Gabriel*

There is no panacea for restoring Asian lacquers. The purpose of the following discussion is to offer suggestions for the restoration of selected lacquer objects in the Asian Art Museum, San Francisco. As restorers know from experience, theoretical considerations of this kind will always need to be revised and adapted to deal with problems that arise during the actual work.

The decision to use certain restoration materials and techniques tends to depend primarily on the restorer's training and, secondarily, on current fashions. For instance, restorers from an Asian background generally favor *urushi* as a restoration and conservation substance, because their training is based on the craft of lacquer-work; restorers in the Western world tend to minimize the importance of artisanal training. The means and methods chosen by lacquer re-



Fig. 2.3. Waterlogged lacquer box, China, Northern Song dynasty (1127–1279 CE), 11.6 x 15.2 x 8.1 cm. After treatment showing effect of coating with linseed oil. Courtesy, Changzhou Museum, Changzhou, China.

storers in Europe and the United States often reflect the nature of their training, be it in the fields of sculpture, painting, furniture, or object restoration.

In the 1960s and 1970s, at the Tokyo National Research Institute for Cultural Properties, an extensive investigation into the use of synthetic resins for restoration was conducted under Toshikatsu Nakazato.<sup>3</sup> W. T. Chase has described similar methods in the United States.<sup>4</sup> In Europe, there is an increasing tendency toward the use of natural products such as fish or sturgeon glue and paste combinations. This trend is driven by the search for compatibility and reversibility and a deeper knowledge of health problems caused by conservation materials. The wax and resin mixtures used extensively since the 1960s

deserve to be banished from lacquer restoration, as they were long ago from the fields of painting and sculpture, because of insufficient compatibility and reversibility and their influence on the corrosion of metals.<sup>5</sup>

For Japanese lacquer masters trying to survive in modern times, the restoration of historic lacquerwork is increasingly becoming an economic factor. The program implemented by the Japanese government to have Asian lacquerwork objects that are in European and American collections restored in Japan by Japanese experts has recently fueled international discussion about suitable materials and training opportunities, because the program is promoting Japanese traditions and values. The Project for Conservation of Japanese Art in Foreign Collections

started in 1990 in the field of paintings. Since 1997 craft works have been added to the list of objects for restoration.<sup>6</sup> In this context, the present colloquium provides a useful opportunity to encourage the exchange of ideas among professionals from Asia, America, and Europe.

*Urushi: Proceedings of the Urushi Study Group*, a publication released by the Getty Conservation Institute in 1988 and based on a conference held in 1985 in Japan,<sup>7</sup> was the first to cover almost every aspect of lacquer technology, conservation, and restoration. It also provided an overview of the practical experiences that had been gained with a range of restoration materials during the past fifty years.

Despite the numerous publications that have appeared since then, our knowledge of certain areas of the lacquer art is still sketchy. For instance, we know very little about the composition of the layers of Japanese export lacquers of the late sixteenth and seventeenth centuries known as Namban lacquers, or of Chinese export lacquers, or of lacquers from the Ryukyu Islands. Moreover, the available research findings are not always fully considered when restoration projects are undertaken.

Back in 1954, J. Okada, writing in an English publication, already conjectured that Namban lacquers had a finishing coat of oil.<sup>8</sup> This could be tung oil, which, according to d'Incarville, was sold as lacquer in eighteenth-century Paris,<sup>9</sup> or perhaps a linseed oil varnish, or a linseed oil and resin lacquer. In the Shōsō-in are Chinese lacquerworks whose oil- or glue-based decorations (*mitsuda-ē*) are coated with linseed oil (*yushoku*).<sup>10</sup> Adele Schlombs also suggests that linseed or sesame oil may be the medium for the pigments and metal particles applied to these Chinese lacquer objects.<sup>11</sup> It can be assumed that the manufacture of linseed oil varnish was known in Asia by the sixteenth and seventeenth centu-

ries at the latest, when the influence of European buyers and missionaries began to make itself felt. The gold-dusted decorations of Namban lacquers are not fixed with a final coat of raw lacquer. Might it not be conceivable that the fragile surfaces of gold and mother-of-pearl were coated with protective varnish in the process of manufacture? Even the crinkled surface coating illustrated by Webb<sup>12</sup> could perhaps represent the original state. Some colleagues have found shellac on the Namban lacquers they studied. Declared to be an alien substance, such coatings have frequently been rigorously removed from chests and cabinets.<sup>13</sup> Although hardly conceivable from a Japanese point of view, it would be worth investigating whether we might not have been removing historical shellac layers or an oil-resin mixture which really ought to be conserved, even on an *urushi* surface. Based on our present state of knowledge, no surface coating removal would be undertaken on furniture, although the yellowed finish is regarded as aesthetically detrimental to the decoration.

Lacquer itself should not always be assumed to be pure *urushi*. As d'Incarville reported, it was common practice in China in the eighteenth century to add 50% tung oil and a high proportion of additives and pigments to lacquer.<sup>14</sup> When we consider that Chinese lacquer may contain up to 50% water and that the *urushiol* content degrades under the influence of ultraviolet light to the point that it can no longer be determined even by Py-GC/MS analysis,<sup>15</sup> the use of *urushi* as a restoration substance should perhaps be reconsidered, at least for certain groups of Chinese lacquers.

Another set of problems arises with Asian lacquerworks that have been incorporated in European furniture. The Asian lacquer coatings have been supplemented with decoration added to adapt them to European tastes and

coated with imitation lacquer so that their finish matches that of the glossy, new piece of furniture.<sup>16</sup> Such objects should be treated to preserve the historical coatings, not to lay the Asian lacquer bare.

Cleaning Asian lacquerwork should be undertaken with caution. Since the 1970s, Japanese colleagues have recommended to European collectors and museums that soap and water can be used to clean lacquers. Demonstrations have given the impression, especially to nonspecialist restorers, that the cleaning of lacquer surfaces is straightforward and can be carried out without risk over large areas. Quite the contrary is true. In her book, Marianne Webb, for instance, vividly describes the damage that can be done to lacquers by polar solvents and water: irreparable discoloration of the surface, abrasion of the top, lightly damaged lacquer layer, diffusion of water into the underlying primer layers.<sup>17</sup> Whether the brownish residue on the cotton swab is necessarily deteriorated lacquer, or might stem from nicotine, or oil, or soot films would certainly deserve a precise chemical investigation. Many lacquers, especially those of the *nurimono* group, a type of undecorated monochrome unpolished lacquers, contain oil additives that can rise to the surface. Also, in the final polishing stage of most other lacquer types, oil is used as a burnishing agent. Cleaning can remove this oil from the topmost lacquer layers.

The formation of craquelure and resultant dulling of gloss on the surface of Japanese lacquerworks is generally considered aesthetically displeasing and is remedied by the application of various substances such as a mixture of ivory black and benzene, resin, wax, oil, or *urushi*. In contrast, on early Chinese lacquers a fine surface craquelure is viewed as highly pleasing aesthetically and used as a criterion to determine the age of a piece.<sup>18</sup> When, in cleaning,

this craquelure is removed along with surface grime and a careless use of water leads to color alterations and dulling of the surface, the object is irreparably damaged and its value considerably decreased.

Yet despite the risks involved in using polar cleansing agents, they are applicable and commonly used to clean lacquer surfaces. Such agents include soapsuds and water, tribasic ammonium citrate, ammonia and water, and saliva. The advantages and disadvantages of the various agents have been repeatedly described in the literature.<sup>19</sup> Experience has shown that the use of soap and water<sup>20</sup> is the most aggressive method and can easily lead to discoloration. Compared with tribasic ammonium citrate or ammonia, for which the concentration of the solution can be controlled, the strength of a soap solution is less easily determined. Both tribasic ammonium citrate in water and ammonia in water (1.5% to 2%) can be used on lacquer without discoloration. Tribasic ammonium citrate appears to clean somewhat more effectively.<sup>21</sup> Saliva has the disadvantage of leaving residues, but possesses the advantage of being available in only small amounts, which precludes the danger of overdampening the surface. The crucial point in cleaning Asian lacquers is, just as in the cleaning of the fragile surfaces of paintings, to work on small areas in succession and to employ cleaning agents with great care.

#### LAN ZHANG

The use of lacquer as a protective and decorative material has a long history in China. The earliest known lacquerware object is a bowl unearthed there at the Hemudu site in Yuyao County and dated to approximately 5100 BCE. Over the intervening nearly seven thousand years our ancestors have left us many beautiful

lacquer objects that have been altered by time both in appearance and quality. Thus lacquer restoration, too, has a long history in China, with many lacquer studios established to repair and restore lacquerware. Records of lacquer restoration are found in Song-dynasty literature. It is a weighty responsibility to preserve such objects, not only because they can be used to study human culture and history, but also because they are exquisite artworks. So there is a great need to establish conservation protocols for lacquerware.

For nearly seven thousand years lacquer objects have been made in various shapes and sizes and in more than one hundred types,<sup>22</sup> ranging from elegant articles used in daily life to large pieces of furniture and even decorations on ancient buildings. The objects have substrates of wood, leather, metal, and other materials. The lacquer layers may be thick or very thin. Many decorative techniques have been used, including lacquer inlaid with gold, mother-of-pearl, or pigments (as in Coromandel lacquer). Each type requires a specific restoration plan, but for all lacquerware, certain general principles of conservation apply:<sup>23</sup>

- The conservation of lacquer should extend the life of the lacquer object, but not renew it. Conservation should delay the degradation of lacquer without replacing it with new material.
- The restoration materials used should remain stable for a long period without developing cracks, shrinking, or becoming deformed or discolored.
- Conservation treatments must maintain the aesthetic and cultural integrity of the original artwork and the original appearance and color.
- Conservators should make selective use of new chemical materials, choosing those that age well and remain reversible.
- As much as possible, the original techniques of

lacquerware should be used in restoration.<sup>24</sup>

- The processes used in treatment should be recorded in detail.
- After treatment, lacquer objects must be kept in an appropriate environment with temperature and humidity as stable as possible.

Conservation and restoration will be more successful if we clearly understand the structure of the lacquerware.<sup>25</sup> The size, weight, and other characteristics of every lacquer object need to be recorded in detail. Size and weight are very useful for restoration and research in providing information about the manufacturing techniques, materials, and condition of the internal structure of the object. The condition of the lacquer film must be ascertained and documented because differences in the composition and appearance of the lacquer layers will determine the restoration plan. The substrate, too, sometimes revealed by damage and losses, must be taken into consideration.

Further analysis will help us to understand more clearly the features and condition of lacquer objects requiring conservation. We can determine the internal structure of lacquerware with X-radiography. With a microscope we can study cross sections of the lacquer layers. The layer structure of each type of lacquerware is different. Samples can be analyzed to identify the substrate, ground, or lacquer components. The substrate may be wood, metal, clay, or other materials. The ground layers may contain sand, bone powder, ceramic tile powder, linen, or other materials mixed with animal glue or lacquer. The surface lacquer may be unpigmented or pigmented black or other colors. An understanding of the composition of the substrate and ground base is very useful for determining treatment. For example, we cannot use water to treat many Coromandel screens and other lacquer objects from the Qing dynasty as they have a ground of clay and ash mixed with

animal glue. Where the glue binder in the ground layers of these objects has disintegrated from aging, it offers little resistance to water. If water is used to clean these objects, the clay in the ground layers will swell and the surface lacquer may become distorted.

Many lacquer objects have changed hands numerous times and have been used and handled extensively. These objects have often been treated by collectors or amateur restorers. Restoration lacquer coatings and other alterations may be obscuring the actual condition and original appearance. Even lacquer objects that appear to be in excellent condition can have many minor surface fissures that are visible only with a microscope.<sup>26</sup> Surface cleaning is necessary to expose the original aesthetic quality and cultural information that is useful for museum research and display. The choice of an appropriate chemical solvent for cleaning is important and must be made carefully. The wrong solvent will harm the lacquer layers. Although pure lacquer is insoluble, the percentage of the *urushi* component in a lacquer film may vary. Lacquer films containing less *urushi* may be vulnerable to certain solvents. Possible solvents for cleaning include ethyl acetate, alcohol, acetone, turpentine, and other petroleum distillates.

Unstable lacquerware—objects having weak ground layers or cracked and distorted lacquer layers—requires consolidation. Archaeological lacquer is particularly likely to need consolidation. When the wood substrate has degraded we often use pine resin or other natural plant resins to strengthen it. Some archaeological lacquers appear stable but have microscopic fissures that require consolidation to prevent loss. For the lacquer film we often use semidrying oils, such as linseed oil, nut oil, and others. The weakest lacquer objects, those on which the lacquer is extensively cracked and cupped, should be consolidated by being soaked in linseed oil. A light

coating of linseed oil would provide adequate consolidation for an object with only fine cracks in the lacquer.

Many art museums require loss compensation on art objects. Filling losses can strengthen the fragile parts of ancient objects and can improve their appearance. The restoration must, however, rely upon the known patterns and design, and not add anything if no evidence remains. Some lacquer objects need to be coated after restoration. A good coating material can seal cracks in the lacquer and prevent the penetration of moisture. Semidrying oils are the best choice.<sup>27</sup> Linseed oil can improve the luster of lacquer that has become dull, and we have obtained excellent results using it to coat Song-dynasty lacquerware (see fig. 3).

Conservation does not renew lacquer, it simply extends its life. Lacquer remains vulnerable even after treatment. The condition of the structure and the chemical components of lacquerware change over the course of time. Storage conditions are very important as adverse environmental conditions can have serious consequences. Temperature and humidity levels must be controlled. Normally lacquer must be kept at a relative humidity of between 55% and 65%, and the temperature maintained below 22°C. With a relative humidity above 70%, there is a danger of mold growth. It is equally important that the relative humidity remains stable. Fluctuations will cause the wood substrate of a lacquer object to absorb and release moisture, which will in turn cause cracking and distortion.

#### NOTES

- 1 R. L. Jaeschke, "When Does History End?" in *Archaeological Conservation and Its Consequences*, (London: International Institute for Conservation, 1996), 86–88.
- 2 A Tang-dynasty (618–906) *qin* (zither) in the

Freer Gallery, F1915.100 (see fig. 1), has a long history of relacquering, which is considered by *qin* experts to be a respectful sign of its age and value.

- 3 Mr. Nakazato was head of the *urushi* and wood section of the Department of Restoration Techniques and the research on the newly developed synthetic resins and their applicability in restoration was conducted in cooperation with the Department of Conservation Science. See Josef Riederer, "Restaurieren mit Kunstharzen in Japan," *Maltechnik-Restaur* 85, no. 2 (1979): 118–26.
- 4 W. T. Chase, "Lacquer Examination and Treatments at the Freer Gallery of Art. Some Case Histories," in N. S. Bromelle and Perry Smith, eds., *Urushi: Proceedings of the Urushi Study Group, June 10–27, 1985, Tokyo* (Marina del Rey, Calif.: Getty Conservation Institute, 1988), 95–112.
- 5 *Ibid.*, 99; and Marianne Webb, *Lacquer Technology and Conservation* (Oxford: Butterworth-Heinemann, 2000), 72.
- 6 See Hiroshi Kato, chief ed., *Project for Conservation of Works of Japanese Art in Foreign Collections*, vol. 1 (Tokyo: Tokyo National Research Institute of Cultural Properties, 1998).
- 7 N. S. Bromelle and Perry Smith, eds., *Urushi. Proceedings of the Urushi Study Group, June 10–27, 1985, Tokyo* (Marina del Rey, Calif.: Getty Conservation Institute, 1988).
- 8 See Jô Okada, *Pageant of Japanese Art* (Tokyo: Toto Bunka, 1954), 59: "In places there are inlaid fragments of blue shell, after the Korean manner, and the entire design has been coated with an oily substance."
- 9 Père d'Incarville, "Abhandlung von dem chinesischen Lacke," *Allgemeines Magazin der Natur, Kunst und Wissenschaften, zwölfter und letzter Theil* (Leipzig, 1767), 115.
- 10 Barbara Piert-Borgers, "Traditionen der Verpackung und Aufbewahrung von Lackarbeiten in Japan ausgehend vom Shôsô-in," in Michael Kühnenthal, ed., *Japanische und europäische Lackarbeiten* (Munich: Bayerisches Landesamt für Denkmalpflege, 2000), 111.
- 11 Adele Schlombs, ed., *Im Licht des Großen Buddha, Schätze des Tôdaiji-Tempels, Nara* (Cologne: , 1999), 138.
- 12 Webb, *Lacquer Technology*, 65.
- 13 See Chase, "Lacquer Examination," 110; and Gunther Heckmann, "Die Lackkabinette der Staatlichen Münzsammlung München," in Kühnenthal, ed., *Japanische und europäische Lackarbeiten*, 472, color plate VI.
- 14 d'Incarville, *Abhandlung*, 115 ff.
- 15 See Barbara Piert-Borgers, *Restaurieren mit Urushi. Japanischer Lack als Restaurierungsmittel*, kleine Monographien, no. 6 (Cologne: Museum für Ostasiatische Kunst, 1987); idem, "Aspects and Problems of the Application of *Urushi* in the Restoration of Objects from European Collections," in *International Symposium on the Conservation and Restoration of Cultural Property, Conservation of Urushi Objects, 1993* (Tokyo: Tokyo National Research Institute of Cultural Properties, 1995), 147–65.
- 16 Johann Koller, Katharina Walch, and Ursula Baumer, "Französische Lackmöbel des 18. Jahrhunderts. Criard, Deforge und Dubois. Eine technische und naturwissenschaftliche Untersuchung der Imitationslacke," in Kühnenthal, ed., *Japanische und europäische Lackarbeiten*, 537–58.
- 17 Webb, *Lacquer Technology*, 72–73.
- 18 See Yu-kuan Lee, *Oriental Lacquer Art* (New York, Weatherhill, 1972), 35–37.
- 19 See Paul Bernhard Eipper, *Die Reinigung von Gemäldeoberflächen mit Tensiden* (Bern: Haupt, 1993), 5–51.
- 20 Even the use of Marseille soap, made of olive oil, can have the same effects.
- 21 Knut Nicolaus, *Handbuch der Gemälderestaurierung* (Cologne: Könemann, n.d.), 352.
- 22 Shixiang Wang, *Xiushilu jieshuo* (The annotated "Lacquer Decoration") (Beijing: Wenwu Chubanshe, 1983).
- 23 Lan Zhang, "The Principles and Methods of Conservation of Waterlogged Wood and Lacquerware," in *A Collection of the Shanghai Museum Theses on Science and Technology of Cultural Relics* (Shanghai: Shanghai Science and Technology Literature Press, 1995), 502–30.
- 24 *Ibid.*, "Research on a Special Skill for Making Lacquerware of the Song Dynasty," in *A Collection of the Shanghai Museum Theses on Science and Technology of Cultural Relics*, (Shanghai: Shanghai Science and Technology Literature Press, 1995), 485–502.
- 25 *Ibid.*, "The Conservation of Waterlogged

Lacquerware in China," *Proceedings of the Seventh International Council of Museums—Committee for Conservation Working Group on Wet Organic Archaeological Materials Conference, Grenoble, 1998* (Grenoble: ARC-Nucleart, 1999), 263.

26 Qinlin Ma, Zhide Hu, and Lan Zhang, "Conservation Techniques for Lacquerware and Carved Wooden Art Objects Excavated from Northern China and Research on the Softening of Lacquer Layers," *Proceedings of the Seventh International Council of Museums—Committee for Conservation Working Group on Wet Organic Archaeological Materials Conference, Grenoble, 1998* (Grenoble: ARC-Nucleart, 1999), 284.

27 Lan Zhang, "A Note on the Conservation of a Thousand Year Old Boat," *Studies in Conservation* 40, no. 3 (1995): 189–193.



### 3 *Methodology and Materials*

JANE WILLIAMS

The focus of this project was how Western collections should be caring for their collections of Asian lacquer. Disagreements between Asian and Western conservators have had their basis in whether or not *urushi* and *urushi*-based mixtures should be used in the treatment of lacquer objects. The discussion centers around the relative importance of compatibility and reversibility of repair materials. In Asia, treating lacquer objects remains part of a (thankfully) still-living tradition of making lacquer artworks that is thousands of years old. The preference for using *urushi* thus stems from confidence in its compatibility with the original materials and from knowledge of how the material will behave in the long term. There is an accompanying concern and skepticism among conservators in Asia about the compatibility, effectiveness, and aging of the synthetic materials that have been developed and embraced by Western conservators in the past fifty years and whose behavior over the long term can be predicted only by tests that simulate aging. Outside Asia, professional conservators have embraced the use of repair materials that can be reversed, that is, undone or removed easily and that can also be easily distinguished from the original materials. This approach has been driven in part by their experiences in trying to interpret the technology of artworks that have undergone

extensive repairs and the need to undo and then re-do those repairs.

Thus, the debate over how best to treat lacquer objects has centered primarily around repair materials. However, materials choice has always been secondary in importance to quality of technique. As the conservation field around the world has become more professional, conservators have reacted to examples of poor and heavy-handed restoration work they encounter. Encountering a lacquer object liberally covered with plaster fills and wax coatings and wondering whether it will be possible to undo the damage caused by the restoration, a conservator in Asia, for example, might be most struck by how inappropriate these materials are. Encountering a lacquer object that has been thickly relacquered and has extensive, visually discordant lacquer fills and wondering whether it will be possible to undo the damage caused by the restoration, a Western conservator might be most struck by how difficult these repairs are to remove. If the adhesive and fill repair materials had been applied carefully, in quantities necessary only to arrest further damage, were restricted to the damages alone, left no residues on the original finished surface, it is unlikely that conservators anywhere around the world would be concerned with or even notice, without good documentation, what materials had been used.

*Opposite page, top: Fig. 3.01. Smoothing PVOH and chalk fills with a rubber spatula. (See p. 00)*

## RECENT DEVELOPMENTS IN THE STUDY OF LACQUER

Efforts that began in Europe and North America in the first half of the twentieth century to develop a methodology for the treatment of cultural property have been increasingly adopted in Asia, as well, in recent decades. This has resulted in a number of conferences and publications. The first major international collaboration toward developing a methodology for the treatment of *urushi* objects was the meeting of the *Urushi* Study Group in 1985, sponsored by the Getty Conservation Institute and the Tokyo National Research Institute for Cultural Properties. In 1990 the International Committee for Conservation established a Lacquer Working Group, which has continued to solicit papers from conservators around the world for its triennial meetings and newsletter. The Tokyo National Research Institute for Cultural Properties has sponsored two additional international symposia on the conservation of *urushi* objects, one in 1993<sup>1</sup> and another in 2003.<sup>2</sup> Since 1996 the Institute has also offered, under the auspices of the International Centre for the Study of the Preservation and the Restoration of Cultural Property (ICCROM), biennial two-week introductory courses in the conservation of *urushi*. In recent years, Japanese publications on *urushi* have often included English translations. For these reasons, Japanese practices in and terminology for the treatment of lacquer objects are more familiar to Western conservators than those used in China or Korea. In 2000 the Bavarian Regional Association for the Conservation of Cultural Property in Munich, Germany, sponsored an international conference on the technology and treatment of lacquer objects.<sup>3</sup> Also in 2000, Marianne Webb published *Lacquer: Technology and Conservation* (Oxford: Butterworth-Heine-

mann), a guide to the technology and conservation of both Asian and European lacquer.

The significance of this increasing dialogue between Asian and Western conservators has been illustrated by Rowan Carter.<sup>4</sup> In her survey of the working practices of lacquer conservators around the world, Carter found that increasing numbers of lacquer conservators in Europe and North America have begun to recognize the importance of spending time in Asia to learn more about working with *urushi*. She found that a number of these conservators are beginning to incorporate *urushi*-materials into their conservation practices. She also saw that Western conservators have become more open to using a permanent material such as *urushi*, in certain, limited applications, as they have begun to encounter the practical limitations in the reversibility of Western conservation materials.

## PROJECT BACKGROUND

In the middle of the 1990s, in the midst of this flourishing of dialogue about *urushi* objects, the conservation department at the Asian Art Museum recognized that the lacquer objects were the part of the collection most in need of treatment for their move to a new museum site. Like most museums outside Asia that have collections of Asian art, or may even specialize in Asian art, the museum does not have a specialist in lacquer conservation and no one on the conservation staff has experience using *urushi*. The museum's conservators decided to address this problem by eliciting opinions and advice from conservators with varied backgrounds and training for the benefit of the conservator who would do the treatment work at the museum. This approach, they felt, would be of the greatest long-term benefit to their staff and to the collection and that, with the production of a book, this expe-

rience could benefit the greater conservation community.

I feel tremendously fortunate to have been able to participate in this project. The conservation staff at the Asian Art Museum has supported me in every aspect of the project, even in the midst of the overwhelming process of moving a museum collection. They helped with complicated interpretations of objects and with the completion of treatments and documentation, particularly at the project's end. I started the project with the condition reports and photographs generated by Katherine Untch in her survey made in 1994–1994 already at my disposal. I also had the incredible opportunity of examining and discussing the specific objects that I would be treating with an international group of conservators who have decades of experience in the treatment of *urushi* objects. My respect for and gratitude to the participants for being so willing to share their expertise and observations is enormous. They raised important questions about the objects and their treatments that were not apparent to me. Their ability to disagree respectfully about their recommendations contributed to the success of the workshop. Some of the participants brought and demonstrated the use of materials, an experience far different from reading about it. These conservators have been generous in their willingness to continue to answer my questions.

During this project, a separate grant from the Asian Cultural Council enabled me to spend a month at the Tokyo National Institute for Cultural Properties getting my first experience using *urushi* and observing their lacquer conservators at work. I was also able to visit the conservation and art studios of Kazumi Murose and Shosai Kitamura, and the studios of a number of craftspeople in Kiso-Hirásawa. In Japan, those people responsible for the care of lacquer objects have usually been trained in an apprenticeship

and have come to the field of lacquer restoration after several years of experience as *urushi* artists. The Tokyo University of Fine Arts and Music now offers a degree course in the conservation of *urushi*, which also includes an expectation of several years of practical experience to achieve competence in the use of *urushi*. My brief experience in Japan in certainly did not prepare me to use *urushi* in the repair of artworks, but it did give me a more practical understanding of the material and a recognition of its complexity. It also gave me an appreciation for the value of specialization in conservation, and for those who approach the conservation of *urushi* as artists in a long-standing tradition.

## THE CASE STUDIES

My discussion here summarizes some of the findings that emerged from this project and that are presented in greater detail in the case studies. In the context of the case studies, it is important to appreciate and respect the willingness of the workshop conservators to publish their assessments of the objects, knowing that my interpretation after analysis and working with those objects for two years might contradict what they understood in just three days of studying them. They were also willing to share with me and to publish their treatment recommendations, knowing that I would be likely to draw mainly on materials from my own experience. While an effort was made to elicit these varied impressions and opinions, my lack of experience using *urushi* meant that it would not be an option for me in the treatment decisions. The case studies necessarily reflect that bias. However, it was instructive to note that there were instances where conservators who are comfortable using *urushi* would not use it, for instance to consolidate a protein-bound ground layer. Even when I could not follow the

recommended choice of materials, I could make use of their cautions and many tips about working techniques and I benefited from their observations about the objects' structure and condition. The organization of the book will allow readers to understand what different conservators would have done and what materials they would have used and why, even, in the event, if my decisions differed from theirs.

To conservators used to the current pace of preparing objects for display, the project's allotment of twenty-two months to treat twenty-two objects may sound generous. However, one point on which all of the workshop conservators agreed was that this would not be enough time, particularly given the size and complexity of some of the objects. The case studies reflect the compromises I made within the time limitations of the project. My first concern was to secure any part of the structure or surface that would be vulnerable to damage or loss in the collection's move to its new building. The second priority was to stabilize and improve the appearance of those few objects in the group that were slated for the first displays in the new museum. One of these was the largest Chinese screen (nearly 3 x 7 meters and decorated on both sides). The need to do a more complete treatment of this very large object reduced the time available for some of the other objects. Of the objects not slated for exhibition, only the smallest and most straightforward received treatment beyond basic stabilization. Given the time constraints, I felt that the collection would be better served by thorough documentation and examination of the objects than by rushed treatments.

#### EXAMINATION

A detailed examination and the results of analytical testing often changed my initial assess-

ments of the objects. One surprise from the examination of the objects was the extent to which most of them had been altered. Two of the objects, the head of a bodhisattva (fig. 7.38) and the Korean cabinet with rayskin inlay (figs. 6.13 and 6.14), were determined to be modern fakes or reproductions. Both have been around long enough to have been extensively restored, which initially added to the confusion in their interpretation. Another object, the Chinese chair (fig. 6.23), was likely made in the Ming dynasty, but had the shape of its cresting rail altered and its arms replaced in a style more typical of the Qing dynasty. The structure of another object, the Chinese chest (fig. 5.28) remains largely intact, but it has been completely resurfaced. Its mother-of-pearl and lacquer decoration, ground, and textile layers cover another complete decorative scheme. In addition to replacing the surface decoration, the new scheme altered the shape of the feet. On one of the small trays (fig. 4.28), the mother-of-pearl design in the center was preserved, while all of the patterning that surrounds this field is a later restoration. These are the more dramatic examples, but every object has a history of restoration with Asian and Western materials and it was sometimes difficult to determine whether the intent behind these interventions was deception or repair.

These revelations may not appear to reflect well on the Asian Art Museum's lacquer collection, but it is important to recognize that the objects included in the project are a fraction of the collection and represent the subgroup of objects in the least stable condition. It is likely that within this subgroup one would encounter more fakes and more heavily restored objects than in the collection as a whole. Perhaps in some cases, as Mr. Zhang suggested for the Chinese carved lacquer box (fig. 4.36), this fragil-

ity reflects flaws or poor quality in the original manufacture of the object. In other cases, poor restoration and the way this restoration has aged has led to a number of subsequent restorations. Clearly some of these objects, such as the Korean box (fig. 5.21), have suffered as much from restoration as from their original damage. Regardless of the reasons, the extensive history of intervention that we detected is probably representative of Asian lacquer collections outside of Asia. They may have undergone more handling in export and certainly have experienced more climatic change than objects that were not exported. It is important for any conservators, whether within or outside of Asia, who become responsible for these objects to recognize this increased likelihood of extensive restoration and alteration.

#### TREATMENT ISSUES

##### *Cleaning*

Cleaning is often the first step in treating lacquer, although frequently some surface consolidation is necessary before cleaning can be done safely. Dry cleaning with soft brushes or cloths is often the starting point. Microfiber cloths and various fine-celled sponges will permit further cleaning without some of the risks entailed by aqueous or solvent cleaning, as long as both are tested to ensure that they have not been treated with substances that may leave residues on the surfaces.

There was consensus among the workshop participants that any cleaning solution should be applied to the surface as minimally as possible and removed from the surface, for instance, by being wiped off with a soft, dry cloth, as quickly as possible. I received many helpful suggestions about what to use to apply the

cleaning solutions. Even cotton swabs may snag or abrade a delicate lacquer surface. Cleaning tests should be evaluated under a microscope to look for the finest scratches. As Ms. Jaeschke pointed out,<sup>5</sup> other materials, such as soft mulberry-fiber paper or cotton jersey, may be better choices for cleaning. Nonpolar solvents, such as mineral spirits, are generally considered the safest solvents for cleaning lacquer, but are often not the most effective.<sup>6</sup> Water, other aqueous solutions, and polar solvents are often much more effective, but entail considerable risk of removing original lacquer, particularly on degraded or light-damaged surfaces.

There was considerable discussion at the workshop about what was being removed from the surface in cleaning. The participants generally believe that when the color on cleaning swabs changes from gray to yellowish brown one is beginning to remove degraded lacquer.<sup>7</sup> However, Jane Norman and Christopher Maines, in an analysis of such yellowish brown swabs used in cleaning lacquer were not able to detect the residue of degraded lacquer. There was some discussion about whether removing some degraded lacquer is necessarily a bad thing, if the cleaning leaves the surface glossier without visibly altering the craquelure or decoration. In some cases, careful cleaning that restores the gloss may prevent the need to apply a coating to the surface to improve its appearance. On the one hand, an effective cleaning, accompanied by measures to protect the surface from further contamination, may increase the value of the object in the eyes of those who care for it and lead to its better preservation. On the other hand even cleaning that gives good immediate, visual results may leave the surface more vulnerable. In Japan, cleaning typically goes hand-in-hand with *urushi* gatame—the process of rubbing minute amounts of dilute

*urushi* into the surface—a process intended to replace what is being removed. Ms. Webb has compared the process of cleaning lacquer to that of polishing silver: Each cleaning removes a small amount of original material, and with excessive or repeated cleaning this loss will become noticeable.<sup>8</sup> There is a need to develop a greater acceptance of dull, aged lacquer surfaces (in the same way that the corrosion patina is now generally accepted for archaeological bronzes), to reduce the demand for either aggressive cleaning or re-coating. Mr. Kitamura has discussed Japanese terms, *koshoku* (the natural change of color due to aging) and *danmon* (to describe the appearance of craquelure on a lacquer surface), that reflect the culture's appreciation of aged lacquer surfaces as something uniquely beautiful.<sup>9</sup>

In most cases, my cleaning of these objects stopped with dry methods. Again, this was due to time constraints and my focus on stabilizing the objects. On some objects with particularly dull or uneven surfaces, such as the Korean box (fig. 6.1) and the Chinese chest, I did cleaning tests to determine what approach gave the best results and to find out what the surface would look like after cleaning. The objects that were cleaned with aqueous or solvent solutions, such as the screen (fig. 8.2), had coatings on them, either documented or identified by examination, so I used solvents tailored toward reducing the known coatings. The most dramatic cleaning was of the heavily restored Chinese chair. This exposed the reason for the thick restoration coatings—they integrated parts of the chair from different restoration schemes and covered a dull and abraded original lacquer surface. Cleaning makes it possible to see the original polychrome and gilded decoration, which had been obscured to a nearly uniform brown by the thick coatings.

#### CONSOLIDATION

The next aspect of treatment is consolidation of lifting lacquer. Conservation usually emphasizes minimal intervention, but for lacquer objects it is important to consolidate the surface adequately. Without treatment, the cracking and lifting of unconsolidated lacquer will progress. However, any treatment will expose it to potential damage by solvents, moisture, heat or a combination of these. The goal of consolidation, then, is to minimize the need for future treatment as well as to prevent further damage and loss. Before this project, I had not thought of the consolidation of flaking lacquer as a two-part process. Because the lacquer layer so often becomes separated from the wood or other substrate at the weaker, more porous ground layer, the lacquer cannot be readhered without the adequate consolidation of this ground layer. Japanese conservators call this step *kijigatame*, or hardening the ground, and Mr. Minney refers to it in his treatment recommendations.<sup>10</sup> While this point might be self-evident, I think it bears mention because in so many discussions of the failure of non-*urushi* adhesives, such as Paraloid B-72, to consolidate lacquer, it is unclear whether this step was taken. Different properties are needed in the solutions used in the two steps. For the consolidation of the ground, a very dilute solution in a slowly evaporating solvent is helpful, so that the consolidant penetrates as far and evenly through the ground as possible, without creating areas of markedly different hardness. For the second step, that of readhering the flakes, the most viscous solution that will flow into the lifting area is needed, possibly in a more rapidly evaporating solvent, to provide the most adhesive strength possible at the point of failure.

Many factors determine the choice of consolidant. The binder used in the ground layers,

usually *urushi* or a protein, is one of these. Some of the Chinese and Korean objects examined for this project have protein grounds. As pointed out above, even someone who would normally use *urushi* in repairs might use another material, usually a compatible protein glue, to consolidate such grounds. *Urushi* may be too hard for and incompatible with the somewhat softer, protein-based grounds. Also, as Mr. Kitamura points out in his recommendations, *urushi* would darken the lighter colored protein grounds that were sometimes used to change the appearance of mother-of-pearl decoration.<sup>11</sup> However, while protein-based or other aqueous adhesives may be considered most compatible with protein grounds, there is a risk that the water in these adhesives may cause problems by swelling or softening the grounds.

Additional factors to consider are the thickness of the ground and the lacquer layers. Thick ground layers can be difficult to consolidate adequately and evenly. The greater amount of dilute consolidant, and thus solvent, that may be required, increases the risks of swelling these layers, particularly if water or polar solvents are used. A particularly thin lacquer layer also poses problems. It may be darkened by the consolidant introduced under it and may be swelled or stretched by water or polar solvents.

The choices of consolidants in the case studies reflect the emphasis in my training on using materials that, if they are not entirely reversible, at least allow retreatment. Various materials have been used to consolidate lacquer and my choices reflect the materials I am comfortable using. The workshop conservators were also careful to frame their recommendations not as being the only or best possible choices, but as what has worked for them. In making my choices, it helped to consider the characteristics of the general categories of consolidants most commonly

used to treat lacquer—*urushi*-based materials, protein glues, synthetic resins in solvents, and aqueous emulsions of synthetic resins.

The workshop and my visit to Japan introduced me to some of the subtleties of using *urushi* as a consolidant. It is important for Western conservators to realize that, by the type of lacquer selected<sup>12</sup> and its dilution with nonpolar solvents and the addition of other materials, such as starches, the strength and tack of *urushi* can be adjusted to the needs of a particular object. Unlike other materials in standard usage as conservation resins, *urushi* is an oil-in-water emulsion that sets by cross-linking in humid air, rather than by evaporation of solvent.<sup>13</sup> No other material in the standard repertoire of conservation resins has these characteristics. Its water content and polarity make it possible to increase the tack of *urushi* for use as a consolidant by adding stickier aqueous adhesives such as rice or wheat starch. At the same time, it can be diluted in nonpolar aliphatic hydrocarbon solvents, which are the least damaging solvents to degraded *urushi*. The complete irreversibility of *urushi* requires a meticulousness in its use in repairs. It is crucial that flaking lacquer and wood joins be positioned absolutely perfectly and any excess adhesive removed completely, because these repairs will be permanent. The long working time of *urushi* makes it possible to re-adjust the clamps and continue to remove excess adhesive for hours. This would not be possible with any of the materials commonly used by Western conservators, who are necessarily obliged to get an area clamped fairly quickly, before the adhesive gels or sets. The long-working time also makes it possible to attend to a broad area in one session and to use very complex arrangements of *shinbari* (pressing with bamboo dowels) during consolidation to secure lacquer surfaces with a great deal of control over where and how much pressure is applied.<sup>14</sup>

While rice and wheat starch adhesives are used mixed with *urushi*, as in *mugi-urushi*, they are not typically used alone. The natural adhesives that are used alone tend to be protein adhesives, because of their greater strength. These include products from mammals, such as hide glue, rabbit-skin glue, and gelatin, and from fish, such as proprietary cold fish glues and sturgeon bladder (isinglass) glues. All have the advantage that they have extended histories of use, so one knows what to expect from them in the long run, and that they remain easily soluble. Their shared disadvantages include the fact that they are soluble only in water, which is the solvent that is usually most likely to damage degraded lacquer. All of them degrade and darken over time and would be difficult to distinguish from original materials in future analysis. I used protein glue on three objects, two of which had protein grounds (a tiered box and the Sho Kannon sculpture, figs. 00 and 00). The third, the Amida sculpture, had been consolidated extensively with protein glue in the past. In each case the lacquer and ground were distorted, and I wanted an aqueous adhesive to relax the layers enough to regain contact with the surface. I believed that protein glues, if they worked to consolidate the lacquer, leave more options for retreatment than aqueous synthetic emulsions—they are less likely to affect the way that solvents or adhesives wet the surface in the future. Isinglass and cold fish glue were my first choices among the protein glues, because they can be used with very little heat, which gives them a longer pot life and poses less risk to the lacquer. I cast out films of a variety of protein glues to compare their flexibility when dry. Cold fish glue (I tested Lee Valley Hi-Tack Fish glue) has the advantage of shrinking far less than the other adhesives do, which might improve its bond strength in practice, but in my compar-

ison it was much more brittle than the isinglass, rabbit-skin glue, gelatin, or hide glue.<sup>15</sup> There is considerable variation in the properties of natural adhesives depending on how they are made and refined.<sup>16</sup> I would like to see more systematic study of the relative strength and flexibility of protein adhesives.

Synthetic adhesives can be divided into two categories: resins dissolved in solvents and emulsions or dispersions of resins in water. Both categories include acrylic polymers and vinyl acetate polymers.<sup>17</sup> Epoxies and polyester resins are not typically used as consolidants or adhesives for lacquer. They are no more reversible than *urushi* is, and are excessively hard and inflexible. Synthetic resins in solvents were my starting point, because unless there is distortion that could be improved by the addition of moisture, I prefer to avoid the risks associated with introducing water to a degraded lacquer or to a ground layer that may contain clays and/or cellulose. Also, while no consolidant introduced into a lacquer ground layer is truly reversible, solvent-based PVA or acrylic resins leave more options for subsequent re-treatment than aqueous synthetic emulsions or dispersions do. Solvent-based resins could, years later, be thinned or dispersed within a layer with a nonpolar solvent. Also, a bond with either resin between a lacquer flake and its substrate could be separated with solvent. Dried films of aqueous emulsion films, on the other hand, if they are affected by solvents at all tend to soften and swell, rather than to dissolve. However, if the acrylic resins I typically use had failed as consolidants for lifting lacquer (which did not happen in the treatments for this project), I would have next tried a synthetic emulsion or dispersion in water. Other conservators have reported success with these when resins in solvent have failed. The success of emulsions or dispersions as consolidants is

likely due more to their greater bulk, and thus gap-filling capabilities, than to greater strength.

My preference is generally for acrylic resins over polyvinyl acetate resins. Some conservators choose poly (vinyl acetate) (PVAC) resins, such as PVA AYAF, with a Tg close to room temperature, over acrylic resins when they want a more flexible resin film or fill. Tests comparing the properties of PVAC and acrylic resin films have not, however, found a significant difference in their flexibility.<sup>18</sup> Because of their smaller molecular weight the PVA resins are softer<sup>19</sup> and more readily reversed with solvents than the acrylic resins. Other conservators avoid PVAC resins because of concerns that they will release acetic acid with aging. This phenomenon has only been demonstrated in significant amounts with PVAC emulsions, and it is not known whether anyone has observed the effects of acetic acid emission from an adhesive source on artworks. Paraloid B-72, first used on artworks about fifty years ago and now ubiquitous in Western conservation, is valued for its balance of strength and flexibility and for remaining clear and soluble with aging. If I needed more strength than B-72 provides, as in the treatment of the helmet (fig. 00), I used Paraloid B48N. While the higher molecular weight and stoichiometry of B48N make it somewhat more rigid than B72, it has greater toughness or breaking strength. The higher molecular weight of B48N make it somewhat slower and more difficult to reverse with solvents than B72 or the PVA resins.<sup>20</sup>

The behavior of these resins varies depending on the solvent used. A film cast from B72 in xylene remains considerably more flexible than a film cast from B-72 in acetone, even long after the solvent has evaporated. A dilute solution of B-72 in a slow-evaporating solvent such as xylene provides good penetration for consolidation of porous ground layers. In a more quickly

evaporating solvent, such as acetone, the resin stays closer to the bond interface and develops tack more quickly, which is useful for adhesive applications. Like water, however, polar solvents such as acetone pose risks to degraded lacquer and should be used with caution.

One issue that deserves more research is the consolidation of fine cracks in the surface of the lacquer. If a degraded lacquer surface had a fine craquelure, but the lacquer remained well adhered to the surface, I left it untreated. This was primarily because, if the cracks are not large enough to be consolidated directly by injection or with a small brush, the dilute consolidant must be applied over the surface. I am reluctant to apply any coating to an original finished surface, because the coating's interaction with the surface will determine in the long term how the object looks. Nevertheless, there are strong arguments to be made that in some circumstances doing nothing will lead to further degradation. Intact lacquer seals the surface of its organic or metallic substrate and makes it less vulnerable to expansion and contraction caused by fluctuations in relative humidity. There is concern among lacquer conservators that fine cracks in aged lacquer allow atmospheric moisture into the organic substrates, accelerating the development of increasingly large cracks in the lacquer and eventually lifting and losses to the surface. In Japan the process of *suri urushi* has traditionally been used to seal the microfissures and restore gloss to degraded lacquer. Mr. Kitamura demonstrated the way in which dilute *ki-urushi* rubbed into a degraded lacquer surface fills the cracks in the surface and recreates a solid network of *urushi* (see figs. 5.13 and 5.14). With dilute *urushi* it is possible to leave on a very minute amount of lacquer on the surface, particularly if the surface is wiped with a dry cloth after each application. This type of minimal application

of dilute *urushi* is very different from the thickly applied relacquering that has created problems for some of the objects in the museum's collection. Like relacquering, however, any application of *urushi* is a completely permanent treatment. There is also some concern that the newly deposited *urushi* may create stresses in the aged surface. Western conservators are also concerned about the effect on the aged lacquer and its substrate of the elevated humidity needed to cure the *urushi*. In some circumstances, conservators (Mr. Zhang and Ms. Piert-Borgers among them) favor rubbing small amounts of drying oil, such as linseed oil or perilla oil, into the surface to seal the cracks. This is a process sometimes used in finishing *urushi* objects. Again a very small amount is used and the surface is wiped to remove any excess. The oils are not as hard as *urushi* is, which may be advantageous for aged surfaces. Because they darken, cross-link, and remain sticky, however, they are not materials typically used by Western conservators.

*Urushi gatame* is a process that has been used in Japan in recent years to consolidate the microfissures without leaving even a thin film of *urushi* sitting on the surface. Dilute *urushi* is wiped over the surface and then the surface is wiped repeatedly with cloths dampened with a nonpolar solvent. In its use of solvent to remove the newly applied *urushi* from the surface, the process of *urushi gatame* differs from *suri urushi*. Because *urushi* becomes insoluble when it cures, repeated *urushi gatame* treatments will not redissolve or move the first applications, but can accumulate until consolidation is adequate. If synthetic resins were substituted for *urushi* in an analogous procedure, they would probably not offer an ideal alternative. The initial applications of dilute synthetic resin would be redissolved and moved by the solvent used in later applications, making it more difficult to adequately fill the microfissures.

For surface consolidation of the finest cracks, arguments of compatibility certainly favor *urushi gatame*. It would be useful to conduct experiments comparing *urushi gatame* to surface consolidation with synthetic resins in solvent. It would also be helpful to evaluate the relative effectiveness of these surface treatments in keeping moisture from penetrating to the substrate. A joint project between the Victoria and Albert Museum and the Tokyo National Research Institute for Cultural Properties is underway to evaluate the process of *urushi gatame* and its effect on aged lacquer surfaces and to compare it to analogous treatments using other materials.

#### LOSS COMPENSATION

The last aspect to be considered is loss compensation. I have generally filled losses to protect the exposed edges of the surrounding lacquer and to seal the substrate. In Japan, I observed conservators using two methods that protect the edges of the losses while saving time in finishing and eliminating the problems of color-matching *urushi*. One was to fill just along the edges, creating a bevel between the lacquer surface and the substrate. Another was to fill losses to just below the level of the surface with a smooth, dark, neutral fill material and not attempt to match the surface gloss or color. With meticulous application, both solutions can look elegant. Either approach eliminates concerns from a Western perspective about *urushi* fills, namely, their irreversibility<sup>21</sup> and changes in color as they age. No matter what fill materials are used, these more minimal applications should be considered as alternatives to the further intervention of exact surface matching.

Even when *urushi* is used for fills that are finished to match the surrounding surface, sanding is avoided completely. Fills may be brought close to the surface level in a minimal number of

applications of *kokuso* or a similar mixture that is bulked to allow it to cure even when applied thickly. The final layers, bulked with increasingly finer materials may be numerous and are increasingly thinly applied. Each subsequent application fills imperfections in the hardened, completely insoluble layer below it. Again, the long working time afforded by *urushi* permits minor adjustments and smoothing the surface. The charcoal that is used for the final polishing removes only microns of fill thickness. The Western approach usually involves fewer steps. Fill materials are often applied to slightly above the original surface level and imperfections are removed by sanding. Small sanding tools are used and sometimes barrier coatings or films are used to avoid contact with the surrounding surface. I found it helpful to try, as much as possible, to adopt the meticulous technique of *urushi* fills, to perfect the surface of the fill as much as possible in the application and to keep sanding to a minimum. The fill I used most often when trying to match the original surface was polyvinyl alcohol and whiting, as suggested by Ms. Webb.<sup>22</sup> It can be applied fairly thickly without cracking (which saved time in multiple applications) and smoothed nicely with stainless-steel or rubber spatulas and alcohol, minimizing the need for sanding. I sealed the surface of the loss with dilute acrylic resin before filling, which helped the adhesion of the fill and protected the surrounding surfaces from exposure to moisture. It can be mixed to the needs of the object. Many proprietary gessesoes and putties were suggested by the workshop participants. I have found some of these<sup>23</sup> easier to work with than the polyvinyl alcohol-based fills, but I have also been frustrated in the past with changes in their formulations and availability. The other main alternative for fills suggested by the workshop participants was bulked acrylic resins. I found these mixtures more useful for filling gaps along wood joins and bring-

ing very deep losses close to surface level than for surface finishing. In these applications a mixture of glass microballoons and cellulose powder gave the mixture both bulk and tooth.<sup>24</sup> Acrylic resins can be bulked with kaolin and calcium carbonate to make very smooth fills, as suggested by Ms. Norman, but I found it difficult to spread and maintain the consistency of these mixtures without the addition of slow-evaporating solvents. In treating objects for the move, I tried to minimize my use of these more toxic solvents due to the inadequacies of the ventilation system in the old museum. While I did not test this extensively, it would seem that adding kaolin to the mixtures of whiting with either polyvinyl alcohol or acrylic resins for surface fills will facilitate smoothing and burnishing them. In addition to using Micromesh abrasive sheets on small sanding tools, the fill surfaces can be smoothed and polished with rubber sculpting tools or cork covered with silk.

The material I used most often for inpainting on this project, FW aqueous acrylic ink, was new to me and suggested by Ms. Jaeschke.<sup>25</sup> The acrylic inks have good light stability and their translucency is superior to both aqueous acrylic emulsion paints and solvent-based acrylic resin paints. The ink can be layered in thin coats with an airbrush or by brush application. Mixing dilute Primal WS-24, an acrylic dispersion, as Ms. Webb and Ms. Norman suggested,<sup>26</sup> into the final coats adds gloss and hardness to better simulate the appearance of lacquer.

#### PREVENTIVE CONSERVATION

The primary goal of consolidating and filling losses to lacquer objects should be preserving and protecting the original surfaces. To achieve these same goals, there is universal interest in preventive measures. This project provided the opportunity to improve the storage of these objects. The move

to the new museum represented an improvement in storage for the entire collection. While the old storage cabinets were made of nonreactive materials—glass and metal—dust could enter through perforations in the sides and tops and gaps along the sliding doors. All of the objects that had custom-made wood boxes had been removed from them at some point, but the boxes had been saved. Objects that were too large to be stored in cabinets were sitting uncovered in storage.

The new metal storage cabinets are airtight and impervious to light. All of the materials involved in their construction—paint, gaskets, and so on—were tested to ensure that they were not reactive. Due to space limitations it was necessary to incorporate compact storage units in the design. To avoid risks associated with vibration, lacquer objects are placed only the stationary end units and not in the moving cabinets. Tyvek or cotton covers were stitched by volunteers for all of the furniture or large screens in open storage. Objects that had custom-made wood boxes were returned to them, unless—the Japanese inkstone box (fig 00) is one—they included materials that are susceptible to corrosion by wood acids or would be stored with objects that are. The objects were placed on support boards made of inert materials, such as Coroplast (a corrugated polyethylene board) or Dibond (an aluminum-polyethylene laminate), to which they were tied or braced for the move to the new museum, and which allow them to be moved within the museum with the minimum of handling. Photos of the objects are attached to the covers, boxes or wrapping to minimize the unnecessary uncovering of objects to see what is inside.

These objects are currently stored and displayed at 50%–55% relative humidity, with an emphasis on keeping the humidity as stable as possible. Because they have become acclimatized to these conditions for more than thirty years

in this museum, the humidity will not be raised to the standard 60% relative humidity recommended in Asia for lacquer objects. Light levels for lacquer objects are maintained below 50 lux on display, and the ultraviolet component of the light is screened out.

## NOTES

1. Kyotaro Nishikawa, ed., *Conservation of Urushi Objects: Proceedings of the International Symposium on the Conservation and Restoration of Cultural Property*, November 10–12, 1993 (Tokyo, Japan: Tokyo National Research Institute for Cultural Properties, 1995).
2. Forthcoming *The Role of Urushi in International Exchange: Proceedings of the 27th International Symposium on the Conservation and Restoration of Cultural Property*, December 3–5, 2003 (Tokyo, Japan: Tokyo National Research Institute for Cultural Properties, forthcoming).
3. The proceedings were published in German and English. Michael Köhlenthal, ed., *Japanische und europäische Lackarbeiten / Japanese and European Lacquerware* (Munich: Bayerisches Landesamt für Denkmalpflege, 2000).
4. Rowan Carter, “Contact and Collaboration: Developments in East Asian Lacquer Conservation since 1978” (research project report, Conservation Masters of Art Programme, Royal College of Art / Victoria & Albert Museum, London, May 2000).
5. See case study for the Korean box (B60M292), in this volume, pp. 00–00.
6. Webb provides a helpful discussion of the issues surrounding cleaning lacquer and the risks and benefits of different cleaning solutions in her book, *Lacquer: Technology and Conservation* (Oxford, Butterworth-Heinemann, 2000), 71–73.
7. See Norman, in this volume, p. 000. Christopher Maines feels that to pursue their preliminary tests would require cleaning tests on a degraded lacquer surface that is known to be uncontaminated by any coatings. Given that almost every historical lacquer object has been coated with something, this might necessitate generating a degraded lacquer sample by accelerated aging.
8. Webb, *Lacquer*, 71.

9. Kitamura, in Köhlenthal, ed., *Japanische und europäische*, 69.
10. See the case study for the Sho Kannon sculpture (B60S420), in this volume, pp. 00–00.
11. Examples in this project where different colored grounds were used under mother-of-pearl inlay are the Korean inkstone cabinet (B62M18) and the Chinese chest (B61M16+).
12. The constituents of the sap and its working properties change according to the climate in which the trees grow and the time of year when the sap is harvested; Webb, *Lacquer*, 5.
13. *Ibid.*, 8.
14. For examples, see the lacquer treatments illustrated in Tokyo National Research Institute for Cultural Properties, Project for Conservation of Works of Japanese Art in Foreign Collections, vol. 2 (Tokyo: Tokyo National Research Institute for Cultural Properties, 2000). Shinbari, where bamboo dowels are held under tension between a wood framework or box and pads on the object’s surface is a very useful clamping method for three-dimensional objects. Pressure can be applied from one side, rather than from two as with clamps. The placement of the bamboo dowels pinpoints the pressure applied. The number of dowels and their diameter and length are selected to control the amount of pressure.
15. Many conservators consider cold fish glue to be more flexible than other protein glues. It is possible that the glue I tested had exceeded its shelf life. It had been purchased two years earlier and I do not know how long before that it had been bottled, which points to another drawback of proprietary glues.
16. For instance, in a preliminary study comparing different isinglass adhesives, higher heating and greater refinement make isinglass films much less flexible; Sarah Foskett, “An Investigation into the Properties of Isinglass,” *Journal of the Scottish Society for Conservation and Restoration* 5, no. 4 (November 1994), 11–14.
17. For the most comprehensive comparison of synthetic adhesives in recent years, see Jane L. Down, Maureen A. MacDonald, Jean Tétreault, and R. Scott Williams, “Adhesive Testing at the Canadian Conservation Institute—An Evaluation of Selected Poly(vinyl acetate) and Acrylic Adhesives,” *Studies in Conservation* 41 (1996), 19–44.

The CCI study of acrylic and PVAC adhesives found that the PVAC resin films were actually more brittle than B72 films. This study, however, compared B72 in toluene to PVAC resins in acetone and ethanol. In discussing these results Jane Down (telephone conversation, 10/04) said that she would expect PVAC homopolymers to be more brittle than B72 due to stoichiometric effects. The greater attraction and cohesive energy between acetate groups relative to the more widely spaced acrylic functional groups lead to greater rigidity. In Eric Hansen, “The effects of solvent quality on some properties of thermoplastic amorphous polymers used in conservation,” *Materials Research Society Symposium Proceedings*, V. 352 (Materials Research Society: 1995), 807–12, Hansen demonstrated that films made from both PVA and acrylic resins have very limited flexibility when acetone is the solvent.

Hansen, 810.

- I know of no direct testing of the aging characteristics of B48N. However, as a copolymer of butyl acrylate and methyl methacrylate it would not be expected to age as well as B72 (C. V. Horie, *Materials for Conservation*, 108.) The CCI adhesives study (Down et al) found it to be acidic.
18. Because of the relationship of bulking materials to binder, the *urushi*-based fill materials I encountered on objects were not any harder than the Western alternatives, and could be removed easily by mechanical methods. It is the *urushi* coatings, either over fills or original surfaces, that are more intractable.
  19. See case study for screen (B69M52), in this volume, pp. 00–00.
  20. The proprietary gesso currently used the most in the museum’s lab is Flügger-Acryl, a compound based on butyl methacrylate and whiting.
  21. This combination has an analogy in kokuso mixtures, which sometimes contain a combination of sawdust for bulk and a small amount of linen or hemp fibers for tooth.
  22. See case study for Korean box (B60M292), in this volume, pp. 00–00.
  23. See Webb, *Lacquer*, 91–93, and the case studies for trays and screens, in this volume, pp. 00–00 and pp. 00–00.

## 4 *Case Studies: Bowls, Trays, and Box*



**B**owl, carved in one piece from a block of wood, with a slightly flared edge, three shallow grooves on the exterior, and a low ring foot (fig. 4.01). It is coated with dark brown lacquer over which bands and designs in red and black lacquer have been painted. An inscription has been incised in the lacquer on the bottom.

### *Conservation Record*

Accessioned in 1965. In 1979, the bowl was “brushed with a soft brush, and waxed very lightly.”

JANE NORMAN WRITES:

### *Condition*

The wood substrate is slightly misshapen but generally intact, except for numerous small losses along the rim. The thin lacquer coating is, however, shriveled, tented, and flaking away from the substrate, particularly on the exterior. In many areas the lacquer is already lost or highly unstable. Museum records show that the bowl was dusted and waxed in 1970. It is possible that it was also treated in the field when excavated, but this is not recorded.

### *Suggestions for Treatment*

The stabilization of the lacquer is the primary concern, although a thorough examination of the wood may reveal its need for treatment. If

areas of wood are weak or breaking apart, local consolidation with Paraloid B-72 in a 1 : 1 : 1 solution of acetone, ethyl alcohol, and xylene may be needed. The three-solvent mixture provides for good penetration and adequate working time. With a brush or dropper, apply a dilute (approximately 5%) solution and eventually increase the concentration of the solution (perhaps to 15%) to saturate the area. Remove excess consolidant on the surface with solvent.

There are several possibilities for stabilizing the lacquer. Given the lacquer's thinness, it might be possible to flatten the raised areas with a heated spatula and a wax and resin mixture.<sup>1</sup> This is similar to the wax formula used to fill unsightly cracks (as suggested for B60M164; see note 8), but the addition of resins such as gum elemi and dammar improves the tack. The wax and resin mixture is heated on a small spatula and poured under the lifted flake with gentle pressure. Excess material can be removed mechanically or with solvent. Another possibility is to fill and consolidate these areas with a solvented acrylic resin such as B-72, bulked out with glass microballoons or fumed silica. This is an example of how the conservator's approach to treatment and familiarity with certain materials becomes part of the decision. Other materials that may be effective include BEVA (an ethylene-vinyl acetate copolymer) and Rhoplex (acrylic emulsions) because the heat used to set the adhesives may help to flatten the raised lac-

Fig. 4.01. Bowl (B65M26), China, Han dynasty, height 10.3 cm, diameter 27.3 cm. After treatment.



Fig. 4.02. Bowl (B65M26), before treatment

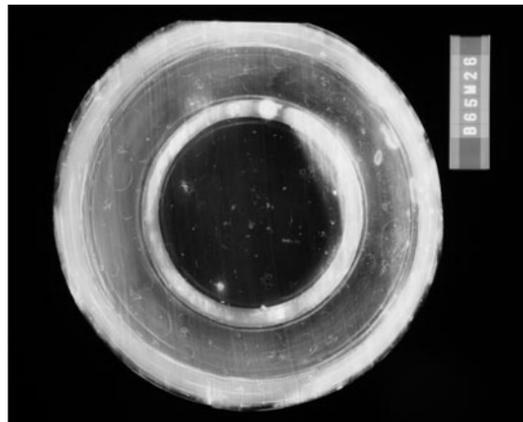


Fig. 4.03. X-radiograph of bowl (B65M26). Technical data: Norelco X-ray unit (150 kV max.), Kodak Industrex M film, 40 kV, 4 mA, 90 seconds, distance from tube, 36 inches.

quer. *Mugi-urushi* (raw lacquer thickened with water and either rice or wheat paste) or *kokuso* (*mugi-urushi* with fine hemp fiber and/or sawdust added) are traditional Japanese materials often used to repair lifting lacquer. For many conservators, they are not an option because of the irreversibility of raw lacquer.

After the lacquer is stabilized, solvents such as ligroin (or other petroleum distillates) or ethyl alcohol might be used to remove the wax coating. The procedure would need to be carefully tested, because the surface may be too fragile to be cleaned or handled further. The losses are probably best left as they are. If filling is desired, the wax formula (note 8), tinted brown, would be a good material to use because it can be applied thinly.

Some museums maintain a policy of restricted use and handling for extremely fragile works of art, limiting handling to the most experienced staff and restricting loans and other activities that could endanger the object. This bowl would be an appropriate candidate for restricted use.

ZHANG LAN WRITES:

#### Condition

The lacquer layer is very thin. Losses to the lacquer expose the underlying wood substrate. This bowl was excavated and was once waterlogged. Some burial dirt remains on the surface (see fig. 4.02). The wood substrate is intact, but in drying it shrank, causing many areas of the lacquer surface to shrivel, become tented, and flake away.

#### Suggestions for Treatment

The wood structure can be determined using X-radiography. From the broken area we could, under a microscope, determine whether it is a softwood or a hardwood. My visual examination and experience suggests that the wood may be Chinese fir or pine. Also from visual observation and familiarity with other, similar objects, I would expect the bowl to have been made from a single piece of wood. The lacquer layer structure is visible along the losses and is typical of Han-dynasty techniques. The lac-

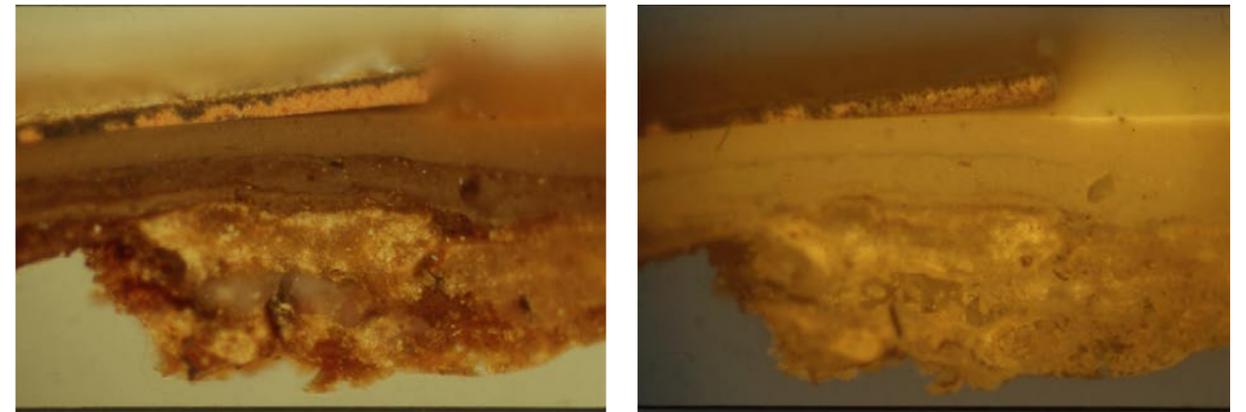


Fig. 4.04. Bowl (B65M26), cross-section sample of surface layers from an area with a thin black line painted over a red line on unpigmented lacquer, shown in reflected light (left) and ultraviolet light (right); photo taken at 200x magnification.

quer is thinner than customary on later objects and no ground layer is used.

Cleaning this bowl should be straightforward, but care needs to be taken to preserve the remaining lacquer and evidence of burial. The bowl may have been treated previously, but there is no visual evidence of any applied consolidant. Also, the bowl is light in weight because the cellulose structure of the wood deteriorated when it was waterlogged while buried. Consolidation treatments often add substantially to the weight of objects. It is very important to determine whether or not the bowl has been treated, and if so, what materials and methods were used. The best way to treat it again would be to find materials and a method by which the wood could be swollen to its original dimensions. This problem is a subject of continuing research and no good solution has yet been found. The only recourse currently available is to reinforce the object in its present shape. With consolidation, further lifting of the lacquer can be prevented. Because the natural resin and cellulose in the wood have deteriorated through age, it is appropriate to use

pine resin with acetone to restore structural integrity to the wood where the lacquer is missing. Excess resin must be removed from the surface after impregnation. In addition to strengthening the wood, pine resin is a good adhesive for securing lacquer to the wood. Because pine resin softens when heated, a hot spatula can be used to flatten some of the curling and lifting lacquer.

The storage environment is especially important for this bowl, which has been weakened by nearly two thousand years of aging. Appropriate environmental conditions, with temperature and humidity strictly controlled, will extend the bowl's life.

JANE WILLIAMS WRITES:

#### Materials and Techniques of Manufacture

X-radiography confirmed that the bowl was carved from a single piece of wood (see fig. 4.03). A ground layer is not visible on the bowl, but is visible in cross-section samples of the lacquer (see fig. 4.04). The dull mustard-



Fig. 4.05. Bowl (B65M26), after treatment, showing support used for transport and storage, designed to stabilize movement while limiting contact between the lacquer surface and support.

yellow autofluorescence of this layer is consistent with that of the lacquer layers. The opaque tan or brown overall lacquer layer is unpigmented. Its color appears to be the result of the bowl's aging, burial, and being waterlogged. The red pigment was identified as cinnabar. Analysis of the black pigment suggested a mixture of materials that may include iron ochre, clay, gypsum and bone black.

#### Treatment History

It seems likely that the bowl would have been treated after excavation, but there is no obvious evidence of consolidation either to the wood or to the lacquer. The only residues on the bowl appear to date from burial, but these were not analyzed because they were left in place and they did not affect the bowl's treatment. The most visible accretions are more radio-opaque than are the lacquer or wood, and may be dissolved metallic components of the lacquer or something in contact with the bowl in burial.

#### Condition

The bowl is in very fragile condition. The wood, where exposed, appears worn and eroded, but is structurally sound. The wood surface is neither powdering nor splintering. The bowl was probably waterlogged at some point and the wood shrank considerably when it was dried, causing the lacquer surface to shrivel, tent, and flake off. Despite this shrinkage, most of the lacquer still conforms tightly to the wood surface. Most of the lacquer losses have been to the rim and the foot. There are more losses to the exterior than to the interior, probably due to greater contact with the exterior during packing and handling.

#### Treatment

Because the bowl is an archaeological object, the treatment goal was to stabilize it while altering its current appearance as little as possible and introducing as little foreign material as possible. The bowl needed to be stable enough to be moved to the new museum without sustaining loss to the lacquer or wood. The wood is very porous and dry but is currently stable. The focus, then, was on adhering or supporting lifted flakes of lacquer that might be snagged or crushed and broken off, and to support tented lacquer on the exterior sides that could be crushed. The surface was very lightly cleaned with a soft brush and vacuum to remove loose surface dust before consolidation. The surface flakes were consolidated using PVA-AYAF resin in 1 : 1 acetone : ethanol. PVA was chosen rather than B-72, normally my first choice of adhesive, because of its good stability, for its smaller molecular size and lower melting point. These characteristics would make it easier to release the lacquer from the wood with solvent or heat if necessary in the future. The relatively higher acidity of PVA should not pose problems in the already acidic context of the lacquered wood. Where lacquer flakes were



Fig. 4.06. Tray (B60M163), after treatment.

lifting but still could achieve good contact with the wood, small sheets of the resin were cast out on polyester film, cut to shape when dry, and inserted under the flake. Solvent was introduced with a small brush to reactivate the resin and then the flake was clamped until dry. Because the adhesive was cast in a film, it stayed where it was and did not soak into the porous wood. *Shinbari* (the technique of using bamboo sticks under compression to apply pressure) was useful for applying downward pressure to the lacquer on the top edge. On the sides, carbon-rod clamps were easier for me to manipulate. On the exterior, the accessible and most precarious tented areas were filled with a mixture of 15% PVA-AYAF in 1 : 1 acetone : ethanol and 1 : 1 3M hollow glass microspheres : CF-II cellulose powder and dry pigment. The mixture, which had the consistency of heavy cream, was either injected or introduced with a toothpick.

A passive support was constructed to secure the bowl for transit and for long-term storage (see fig. 4.05). It will also be kept covered from now on to protect it from dust and light. □

**T**ray (B60M163), China, 18th century(?), Length 38.1 cm, width 12.7 cm, height 2.5 cm. Shallow rectangular, lacquered tray with angled sides and a slightly raised, gilded border between the center panel and the sides (fig. 4.06). The front side only is decorated with mother-of-pearl inlay. The central field, set within a cartouche, shows a scholar and three attendants near a pavilion surrounded by trees, water, and mountains. The cartouche is surrounded by clouds on a diaper pattern. The sides depict birds and foliage, interrupted on the long sides by the same clouds and diaper pattern.

#### Conservation Record

The tray was accessioned in 1960 as part of the Avery Brundage gift. In 1970 it was "dusted, cleaned and lightly waxed."

#### JANE NORMAN WRITES

#### Condition

The tray appears to be structurally sound. The mother-of-pearl and the gold on the border

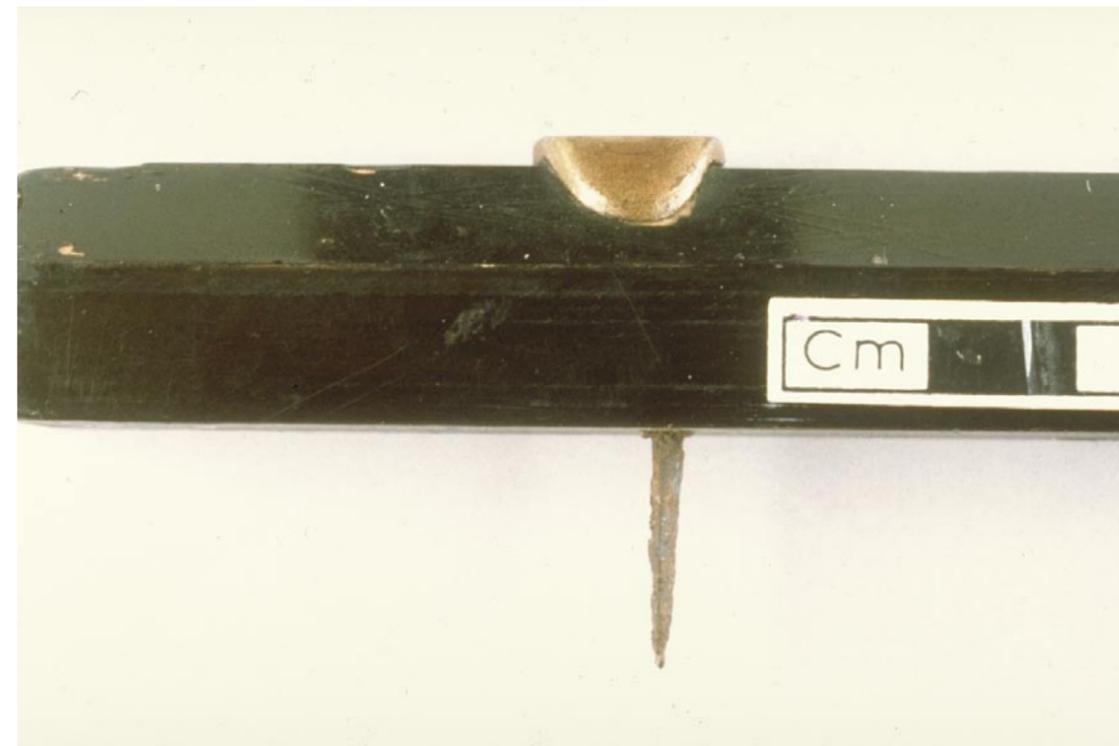


Fig. 4.07. Frame from two-fold screen. Japan, Edo period (1615–1868), lacquer. Courtesy, Freer Gallery of Art and Arthur M. Sackler Gallery, Smithsonian Institution, Washington, D.C., F1970.22. Detail of a test cleaning on a black lacquer frame that has been dismantled from the screen; cleaning resulted in a marked improvement to the clarity and luster of the lacquer. Analysis by Py-GC/MS showed no identifiable lacquer in the removed material.

appear stable at present. The surface is dull from grime. A brown residue (the remains of a previous relacquering) surrounds many of the tiny inlay fragments. The lacquer is in generally good condition, with the usual fine craquelure and larger cracking seen on old lacquer objects. There are a few small losses to the lacquer surface on the back, near one corner, exposing the wood support. The exposed wood has evidence of insect damage (tunneling), although whether this is recent or active was not determined.

#### *Previous Treatments*

In addition to the 1970 treatment, there is also evidence of former repairs made to the corners and along the edges of the rim. These appear to have been done with lacquer.

#### *Suggestions for Treatment*

It is fortunate that the mother-of-pearl and the lacquer are stable; so often they are not. The first concern would be to make sure that the tunneling seen on the back is from a former, rather than an active, pest problem. Sealing the tray in

a polyethylene bag for a few months and checking for evidence of new frass is recommended. If the infestation is active, the tray should be fumigated immediately.

The wax coating should be removed, if possible, especially as its identity is not known. Some waxes become hazy and ultimately intractable over time.<sup>2</sup> For most lacquer objects, especially those housed in a well-protected museum environment, it is unnecessary to apply a coating. Wax can provide a glossy appearance to a dulled lacquer surface, and certain wax products may even be appropriate for some objects,<sup>3</sup> but that is not the case with this tray. Solvent tests indicate that the wax can be removed. Often ligroin (or other petroleum distillates) or ethyl alcohol are recommended solvents. Wax coatings sometimes fluoresce under ultraviolet (UV) light. By checking under UV light before and after treatment, a conservator can be assured of the complete removal of a coating that is difficult to see in normal light.

Once the coating is removed, the lacquer can be cleaned. Although the tray was dusted in 1970, it may not have been sufficiently cleaned. Cleaning lacquer, especially objects with mother-of-pearl inlay, is painstakingly slow. A hand-rolled cotton swab with a very small head is used, and dampened very slightly with distilled water. The importance of using the barest minimum of water cannot be overemphasized. Often, merely wetting the tip of a bamboo skewer and then rolling it in a bit of cotton wool is sufficient. Gently rolled over a small area of the lacquer, the swab will pick up grime. The area is then quickly dried with another, dry swab. This same technique can be used for the mother-of-pearl, with great care taken not to disturb the inlay or leave behind cotton lint from the swab. Water or ethyl alcohol, whichever is more effective, can be used.

The extent to which a lacquer object is cleaned by this method is a judgment call for the conservator, who may be influenced by the museum's aesthetic approach to exhibiting works of art or by the object's contextual significance. Cleaning can, however, produce a dramatic improvement. Many objects regain the deep luster for which lacquer is so admired (see fig. 4.07). The level of cleaning described will often remove a dark-colored layer that can be difficult to identify. Does it contain the uppermost layer of lacquer (or a degraded portion of it) or is it simply dirt and grime?

Analysis of the dark-colored matter removed from several black lacquer objects that have been cleaned at the Freer Gallery of Art revealed that the removed matter did not contain components that would definitively identify them as lacquer. Among other constituents, mostly short-chain dicarboxylic acids, the samples contained fatty acids that are commonly found in many organic compounds.<sup>4</sup> The fatty acids most notably found in lacquer were not detected. The removed matter might possibly contain components of degraded lacquer but was more likely to be normal dirt and grime. Studies of degraded lacquer have not yet completely identified its components, but current research continues to pursue this question.<sup>5,6</sup>

This method of cleaning, with a minimum of water, would not be recommended for all lacquer, and particularly not for objects in a degraded condition. Spot-cleaning tests on the tray under consideration show that below the dull, upper layer is a stable, deeply lustrous surface. Removing the grime would highlight the mother-of-pearl against the rich black background. Even if the cleaning removes degraded lacquer (a possibility but not yet scientifically proved), the effect may be comparable to cleaning tarnished silver. Once the tarnish



Fig. 4.08. Tray. China, Ming dynasty (1368–1644), lacquer, mother-of-pearl. Courtesy, Freer Gallery of Art and Arthur M. Sackler Gallery, Smithsonian Institution, Washington, D.C., S1997.34. Mother-of-pearl inlay, highly magnified; the thin black layer obscuring some of the inlay is the result of relacquering where the excess lacquer was not removed.

is removed—to the great visual improvement of the silver—and if the object remains in the controlled, acid-free environment of a museum, it is unlikely that it would need to be cleaned again. Similarly, if a lacquer object is kept in the clean, controlled environment of the museum, it may never need further cleaning beyond a light dusting.

The brown lacquer residue surrounding many of the mother-of-pearl sections is quite thick in some areas and masks the inlay's fine detailing. It is usually possible to remove some of this excess lacquer mechanically, using a fine, pointed bamboo skewer (a sharp tool such as a surgical scalpel might scratch the mother-of-pearl). Although this work is not necessary and time may not permit such a slow task, the overall effect could be a notable improvement (see figs. 4.08–4.10).

The relacquered corners and edges are reasonably well done, and would not be worth removing. They could be painted to blend better with

the surrounding surface. Discolored repaired areas can be overpainted easily with acrylic polymer paints. If the gloss on the overpainted areas needs adjustment (often acrylic paints are duller than the surrounding lacquer surface), one or two coats of Primal WS-24 (an acrylic colloidal dispersion) is a recommended material. As an aqueous solution, it is easily applied to an acrylic painted surface and can be thinned with water to alter the gloss. It is commercially available as a 36% solution but, when diluted to an 18% solution, it is frequently a good match for a black lacquer surface (see figs. 4.11–4.13).

The losses on the reverse side need to be stabilized to prevent further damage, and filled to complete the visual appearance of the surface. If time is short, these areas can be stabilized and not filled. B-72 (an ethyl methacrylate/methyl acrylate copolymer resin) is brushed on the exposed wood substrate in an approximately 15% solution in acetone or, for a slower volatilizing solvent mixture, in a 1 : 1 : 1 solution of acetone, ethyl alcohol, and xylene. If time allows, after the B-72 has sufficiently set (at least twenty-four hours), the losses can be filled with any of several fine surface spackling compounds. Some are commercially available, for example Modostuc by Plasvero, a polyvinyl acetate putty, or Polyfilla Fine Surface by Polycell, a styrene-acrylate putty. Other compounds can be mixed together, such as B-72 with 2 : 1 kaolin and calcium carbonate.<sup>7</sup> These products have minimal shrinkage and a suitable density. Modostuc is available in white or mixed with iron oxide pigment to match nine different wood colors. Polyfilla and the B-72 compound can be tinted with dry pigments to darken them slightly. When dry (several layers may be required if the gap is deep), the filling may be carefully carved and sanded to a smooth surface. It can be in-painted with acrylic polymer paints and coated, as described above, with WS-24 to match the surrounding gloss.



Left: fig. 4.09. Table. China, Ming dynasty (1368–1644), lacquer, mother-of-pearl. Courtesy, Freer Gallery of Art and Arthur M. Sackler Gallery, Smithsonian Institution, Washington, D.C., F1995.5. Before treatment (detail). The inlay is extensively covered in previous relacquering.



Right: fig. 4.10. Table. China, Ming dynasty (1368–1644), lacquer, mother-of-pearl. Courtesy, Freer Gallery of Art and Arthur M. Sackler Gallery, Smithsonian Institution, Washington, D.C., F1995.5. After treatment (detail). Mechanical removal of the lacquer covering the inlay resulted in a more attractive appearance.

#### ZHANG LAN WRITES:

##### *Condition*

The loss to the lacquer on the bottom reveals that the tray has a wood substrate. The evenly spaced wood grain and my knowledge of traditional woodworking techniques suggest to me that the wood may be fir. The tray appears structurally sound. The surface is dusty and there is grime or possibly other residues on some of the mother-of-pearl inlay. There are many small cracks on the surface lacquer of the bottom and there is a loss of lacquer at the corner of the underside. This loss reveals that the tray has been previously repaired (see fig. 4.14).

##### *Suggestions for Treatment*

The wood structure can be determined by X-radiography.<sup>8</sup> The lacquer layer structure is visible along the edges of the centimeter-square loss to the lacquer.

To determine a suitable cleaning solution, the grime or other residues should be tested. Solvents can be harmful to the cracked lacquer and may weaken the adhesion of the mother-of-pearl to the surface. Some of the apparent grime around the edge of the mother-of-pearl may be the remains of lacquer from manufacture. If so, it would be difficult to remove with any solvent. A small test showed that some of the surface grime can be removed with pure water on a cotton swab. More persistent grime or residue may require more than one cleaning step. An appropriate solvent can be selected to remove the remaining residues. In cleaning, especially when using polar solvents, one must avoid allowing the solvent to penetrate into the lacquer layers. Cleaning must be done very carefully.

After ascertaining the structure of the lacquer layers, we can make a restoration plan. The loss on the bottom should be filled to prevent further loss to the surrounding lac-



Fig. 4.11. Inlaid lacquer box lid. Japan, Ryukyu (16th century), lacquer, mother-of-pearl. Courtesy, Freer Gallery of Art and Arthur M. Sackler Gallery, Smithsonian Institution, Washington, D.C., S1987.386. Lid, showing many old lacquer fills in areas of loss.

quer. First, as much as possible of the previous repair materials should be removed. Then the edges of the original lacquer layers should be sealed with glue or lacquer. The best way to fill the losses is to use traditional lacquer materials and techniques, but these require more time and greater skill than do modern materials. Traditional techniques involve many difficult and laborious steps, including applying and polishing the lacquer ground layers, coating the fill with multiple

coats of lacquer, and polishing repeatedly. It is very difficult to match the color and gloss of new lacquer to original, aged lacquer, particularly because the lacquer color changes in the drying.

Because there are so many small cracks on the surface of this piece, it should be coated to improve the adhesion of the mother-of-pearl to the lacquer and to prevent further cracking of the lacquer. A semidrying oil, such as linseed oil, can be used.

#### JANE WILLIAMS WRITES:

##### *Materials and Techniques of Manufacture*

X-radiography confirms that the tray was constructed from five pieces of wood, a rectangular central panel and four sides, glued together. The surface was covered with a layer of very open, plain-weave textile. The ground layer is a relatively coarse, dry, brownish gray mixture. The thin mother-of-pearl inlay pieces were cut, details of the flowers and birds were drawn on the reverse with bluish paint or ink, and the front surfaces were incised with linear details (see fig. 4.15). This tray is the only object with mother-of-pearl inlay examined for this project that shows underpainting on the inlay. The inlay pieces were adhered to the ground, perhaps with animal glue rather than lacquer. In some areas where inlay has been lost, the ground layer is exposed and in other areas there is a thin lacquer layer that could reflect later repair. Then the tray was coated with layers of lacquer. When these had dried, the surface was abraded and polished to remove the lacquer over the inlay. The raised border between the central panel and sides has a layer of gilding, partially obscured by relacquering, that appears to be original.



Left: fig. 4.12. Inlaid lacquer box lid. Japan, Ryukyu (16th century), lacquer, mother-of-pearl. Courtesy, Freer Gallery of Art and Arthur M. Sackler Gallery, Smithsonian Institution, Washington, D.C., S1987.386. Lid, before treatment (detail).



Right: fig. 4.13. Inlaid lacquer box lid. Japan, Ryukyu (16th century), lacquer, mother-of-pearl. Courtesy, Freer Gallery of Art and Arthur M. Sackler Gallery, Smithsonian Institution, Washington, D.C., S1987.386. Lid, after treatment (detail); old lacquer fills were overpainted with acrylic paints and coated with Primal WS-24.

##### *Treatment History*

The tray has been completely relacquered over extensive fills with a fine pinkish beige material. The fill material is visible through the translucent restoration lacquer and in losses or fine cracks to this layer. The restoration covers crosswise cracks in the older lacquer that are now detectable only in the X-radiograph (see fig. 4.16). It also covers extensive insect damage. Tunneling and frass left by wood-boring insects are visible in a hole in the lacquer on the underside. Additional evidence that the damage is extensive is that none of the original brownish gray ground remains in this area, only the pinkish beige restoration ground. Insect tunneling cannot be precisely identified in the X-radiographs, though there are areas where the wood appears less dense. The restoration fill material was not applied meticulously. It is smeared over the inlay in a few areas. Also,

the fills were not all brought to the same level as the original lacquer. On the restored edges, for instance, the surface level is lower and more uneven than it is on the front sides, where the original surface remains intact below the restoration lacquer. After the losses were filled, an unpigmented restoration lacquer was thickly applied to the entire surface, over both the original lacquer and the filled damaged areas. This material was not identified as lacquer by analysis, but rather by its appearance in visible light (translucent brown with a hard gloss) and in UV light (where it fluoresces a very dull orange color). When dry, this layer was scraped off the inlay (jagged tool marks are visible around the inlay), but not very carefully; the lacquer overlaps or completely covers inlay in many places. Probably in the same restoration campaign a light orange lacquer was applied to the raised border around the central panel. It



Left: fig. 4.14. Tray (B60M163), before treatment; detail of restoration lacquer and black residue obscuring mother-of-pearl.

Right: fig. 4.15. Tray (B60M163), after treatment, showing mother-of-pearl after cleaning; blue painted lines are visible on the reverse of inlay pieces.

appears to contain a sparkly yellow pigment and may have been intended to simulate the gold leaf that was applied to this border originally.

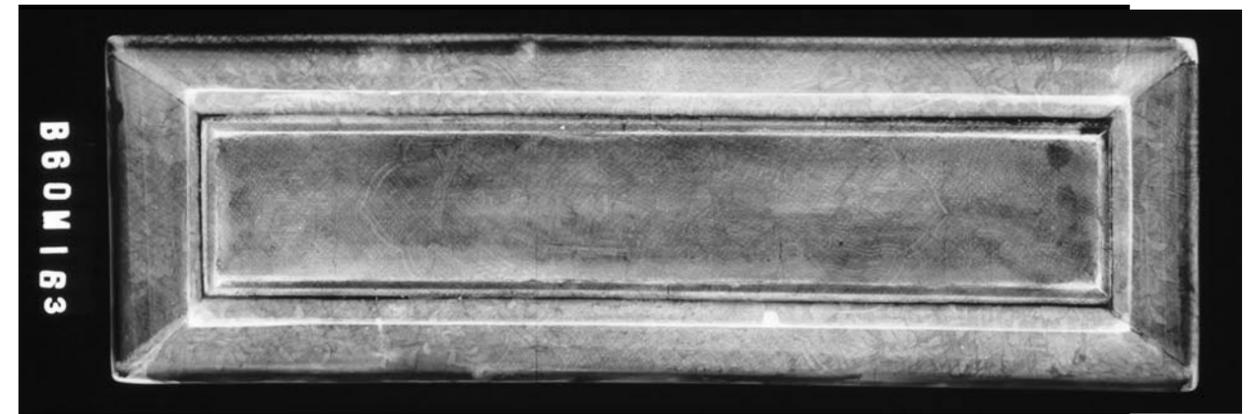
Since the relacquering there has been at least one additional campaign. A reddish brown repair material is visible around the perimeter of the central panel. This material appears to have been applied to fill a crack between the central panel and sides that developed after the overall relacquering. A dull black material, possibly a polishing compound, was smeared over much of the front surface, and remains on the surfaces of the inlay and the lacquer. This material, which strongly absorbs UV light, may in some areas be easily scraped off with a bamboo stick or softened with swabs dampened with ethanol; in other areas, it is much more intractable.

The wax applied in 1970 does not fluoresce in UV light. The only solvent combination that appears to have some effect on the wax is a mixture of ethanol and Stoddard solvent in equal parts.

#### Condition

The tray is structurally stable at this time. There are a few minor areas of instability and loss to the surface. The location and shape of the lacquer loss on the underside (see fig. 4.17) suggest that it occurred when the tray, which was held down to a display surface with a small dab of wax, was lifted up without first releasing it from the wax. The loss appears to have since been consolidated with clear resin. As described above, the wood exposed here is thoroughly tunneled by wood-boring insects and filled with frass, and no original lacquer or ground remains. No exit holes are visible anywhere on the lacquer surface, so the insect damage must be old and predate the restoration lacquer. As recommended by Ms. Norman, the tray was kept in a sealed bag for a few months and no new insect activity was observed.

The restored lacquer surface is in good condition overall, except for a few very mi-



Second from bottom: fig. 4.16. X-radiograph of tray (B60M163). Technical data: Norelco X-ray unit (150kV max.), Kodak Industrex M film, 45 kV, 6 mA, 45 seconds, distance from tube, 36 inches.

nor losses and fine cracks. The bird inlay at the middle of the proper right side panel is lifted slightly.

The repair to the corner of the tray could be toned to match the surrounding surface better. While the application of the restoration ground and lacquer was not perfectly meticulous, the lacquer was smoothed and polished carefully, so that the tray now has a fairly well integrated and glossy appearance. The surface of the tray is dusty and has visible fingerprints.

#### Treatment

The black material smeared over the front surface of the tray is currently what is most adversely affecting its appearance. The other primary aesthetic problem is that excess restoration fill and lacquer are obscuring inlay. The surface was cleaned first with a soft brush and vacuum. A solution of 1 : 1 ethanol : Stoddard solvent was then applied to clean



Above: fig. 4.17. Tray (B60M163), before treatment; detail of loss to lacquer on underside revealing insect tunneling of wood.

Below: fig. 4.18. Tray (B60M163), after treatment; detail of loss to lacquer on underside after filling and inpainting.



Fig. 4.19. Tray (B60M164), after treatment.

the surface and reduce the wax coating. The cleaning solution was wiped on with a piece of soft cotton jersey and then wiped off with a dry cloth. The black material was removed from the surface Working under a binocular microscope, I then removed as much of the black material as possible using, first, tiny hand-rolled cotton swabs dampened with ethanol or 1 : 1 ethanol : Stoddard solvent, the solvents that were most effective in softening this material. (Stoddard solvent alone, acetone, and water were also tested.) Then, as Ms. Norman suggested, a sharpened bamboo stick was used to remove some of the black material, which in many areas remained intractable.

The restoration lacquer also was too hard and insoluble to be removed from the inlay by these steps. A miniscalpel was used to remove the remaining black material and restoration lacquer. The scalpel was polished on Micromesh to remove any irregularities in the edge of the blade that might scratch the inlay. It was held at a low angle to the surface and used to lift the lacquer or black material, avoiding contact between the blade and shell as much as possible. The key to doing this without scratching the inlay was the use of high magnification and the miniscalpel which has fine, sharp blades. Fig. 4.15 shows one area after cleaning.

The ground in lifting areas of lacquer and inlay was consolidated with 5% B-72 in 4 : 1 acetone : ethanol. The consolidant was flowed in with a small brush, and then the area was covered with polyester film and weighted to slow the evaporation of the solvent and optimize penetration of the consolidant. A thicker solution, 15%–20% B-72 in acetone, was used to adhere lifting lacquer and inlay. The color of the inlay did not change as the result of the consolidation treatment. After being sealed with dilute B-72 in acetone, the larger loss to the lacquer on the bottom and the smaller isolated losses were filled with a mixture of 6% polyvinyl alcohol in water and 1 : 1 calcium carbonate : kaolin. The fills were smoothed as much as possible when applied, and then were sanded with successively finer Micromesh up to 12,000 grit. The fills were painted with Rowney FW acrylic inks. Several coats of ink were used to build up the color in thin smooth layers on the larger fill. This was not visually necessary for the smaller (1/8-inch) fills. Primal WS-24, diluted slightly from the stock solution with deionized water until it brushed out well, was mixed with the final coats for gloss. The Primal made the surface harder and made it possible to sand with fine-grit Micromesh between the last few coats. Fig. 4.18 shows the larger loss after filling. □

**T**ray (B60M164), China, 16th century (?), Length 46.8 cm, width 8.7 cm, depth 1.8 cm. A shallow, rectangular, lacquered tray with angled sides (fig. 4.19). The central flat panel has mother-of-pearl decoration depicting two figures on a path in a tree-covered mountainous landscape. The figures are shown approaching a group of buildings partially obscured by clouds. The front edges of the tray are undecorated, on the exterior the sides have a diaper design in mother-of-pearl. It has double rows of twisted wire bordering the central panel on the front and at the top and bottom edges of the reverse side panels. The origin of this tray has been questioned numerous times. It has been labeled variously as Chinese, Korean, and Ryukyuan and has been assigned dates from 1600 to the early twentieth century. Most recently it has been described as Chinese by Michael Knight, the Senior Curator of Chinese Art at the Asian Art Museum, based on its shape and its use of very tiny inlay pieces.

#### Conservation Record

Accessioned in 1960 as part of the Avery Brundage gift. There is no extant record of its treatment in the museum or prior to being accessioned.

JANE NORMAN WRITES:

#### Condition

Although the tray is structurally sound, a wide

crack in the lacquer runs around the perimeter of the rim on the front side (see figs. 4.20 and 4.21). The surface also has many smaller cracks. All the corners have been previously restored with a somewhat rough, dark material, possibly lacquer. There are two paper labels on the back. The surface is soiled and dusty. The mother-of-pearl and the lacquer appear stable at this time.

#### Suggestions for Treatment

The wide crack appears to be old and reasonably stable, suggesting that it does not need further support from an adhesive at this time. For aesthetic reasons, it might be desirable to minimize its appearance by filling it, but this is not structurally necessary. Consultation with a curator may be appropriate at this point. A fill material would need to be relatively soft in case there is future movement along the crack. Wax compounds tinted with black pigment can be used for this purpose (see figs. 4.22 and 4.23).<sup>9</sup>

Any loose areas of mother-of-pearl or lacquer (for which a closer examination is suggested), could be consolidated locally with B-72 in solvents as described for B79M7 (see page 000). Spot tests reveal that the lacquer and mother-of-pearl could be cleaned with a small amount of water, or water and ethyl alcohol, as described for B60M164 (see p. 000).

The appearance of the restored, roughly



Top: fig. 4.20. Tray (B60M164), before treatment.

Second from top: fig. 4.21. Tray (B60M164), detail before treatment, showing a deep crack in the lacquer.

Above left: fig. 4.22. Dish. China, Yuan dynasty (1297–1368), lacquer, mother-of-pearl. Courtesy, Freer Gallery of Art and Arthur M. Sackler Gallery, Smithsonian Institution, Washington, D.C.,

S1987.369. Before treatment; reverse side, showing a deep crack where the sides meet the bottom.

Above right: fig. 4.23. Dish. China, Yuan dynasty (1297–1368), lacquer, mother-of-pearl. Courtesy, Freer Gallery of Art and Arthur M. Sackler Gallery, Smithsonian Institution, Washington, D.C., S1987.369. After treatment; the crack was filled with a tinted wax mixture; see note 8 for the formula.

textured corners could be improved by sanding and/or carving and then repainting them with black acrylic paint. This could be followed by one or two coatings of WS-24 if needed to match the surrounding gloss. The paper labels, which might be discoloring the lacquer, should be removed and saved.

#### ZHANG LAN WRITES:

##### *Condition*

The tray has a wood substrate. The evenly spaced wood grain and my knowledge of traditional woodworking techniques suggest to me that the wood may be fir. The tray appears structurally sound. The interior lacquer surface has a crackle pattern, and there is a wider crack running round the interior perimeter. There is evidence of previous repairs to the proper left end. There are two self-adhesive paper labels on the bottom. The lacquer is not of high quality or purity and looks very dull (see fig. 4.20).

##### *Suggestions for Treatment*

We can determine the wood structure by X-radiography. We can also determine the lacquer layer structure through the wide crack running round the interior perimeter. There are many small cracks on the surface. The surface layers have no luster. The tray's surface appearance is very different from that of one

of the other trays in this study (B60M163) in that its color is faded and dull. The rough surface is evidence, principally, of the maker's lack of skill and use of inferior materials and, secondarily, of poor storage.

Removing the self-adhesive paper labels should not be difficult. The surface of the object also needs an overall cleaning for aesthetic reasons. The cleaning solution must not harm the cracked and deteriorated lacquer. After choosing an appropriate solvent, we can remove the labels and other residues. As with the tray B60M163, care should be taken to prevent the cleaning solution, particularly if a polar solvent is used, from penetrating into the lacquer layers.

Once we know the structure of the lacquer layers we can determine the plan for restoration. The wide parts of the crack around the interior perimeter need to be reinforced or the crack will expand and there will be further losses to the lacquer near the edge. Ideally, the crack should be repaired using traditional materials and techniques. These, however, require a great deal of time and skill, so instead, modern materials could be used. Traditional techniques involve many difficult and laborious steps, including applying and polishing the lacquer ground layers, coating the fill with multiple coats of lacquer, and polishing repeatedly. It is difficult to match the color and gloss of new lacquer to original, aged lacquer, particularly because lacquer changes color in the drying. Matching the restoration lacquer

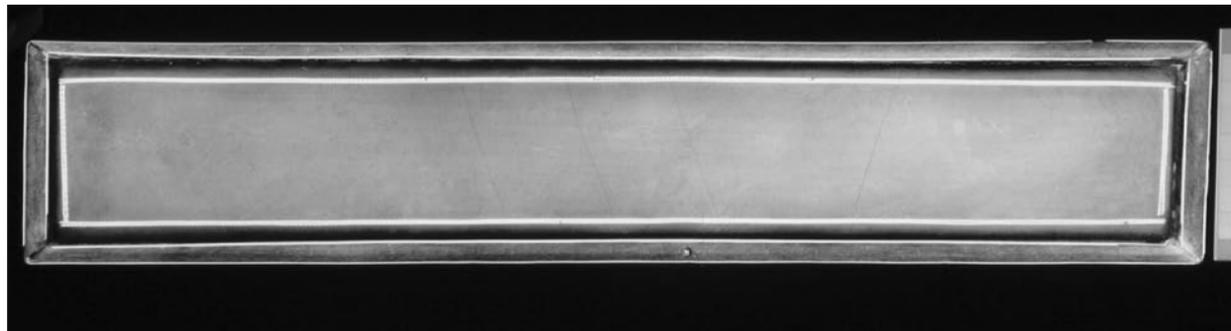


Fig. 4.24. X-radiograph of tray (B60M164). Technical data: Norelco X-ray unit (150kV max.), Kodak Industrex M film, 45 kV, 6 mA, 45 seconds, distance from tube, 36 inches.

to the existing lacquer will be particularly difficult and time-consuming for this tray because the surface has no gloss and many fine cracks. The tray should be coated with a semidrying oil to improve the adhesion of the mother-of-pearl to the lacquer and to prevent further cracking of the lacquer.

JANE WILLIAMS WRITES:

#### *Materials and Techniques of Manufacture*

The structure of the tray was confirmed by X-radiography (see fig. 4.24). The tray was constructed from five glue-joined pieces of wood—one for the central rectangle and four for the narrow sides.<sup>10</sup> The wood appears to be a softwood. Its even grain and the pronounced difference in density between the earlywood and latewood are visible in the X-radiograph. The front surface only was covered with a layer of plain-weave textile, presumably to reinforce the joins, before the lacquer ground layers were applied.<sup>11</sup> A coarse, brownish gray ground, visible in cracks and small losses to the lacquer, was applied next. The very thin mother-of-pearl inlay pieces were cut, adhered to the ground and incised with linear details. The inlay decoration was applied to the

central panel on the front and to the side panels on the reverse. The mother-of-pearl used on this tray is thinner, whiter, and less iridescent than that used for the other inlaid lacquer objects in this study (cf. B60M163, B79M7 and B77M21). A different type of shell may have been used, but it is impossible to accurately identify the variety when the fragments are so small. The diminished iridescence may be due in part to the thinness of the inlay on this tray.

Copper-alloy wire was twisted in pairs and applied to the surface in double rows. For two of the pairs on the long edges, discontinuous shorter lengths of wire were used. The wire on the central panel is of a heavier gauge than that on the side panels. The wire has a seam and appears to be made from a flat ribbon of metal rolled into a tube (see fig. 4.25). Twisted wire borders appear on trays from China, Korea, and Ryukyu,<sup>14</sup> so this feature does not help to identify the tray's origin. The wire may serve to protect or reinforce the edge and seams as well as to decorate them.

The tray was then coated with layers of dark brown lacquer. In cross-section samples of the lacquer there is no evidence of pigments added to the lacquer (see fig. 4.26). When these layers had

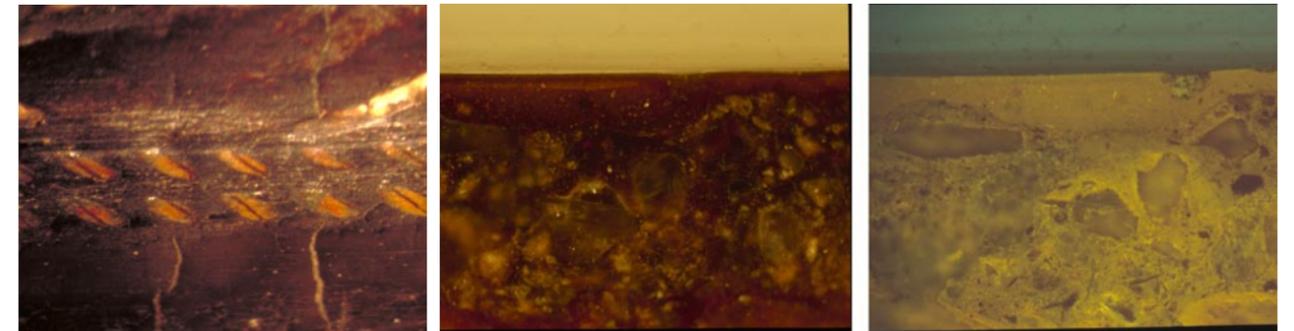


Fig. 4.25. Tray (B60M164), photomicrograph showing wire structure.

Fig. 4.26. Tray (B60M164), cross-section sample of surface layers, shown in reflected light (left) and ultraviolet light (right), photo taken at 200x magnification.

dried, the lacquer was abraded or scraped off the inlay surfaces and the rest was polished. Because restoration lacquer has submerged the inlay decoration, it is difficult to determine whether the inlay was originally level with the finished lacquer surface or slightly lower. It is also impossible to tell how the final applications of lacquer were removed from the inlay surfaces.

#### *Treatment History*

The number of different restorations the tray has undergone suggests that a twentieth-century date is unlikely.<sup>13</sup> While no treatment records exist, the tray has had at least four repair campaigns. The front has patches of a dull, coarse, gray fill material around most of the inlay and in areas where inlay is missing, which indicates that it is a repair material.<sup>14</sup> The tray was relacquered overall on top of this material. The process of polishing the restoration lacquer exposed the highest points of this fill material. This material could not be sampled for analysis because the surface remains intact in all of the areas where it was applied.

The restoration lacquer in many areas obscured mother-of-pearl inlay. This restoration lacquer has developed a fine craquelure. Where

I subsequently exposed more of this layer by mechanically removing later lacquer overfilling, there is no craquelure. It appears that the craquelure developed as the result of more recent light exposure. The current dull appearance of the tray, then, seems to be due to fine fissures in a restoration lacquer, rather than to the poor quality of its manufacture as Mr. Zhang suggested. Of course, poor manufacture could still be at least in part responsible for the extensive restoration this tray has needed over time.

Localized repairs were subsequently done at the corners with a fine pinkish ground.<sup>16</sup> The corners, the entire underside, and the edges were then coated again with what appears to be lacquer that has a greener brown tone than the burgundy brown of the first relacquering.<sup>17</sup> The same greenish brown coating is also spattered across one side of the front central panel.

In the third round of repairs a fine white fill material, was used to fill cracks along joins at three of the corners and at the proper right end. The white fill could be a protein glue and whitening or *gofun* mixture, because it is very soluble in water and tests positive for carbonates. The white fills were coated locally with brown lacquer. Two pieces of inlay on the tree toward the

proper right side were replaced in the same restoration. They are slightly thicker and fluoresce whiter than the rest of the inlay in UV light. There is evidence of the same white fill material around them, covered with the same restoration lacquer. The use of what seems to be lacquer here suggests that these repairs were done in Asia or by Asian-trained restorers.

The most recent campaign involves repairs to one end and corner that, because of the materials used, were probably done by Western restorers (see fig. 4.21). The end broke off and a crack opened along the join on the adjacent long side. A shiny, dark, slightly sticky material that is soluble in acetone was used as an adhesive in the join at the end and in the corners. A reddish beige material was applied very sloppily to fill the cracks and is smeared over the surrounding surface. The repair areas were covered generously with a thin, shiny, dark paint, perhaps an oil paint, which fluoresces a dull green color in UV light and is somewhat soluble in acetone.

#### *Condition*

The tray is currently in good, stable condition overall. The crack around the interior perimeter between the central panel and the sides is generally stable, although there are a few small fragments of lacquer along the crack that move slightly under light pressure. There are fine cracks throughout the front surface, predominantly running crosswise. There are three larger, diagonal, crosswise cracks on the reverse. The cracking on the front appears to be the result of deterioration due to light exposure. The development of the large, isolated cracks on the reverse may be related to the application of the coarse fabric to the front only. All of these cracks appear stable at this time. On the reverse, a crack has reopened at an old repair along one join. There are very minor losses to the wire inlay and numerous losses to the inlay throughout

the tray. The inlay that remains appears stable.

The old repairs at the proper left end are sloppy and cover the original lacquer. The repairs to the corners do not match the color of the surrounding lacquer. Some of the restoration lacquer on the front obscures inlay. The front surface of the tray is very dusty and has visible fingerprints on the underside and edges. One of the labels adhered to the tray reads “No. 210 Made in Japan.”

#### *Treatment*

The surface was first cleaned very carefully with a soft brush to remove loose dirt. A vacuum held a few inches away from the surface, to avoid suction of any of the original material on the tray that may have been loose, absorbed the lifted dirt. The surface was cleaned overall with a soft cotton linter very slightly dampened with ethanol. The cleaned areas were wiped immediately afterward with a dry cloth. In the overall cleaning, areas with inlay or possibly lifting lacquer were avoided. The surface of the inlay and more delicate areas of lacquer were cleaned with ethanol applied with cotton swabs. This cleaning I did while looking through a binocular microscope. Some of the inlay that had appeared to be well adhered could, under magnification, be seen to move slightly when touched with a swab. These areas were consolidated during cleaning by flowing 15% B-72 in acetone under the inlay with a small brush and immediately removing any excess adhesive with acetone on a small swab.

The self-adhesive labels were removed mechanically by slowly lifting and loosening them underneath with a scalpel, keeping the scalpel nearer to the label than to the lacquer surface. The adhesive residue was removed from the lacquer surface with ethanol and cotton swabs. Ethanol was not used to loosen the labels because the inks on the labels were soluble in



Fig. 4.27. Tray (B60M164), detail after treatment

ethanol. The labels will be kept in the museum registrar's records.

The next step—taken for purely aesthetic reasons rather than for stability—was to reduce the restoration lacquer on the surface. On the main design field relacquering was removed where it obscured mother-of-pearl inlay. The restoration lacquer tends to crack and lift where it lies on top of inlay, which makes it easier to find the inlay and the to remove the later lacquer safely. This was done with the use of a miniscalpel as described for tray B60M163. A sharpened bamboo stick was not suitable for this task as it required more pressure to move the lacquer, which could dislodge inlay and take off more lacquer than desired. The purpose of this process was to expose design elements that had been obscured. Some of the inlay is more deeply submerged in lacquer and the lacquer is not as easily lifted from its surface. Difficult areas were left alone. Also, because treatment time is limited and these areas are hardly visible on display, the restoration lacquer was not removed from the diaper pattern inlay on the exterior sides.

The last treatment step was to remove the sloppy localized repairs. A small swab dampened with acetone was used to remove the paint on the most recent repairs to the proper left end and the upper proper right corner. The lumps of hard reddish beige fill material were carved down with a miniscalpel until only a skin of this material remained. This skin then peeled nicely from the surface with the scalpel. Excess white fill and the dark shiny adhesive removed with a swab lightly dampened with deionized water. Because this fill is so readily soluble in water, it could be removed even where it was still covered with restoration lacquer; then the restoration lacquer could be peeled away with the scalpel. In some places around the repairs the restoration lacquer had been smeared thinly directly over the previous lacquer with no intervening fill material. As it could not be safely removed without scratching the underlying lacquer, it was left. The remaining localized repairs were also left, because they are stable and are not causing any damage to the tray. Because some of the materials are at least as strong as the origi-

nal materials, it is likely that the original would be damaged in the process of removing the repairs. The overall restoration lacquer coating or coatings could be removed only by polishing or sanding, but neither process could be used without altering the original finished surface.

Once the excess repair materials had been reduced, depressions in the repaired areas were filled with a smooth mixture of 15% B-72 in acetone mixed with 1 : 1 calcium carbonate : kaolin. In the small losses, such as cracks, the fill was simply smoothed with a tiny spatula dampened with acetone. On the larger losses at the corners the fills were smoothed with fine sandpaper and Micromesh. The fills were toned with Rowney FW Acrylic Artists ink. Since the surface of this tray is fairly dull, the fills did not need additional gloss to match the surrounding surface.

The open crack on the front between the top and central panels was examined under the microscope and a few tiny islands of loose lacquer were located along it. These were consolidated by first introducing 5% B-72 in 4 : 1 mixture of acetone and ethanol to consolidate the ground. A resin used to consolidate the ground should offer good penetration and even dispersion. An aqueous consolidant was not used in order to avoid exposing the lacquer and ground to the possibly damaging effects of moisture. The lacquer and ground, for instance, are not badly distorted in a way that could be ameliorated by the introduction of water. B-72 was chosen for its excellent aging characteristics, appropriate strength, and its solubility in a range of solvents. B-72 in acetone is considerably less viscous than B-72 in nonpolar aromatic solvents, so it should penetrate better in acetone. Acetone, however, evaporates very quickly, which can cause the resin to be pulled back to the surface with the evaporating solvent rather than remain deep within the ground. Ethanol, a solvent that evaporates much more slowly, was added to retard the evaporation of the con-

solidant. Because ethanol is so hygroscopic and acrylic resins are very hydrophobic, the amount of ethanol added was kept to 20%. The tray was covered with Mylar and light weights to prolong the drying. When the consolidant had dried, a solution of 15% B-72 in acetone was introduced with a small brush to secure the loose flakes. Here the resin was used in straight acetone because the rapid evaporation of the solvent is not a problem in an adhesive.

Mr. Zhang recommended filling the open crack and Ms Norman thought perhaps filling was necessary only for aesthetic reasons. The lacquer along this crack is generally quite stable. The crack may make the wood more vulnerable to fluctuations in relative humidity. However the tray is not scheduled for display and will be stored in the museum in its own paulownia wood box. Also, because the crack is on the interior, this area is not vulnerable to handling and any future loose flakes will remain contained within the tray. Thus I felt that filling the crack is not currently necessary for the stability of the object. Because the tray is not scheduled for display and my treatment time is limited, filling it for aesthetic reasons is also not necessary.

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Fig. 4.28. Tray (B79M7), after treatment.

**T**ray (B79M7), China, Yuan, 14th century, Length 40.2 cm, width 11.3 cm, height 2.0 cm. The object is a shallow rectangular tray with angled sides and a low, raised foot. The decoration is done in mother-of-pearl inlay on lacquer. The central panel has a lengthwise design of three birds perched on a tree that is emerging from a group of large rocks. This design is set within a cartouche. The area outside the cartouche on the central panel and the front and back of the side panels are covered with a diaper pattern.

#### *Conservation Record*

The tray was accessioned in 1979 and there is no record of its treatment in the museum or prior to being accessioned.

#### JANE NORMAN WRITES:

##### *Condition*

The tray is made of slats of wood fitted and adhered together, covered with a woven textile (see fig. 4.29), and then a clay and lacquer compound as a ground for the black lacquer sur-

face. Although structurally sound, the surface is generally unstable because there are many areas of loose or lifting mother-of-pearl and lacquer. Two small pieces of shell are already detached but have been saved. In many areas the mother-of-pearl inlay is lost. Most losses are small and not very noticeable but one large missing piece (or pieces) was the top half of the bird in the middle of the landscape. The lacquer surface shows the usual fine craquelure and larger cracking patterns seen on old lacquer objects. Small bits of lacquer are, however, lost entirely, particularly on edges and corners, and many areas are currently unstable.

The surface is soiled and a brown residue (the remains of a previous relacquering) obscures many of the edges on the mother-of-pearl fragments. Old lacquer fills are seen on three of the corners. They are browner in color than the surrounding black surface.

##### *Suggestions for Treatment*

The priority is to stabilize the loose mother-of-pearl and the lacquer flakes. For the mother-of-pearl it is especially important to use an



Fig. 4.29. X-radiograph of tray (B79M7) showing construction. Technical data: Norelco X-ray unit (150kV max.), Kodak Industrex M film, 35 kV, 6 mA, 90 seconds, distance from tube, 36 inches.

adhesive that will remain clear and colorless. B-72 is a good choice for both applications. Determining viscosity is a matter of practice. It can be thinned with solvent when it is to run under the shell pieces (perhaps a solution of between 10% and 15%) or used at a higher concentration (perhaps between 15% and 30%) for greater viscosity under the lacquer flakes. Solvents can be simply acetone or any combination of solvents that the conservator prefers. A solvent mixture of 1 : 1 : 1 acetone, ethyl alcohol, and xylene allows for more working time than straight acetone does, and is often helpful for setting down mother-of-pearl. The B-72 solution is dripped in from a fine-pointed brush along the edge of the lifted or loose area and allowed to flow underneath. This may require several applications, but too much consolidant is no better than too little. Excess must be removed with a solvent as soon as possible. The two detached flakes can be readhered with the solvented B-72 solution.

Most areas, and certainly the two detached flakes, will need to be weighed down so that they will set in place, and two methods are recommended. One can use simple weights (sandbags or lead shot) separated from the object by

a layer of Mylar film. Or one can use a *shinbari*, a Japanese six-sided wooden frame with a solid top and bottom and open sides (see fig. 4.30). The object is placed onto the bottom of the *shinbari* and gently braced with wooden blocks. Pressure is applied to the small area under repair (in this case the lifted flakes) via long, flexible wooden dowels that are inserted between the ceiling of the frame and the object. (Mylar and a dense padded material such as linoleum tile or cork serve as barrier materials between the end of the dowel and the object.) This system is best suited to lifted or detached lacquer that cannot easily be made to lie flat. The pressure exerted on the area of repair can be controlled by the length (and therefore the tension) of the dowel.

After the tray is stabilized, the surface can be cleaned. Spot-cleaning tests with a slightly dampened cotton swab on the plain black areas revealed a distinct improvement in the clarity and depth of the lacquer. If time permits, it may be desirable to remove some of the brittle brown lacquer residue covering the edges of much of the mother-of-pearl. The techniques for cleaning lacquer and removing residue described for the oblong tray B60M163 (page 000) can be used.

The losses to the lacquer and the mother-of-pearl could remain untreated, provided they are stable. The losses to the lacquer are not very noticeable, but they could be filled, as described above for B60M163 (see page 00). The mother-of-pearl loss to the bird is more troublesome; some conservators might fill it with new mother-of-pearl or a synthetic substitute. Frequently, however, a stabilized loss is preferable to a less-than-perfect restoration.

To minimize their appearance, the old brown lacquer repairs on three of the corners could be in-painted with black acrylic paints and coated with Primal WS-24, as described above for B60M163, to match the gloss.

#### ZHANG LAN WRITES:

##### *Condition*

The tray is made of wood with mother-of-pearl inlay. Fir was traditionally used for such objects. The tray appears structurally sound. The lacquer layers are cracked and lifting in several locations. There are other small losses of inlay and lacquer around the edge. The inlay is also lifting in many places and a piece of shell for the bird in the center proper right is missing. One of the other mother-of-pearl birds has become detached from the lacquer layer (see fig. 4.31). The surface is extremely dusty overall.

##### *Suggestions for Treatment*

The wood structure is apparent from the existing X-radiographs. The lacquer layer structure can be studied along losses. The solubility of the surface grime should be tested to select an appropriate cleaning solution. Sometimes ethanol is safer than pure water for removing surface residues, because the water will penetrate more quickly than ethanol will into cracked surfaces, which this tray has. I believe that water may



Fig. 4.30. Dish. China, Ming dynasty (1368–1644), lacquer. Courtesy, Freer Gallery of Art and Arthur M. Sackler Gallery, Smithsonian Institution, Washington, D.C., S1987.384. A *shinbari* is being used for support while the dish is undergoing repairs.

harm the ground layer, because its surface tension is so high. The solvent must not weaken the adhesion of the mother-of-pearl to the lacquer and must not cause the cracks to expand. Once an appropriate solvent is selected, the surface grime can be removed, avoiding penetration of the solvent, particularly if it is a polar solvent, into the lacquer layers.

Once the lacquer layer structure has been determined, a treatment plan can be made. If necessary for display, the missing shell inlay for the bird can be replaced by carving a new one. The detached bird will be readhered in its original position. If the losses to the lacquer layer

are not filled, the edges of the losses should be consolidated. The best way to repair the lacquer is with traditional materials and techniques, but these require more time and greater skill than do modern materials.

Because there are many small cracks on it, the surface should be coated to help the mother-of-pearl adhere to the lacquer and to prevent further cracking of the lacquer.

JANE WILLIAMS WRITES:

#### *Materials and Techniques of Manufacture*

The tray was constructed from five pieces of wood that have been glued together to make the central panel and sides. Underneath, the side pieces extend beyond the central panel to make a shallow raised foot. The surface layering on the tray was studied with cross-section samples. The surface was covered with a plain-weave textile (visible in the X-radiograph). A coarse, gray brown ground layer was applied over the textile. The autofluorescence of this layer in UV-violet light, a gray white color, is distinct from that of the lacquer layers and is consistent with the appearance of protein glue binders, but the binder was not analyzed (see fig. 4.32). With reflected light microscopy, ash and clay are visible in this layer. The layer above the ground layer appears to be lacquer mixed with black pigment or ash. The mother-of-pearl inlay was set onto wet black lacquer. Where inlay has detached, a thin layer of black lacquer is revealed and the impression of the inlay is left in the lacquer. One cross section includes a fragment of inlay that is submerged in the black pigmented lacquer layer, confirming that the inlay was set into this layer when the lacquer was still wet. Next, additional layers of lacquer were applied to even out the surface and, when dry, were polished down flush with the inlay. Each of the samples has,

on top of the black lacquer, at least one layer of clear, unpigmented lacquer.

The mother-of-pearl pieces are extremely thin. They have finely incised lines in their surfaces that were not cut all the way through. This incising must have been done after the inlay was adhered in place and was firmly supported. The lines were chiseled with a tool having a rounded tip. With magnification, one can see that each cut consists of a series of curved tool marks. Most of the incised lines have lacquer in them, suggesting that the designs were cut before the final lacquer layers were applied.

#### *Treatment History*

This tray has been repaired several times. Visual examination and microscopy suggest that the area within the central cartouche is the only part of the tray that has not been recoated with lacquer. The lacquer surface within the cartouche is level with the inlay and neatly conforms to the outlines of the inlay. This area has a dull, black appearance with a fine craquelure throughout. This area also has throughout it larger cracks, predominantly crosswise, that do not continue across the surrounding surface.

The sides of the tray and area outside the cartouche on the central panel were relacquered in the same campaign. These areas fluoresce a dull orange color in UV light, while the area within the cartouche absorbs UV light. The later lacquer can be seen to overlap the original lacquer at the border of the cartouche, and dots of it are spattered across the cartouche. The sides of the tray must have been more damaged than the center, because they appear to have been resurfaced down to the textile layer, with the inlay also replaced, while the outer areas of the central panel were simply relacquered over the original lacquer and inlay. The diaper pattern on the sides has diamond-shaped inlay at its centers, whereas



Fig. 4.31. Tray (B79M7), before treatment.

the same pattern on the central panel has foliate inlay pieces. Only traces of the gray ground layer found on the center of the tray are found on the sides (see figs. 4.32 and 4.33). Instead, the sides have a different ground layer that is much finer and pinkish in color. In cross section (see fig. 4.33) this ground layer has an autofluorescence very similar to that of the lacquer layers and distinct from the original ground. The inlay on the sides was adhered directly to the ground layers and not to a substantial wet lacquer layer. The inlay in these areas is still partially covered by an unpigmented *urushi* layer that was scraped away, rather than polished down, to reveal the inlay. The scraping tool marks are visible around the inlay and the lacquer is higher than the inlay, rather than level with it as it would be if polished down.

Significant areas of inlay appear to have been replaced with new mother-of-pearl, including the remaining parts of all three birds and the largest piece of inlay in the. These inlay fragments do not fit well in their recesses, their incised lines are sharper and in places cut through the shell, and they fluoresce a brighter white in UV light than the rest of the inlay. Where the

replacement fragments are loose or detached, a white powdery fill material, also found in the large crack at the bottom of the cartouche, is visible below them. This material was sampled and tested positively for carbonates—in dilute hydrochloric acid it dissolved completely with effervescence—and it softens readily in water. A fine, gray fill material (also carbonate-based) is found around some small cracks and loose inlay. Both of these materials are partially covered with brown lacquer, so these fills appear to predate or be contemporary with a relacquering campaign.

#### *Condition*

The tray is currently in unstable condition, the lacquer flaking and the inlay loose. The most unstable area is the open crack at the bottom of the cartouche (see fig. 4.34). Here a large area of the lacquer within the cartouche is lifting. Several small pieces of inlay that form the border are loose or missing, and the old white fill in the crack is now crumbly and loose. Along losses to the edges of the tray, small areas of the lacquer, ground, and inlay are lifting together. In all cases the separation appears to be occurring

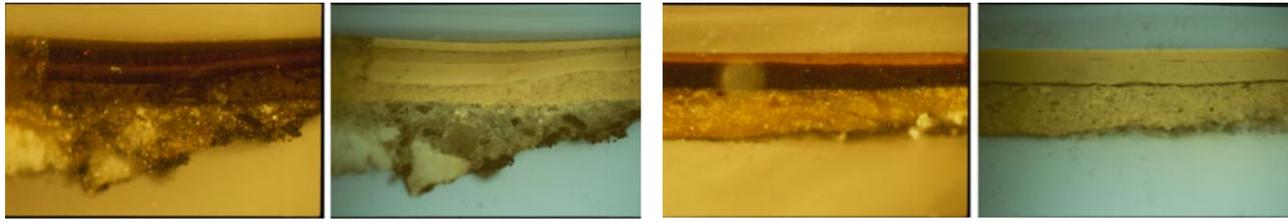


Fig. 4.32. Tray (B79M7), cross-section sample of original surface layers, taken from central design field, shown in reflected light (left) and ultraviolet light (right), at 00x magnification.

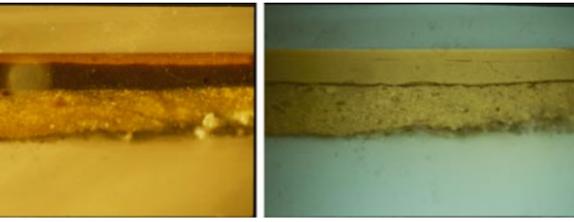


Fig. 4.33. Tray (B79M7), cross-section sample of restoration surface layers, taken from side of tray, shown in reflected light (left) and ultraviolet light (right), at 00x magnification.

within the ground layer, because this layer is the weakest and least cohesive.

Several pieces of inlay, most of them replacement pieces, are loose or detached. Most of the inlay from one bird near the center has been lost since the museum acquired the tray in 1979. The black lacquer in the central cartouche has two streaks of lighter brown discoloration, possibly water staining. The underside of the tray has a dull area in one corner where the surface was etched or abraded, perhaps when a label was removed. The surface of the tray is dusty and grimy.

#### Treatment

Because the lacquer and inlay are so fragile, the tray could not be cleaned with a brush and vacuum prior to consolidation. Except for the unstable areas, it was cleaned with soft cotton jersey dampened with Stoddard solvent, followed immediately by dry jersey to remove accumulated surface dust.

Dilute B-72 (approximately 5%) in 4 : 1 acetone : ethanol was used to preconsolidate the ground. This adhesive and solvent mixture was selected for the same reasons it was used for B60M164 (see page 000). It was introduced with

a small brush and then the area was covered with Mylar and weighted with small sandbags just heavy enough to keep the lacquer flat. This pre-consolidation step seems particularly important when the lacquer is lifting because of the poor state of the ground. It should minimize the disparity between localized stronger, consolidated areas and the weaker areas that the adhesive does not penetrate.

Mr. Zhang recommended using traditional materials to consolidate the lacquer. This would mean using aqueous protein glues or *mugi-urushi* to secure the lacquer. Mr. Zhang cautioned against using water on this weak ground, which does appear to have a protein glue base, rather than a lacquer base, and so would be more vulnerable to moisture. For a protein glue ground, *mug-iurushi* would be too strong an adhesive. Ms. Norman recommended B-72 as an adhesive, and this is what I selected, using 15% B-72 in acetone to reattach the flaking lacquer. The consolidant was used successfully in the largest lifting area at the end of the cartouche and in several other smaller areas, but then I encountered problems in one of the last areas to be treated. As previously, I



Fig. 4.34. Tray (B79M7), detail before treatment.



Fig. 4.35. Tray (B79M7), detail after treatment.

introduced the consolidant with a small brush and cleaned off the excess with swab dampened with acetone. The area was weighted, again with a Mylar barrier, and more heavily than for the preconsolidation step to ensure tight contact between wood, ground, and lacquer. When I removed the weights to check the area after about fifteen minutes, the lacquer layer had swelled and bulged. I left it for another five to ten minutes without weights so that the solvent could evaporate off a little more, and then put the weights back on. The lacquer returned to its original position and appearance without permanent visible change. The swelling of the lacquer layer occurred in an area that had been relacquered. The swelling may have occurred because restoration lacquer is thinner than the original lacquer, or because it had a different composition from the original.

The loose inlay was reattached with 15% B-72 in acetone. Adhesive introduced behind the shell is likely to change its color, no matter what adhesive is used. The shell looks whitish with air behind it (when it is loose) and more green or pink when it is securely attached to the dark ground. The inlay darkened slightly

when consolidated, but there is so much replacement inlay on this tray that the variation is not noticeable.

Losses to the lacquer were filled in order to prevent future damage and loss. Filling the losses is particularly important on objects like this one in which the numerous tiny fragments of inlay divide the lacquer into numerous islands. It is very easy for the inlay and lacquer fragments to snag or otherwise become detached. B-72 in acetone bulked with 1 : 1 kaolin : calcium carbonate and dry pigments was used. These losses were tiny and could be adequately smoothed with a spatula dampened with acetone. The fills were toned with FW Acrylic Artists' inks mixed with Primal WS-24 for gloss. Fig. 4.35 shows a detail of the damage at the bottom of the cartouche after it has been consolidated and losses filled.

There was insufficient time to remove lacquer that is obscuring the inlay. In the future, if the tray is selected for display, the replacement of the missing inlay will be discussed with the curator. Possibilities include Mylar inserts toned with mica pigments or mother-of-pearl that has been marked to indicate that it is a restoration. □



Fig. 4.36. Covered box (B77M24), after treatment.

**C**arved Lacquer Box (B77M24), China, Ming dynasty, 1368–1644, height 13.5 cm, width 25 cm, depth 24 cm. This lidded box is hexagonal with indented corners (fig. 4.36). The top of the lid is decorated with red carved lacquer and the sides of the lid and box have red carved lacquer design elements on a yellow brown lacquer background. The interior and underside are coated with black lacquer. On the top of the lid is depicted a scholar seated in a pavilion with two attendants. Pine trees, rocks, and water surround the pavilion. The three levels of the side decoration depict different flowers set in rectangular panels. A meander runs around the side of the foot.

#### *Conservation Record*

The box was accessioned in 1977. No extant record of its prior treatment.

JANE NORMAN WRITES:

#### *Description*

The substrate, as confirmed by existing X-radiographs, is constructed of slats of wood. Two types of textiles have been used to line the wood and may be seen in areas where the lacquer surface is lost: a nonwoven fabric on the exterior and a plain-weave fabric on the rim and interior. X-radiographs also reveal many previously restored areas of lacquer on the top of the lid. These restorations are well carved and may be very old (see fig. 4.37).

#### *Condition*

Although the box is in generally good condition, several fragments of red lacquer have become detached; five have been saved. The overall surface has deep cracks and some of the lacquer has warped. Under high magnification, one can see that some areas have an extensive craquelure but others, such as the sides and the restored areas

of the top, do not. This suggests extensive but selective relacquering. The restored areas are a slightly different color from the surrounding surface. On the top of the lid there are glossy areas and white deposits, both of which are soluble in acetone and may be residues from synthetic materials used in previous repairs. The underside of the box is very dirty.

#### *Suggestions for Treatment*

The detached pieces need to be readhered and an acrylic resin, such as a 25% to 30% solution of B-72 in 1 : 1 acetone and ethyl alcohol, would work well. The fragments could be clamped or set into a *shinbari*, as noted for B79M7 (see p. 000), to secure them while they are drying. It would be useful to check the box carefully to make sure that other fragments are not loose, and adhere them with the B-72 where needed.

The glossy and white adhesive residues can be removed easily with acetone. If the surface can be safely cleaned with ligroin (petroleum benzene) or ethyl alcohol, the procedure might remove the wax that was applied in 1970. Whatever solvent is selected must be used sparingly to prevent it from sinking into the cracks and swelling the wood substrate. The black underside of the box needs cleaning. Water or 1 : 1 water and ethyl alcohol, used sparingly, would be most effective.

The decision to fill remaining losses to the lacquer surface may include consultation with a curator or be based on an established approach to cosmetic fills. If fills are desired, they could be done with a commercial spackling compound such as Polyfilla or Modostuc, or with a mixture of solvented Acryloid B-72, calcium carbonate, and kaolin, as described for B60M163 (see p. 000). After being shaped and smoothed, the fills could be in-painted with acrylic paints and have their gloss matched to the surrounding lacquer with one or two coats of Primal WS-24,

as described for B60M163. The discordantly colored restorations on the top could also be treated with the same in-painting and Primal methods to minimize the difference in color.

ZHANG LAN WRITES:

*Condition*

The box, made of wood with thickly carved red lacquer on a yellow brown lacquer background, appears structurally sound. In areas of loss, it appears that the ground layers contain flax mixed with ash, as was used traditionally. The construction of the box is not as good as that of many other examples of carved lacquerware I have seen in China.

The thickly carved cinnabar lacquer is cupped and pulling away from the wood substrate in several locations. Five detached pieces have been saved. There is evidence of previous restoration campaigns; the surface of the lid is glossier in some areas, presumably from a previously applied adhesive. In these areas the lacquer has cracks or is cupping, perhaps caused by large quantities of polar solvent, such as acetone, used in the adhesive mixture. The original lacquer, ground layers, and wood have different surface tensions and will absorb the solvent at different rates, which may lead to cracks and cupping. The surface has dust and dirt overall (see fig. 4.38).

*Suggestions for Treatment*

The wood structure of the box is apparent from existing X-radiographs (see fig. 4.37). Existing losses facilitate the study of the lacquer layers. In the X-radiographs many previous repairs are discernible as areas of higher density even though they are not visible on the surface. Those areas have a higher cinnabar content. The restoration lacquer covers the original lac-



Fig. 4.37. X-radiograph of lid of covered box (B77M24), showing previous restorations. Technical data: Norelco X-ray unit (150 kV max.); no exposure records available.

quer. I believe that this box was repaired at the time of manufacture, because the restorations have the fine cracks typical of aged lacquer and were done using the same techniques. The techniques used for carved lacquer usually protect the wood perfectly, so I do not know why the cracking on this box is so extensive, especially on the interior.

The dust and dirt should be removed from the surface to show the bright red and pure yellow that are the original colors. (For an illustration of the effect of cleaning on a similar object, see figs. 4.39 and 4.40.) Cleaning must be done carefully as the thin lacquer background is not sound. Some cracked or broken areas may need reinforcement before cleaning. Because the lifting lacquer is so thick and hard, the conservator may need to test different reinforcement materials to find one that is effective. Surface cleaning must be done very sparingly, so that the solvent, particularly if it is a polar solvent, does not pen-



Fig. 4.38. Covered box (B77M24), before treatment.

etrate into cracks and damage the lacquer. On other objects I have found that acetone can be used safely to remove adhesive residue and, in a small cleaning test, I found that acetone removes the shiny adhesive residue on the lid of this box.

Once the lacquer layer structure has been determined, we can make a treatment plan. The first step is to consolidate the exposed wood and ground where the lacquer is cracked or has losses with a material such as pine resin, dammar resin, or B-72. This will help stop the cinnabar lacquer from pulling away from the wood substrate. Then the five pieces of thickly carved lacquer can be readhered in their original positions. Additional losses to the carved lacquer can be filled by making a silicon rubber mold from a similar, surviving design element, casting a replacement piece with a suitable material, carving the new piece to fit the loss exactly, and gluing it to the surface.

Once the lacquer box has been cleaned entirely, it will appear dry and dull because there are many small cracks on the surface. Because the lacquer surface on this box is in better condition than that of the other objects I examined, I suggest that nut oil, rather than linseed oil, be applied as the final step in treatment. Excess oil can be wiped off using a soft cloth, leaving a thin layer of oil on the surface. This will improve its appearance for display purposes.

JANE WILLIAMS WRITES:

*Materials and Techniques of Manufacture*

In an X-radiograph of the object one can see that the box is made of several pieces of wood. The top and bottom surface are predominantly made up of parallel strips of wood (3–5 cm wide) with one side section added cross-grain to each. The sides of the box have not been X-radiographed, but are presumed to be made of bent strips of wood. This structure is visible in a damaged area on the foot support. After the wood support was glued together, a layer of plain-weave fabric was adhered to areas of the surface. The fabric weave is visible through the lacquer on the interior bottom of the bowl, but not elsewhere. In a loss to the exterior rim of the bottom half, the plain weave fabric is visible wrapping the rim but appears to stop about 1 cm into the floral design field.

The ground layer or layers were applied next. The ground layer that is visible throughout the exterior of the box is a fairly thick (about 2 mm), coarse gray layer with black (ash?) inclusions and loose fibers mixed into it. These loose fibers are what Ms. Norman describes above as a non-woven textile layer. The ground layer must have been a fairly dry mix, because the fibers are not saturated with binder. Rather than trying to remove a sample of the thickly carved



Fig. 4.39. Box with red carved lacquer before cleaning. China, Qing dynasty, Qianlong period (1736–1795), lacquer on wood, 16 x 16.5 x 7.5 cm. Courtesy, Shanghai Museum, Shanghai, China, #7556.

surface layers to study the stratigraphy of the surface, the exposed edges of some of the detached fragments were polished and studied before they were reattached. Layers and layers of lacquer (about 25 original layers were identified in cross-sections) were then built up, with each allowed to dry before the next was applied. A landscape was then carved into the lacquer on the lid and floral designs carved on the sides. The low-relief areas of the landscape (air, water) consist of red brown layers, then a black divider layer (or layers?), and then the high-relief areas were built up with more red brown layers. The black divider layer was used as a guide during carving to prevent the knife from going through the lower layers. The floral design fields on the sides have a yellow brown background layer



Fig. 4.40. Box with red carved lacquer after cleaning. China, Qing dynasty, Qianlong period (1736–1795), lacquer on wood, 16 x 16.5 x 7.5 cm. Courtesy, Shanghai Museum, Shanghai, China, #7556.

(or layers?), upon which red brown lacquer for the high-relief flowers was layered, again with a black separation layer applied first. There are knife marks in the yellow brown layer from the carving. Fig. 4.41 shows this sequence of layers on a fragment from one of the side borders.

#### *Treatment History*

The treatment history of the box is complicated. In order to identify the different repair campaigns, the lid was examined with a binocular microscope and compared with its X-radiograph and then the information was charted on a diagram (see figs. 4.37, 4.42, and 4.43 to compare photograph, X-radiograph, and diagram of lid). In the first restoration all of the high-relief surfaces were coated with an orange-red lacquer (visible on the large rocks at bottom), which is discernible

because it has developed a fine craquelure overall. This coating was identified as a repair, because it drips down into a crack in one carved lacquer tree trunk. Other cracks in the trunk, visible only in the X-radiograph, are covered by this layer. The second campaign, with a dark red lacquer with fine, glittering inclusions, was more involved, using carved lacquer to coat surfaces, fill cracks and replace relief elements (see diagram, fig. 4.43). It coats most of the relief decoration on the sides. It is visible in fig. 4.41, the cross-section fragment from one of the raised bands framing the flowers. Multiple coats were applied to the side of the raised band, then the top was polished flat and coated with several more coats of lacquer, and finally the side was carved down. The lacquer from the second campaign visibly overlaps the first repair lacquer. The high-relief areas that were replaced in this campaign, such as the figure on the rocks, have a grainy texture in the X-radiograph and are less radio-opaque than other relief areas, suggesting that they may have a core that is a material less dense than pigmented lacquer. The dark red lacquer was also used to fill cracks and to attach the replacement lacquer pieces (these areas are radio-opaque lines in the X-radiograph). The third relacquering was done with a bright orange red lacquer on the lid and relief areas on the sides and with a brown lacquer in the recesses on the sides. This restoration campaign was much more careless than the previous two. It was used in isolated areas on the lid to fill cracks and losses and appears more extensively on the sides. Losses were filled with a buff-colored fill material and coated thinly with lacquer that overlaps the original sloppily. In recesses on the sides, brown lacquer was applied over this orange-red lacquer to blend better with the original yellow-brown background. There may have been more relacquering campaigns, but the three mentioned are the most extensive and easy to distinguish.

More recent repairs to the box were done with a resin. Lacquer in many areas (see diagram,

fig. 4.43) was consolidated or reattached with a clear resin that has very little fluorescence in UV light and is slightly soluble in acetone.

#### *Condition*

The wood structure is in stable condition but the lacquer surface is currently cracked and lifting throughout the box. Some areas of high-relief lacquer have warped and pulled away from the surface as much as 0.5 cm. A few fragments have become completely detached and a number of small fragments have been lost. There are numerous losses to the yellow brown background lacquer between relief elements on the sides of the box. Much of what remains is cracked and loose. There are large cracks in the original and the repair lacquer layers throughout the box. The surface of the box is very grimy and dusty. The resin that was applied as a consolidant covers large areas of the visible surface and is shiny and darkened.

#### *Treatment*

An intern in the department, Chris White, cleaned the box under magnification, using fine cotton swabs rolled onto toothpicks. The tiny swabs were dampened very slightly with deionized water. Cleaning proceeded very slowly; it took about one hour to clean a square inch of the lid. In one area, where a very thin lacquer or resin had been applied over the buff fill, water dulled the surface and so this area was not cleaned. The glossy resin on areas of the surface of the lid could be made to swell and was dulled with acetone, but could not be made sufficiently soluble to be removed completely from finely carved recesses. The cleaning of the lid removed substantial dust and grime (see fig. 4.44) but, once the homogenizing dirt layer was removed, the visual differences between the various restorations were more visible.

The sides proved more difficult to clean and there was not enough time to clean them

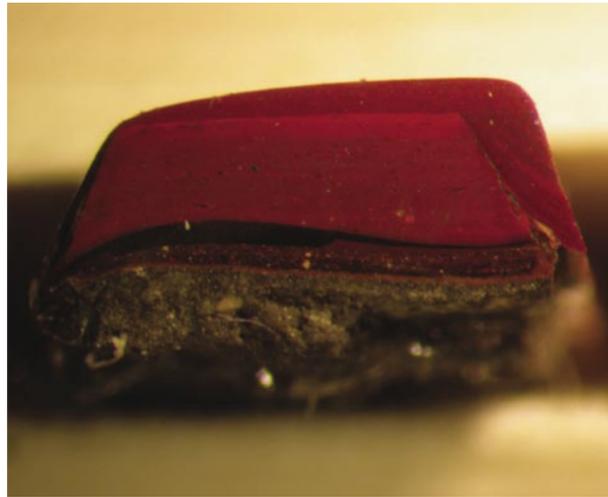


Fig. 4.41. Cross-section of surface layers on relief band on side of box (B77M24); note carved lacquer restoration layers on right side and top of sample. Separation is occurring between the original and restoration layers. The black separation layer seems to fill a loss in the top layer of brown lacquer below it, perhaps indicating flaws in manufacture.



Fig. 4.42. Box (B77M24), after treatment, lid.

completely. The thin lacquer in the recesses has cracked and curved up and is vulnerable to snagging. Some areas were left until further consolidation and possibly filling could be done.

In some areas on the sides a layer of applied gray toning with an unknown binder was detected in the recesses of the carved decoration. It could be distinguished from actual dirt by its tenacity and gray color and by the lack of sharp carving detail in the recesses.

Loose areas of lacquer were consolidated as they were encountered during cleaning by flowing in 15% B-72 in acetone with a small brush. Where fragments had become detached, the ground was consolidated with 5% B-72 in 4 : 1 acetone : ethanol. The fragments were then readhered using 15% B-72 in acetone. The losses

and cracks in the lacquer on the recesses of the sides should be filled to protect the edges of the thin lacquer from further damage. The gaps under the lifting carved lacquer where there is no longer contact with the ground also should be filled to provide them with support. I would use a bulked B-72 mixture in both cases because the solvent-based mixture would be separable from the water-soluble ground. The B-72 mixture can be formulated to be introduced into the losses as a consolidant as well as a gap filler, whereas proprietary gessos and the PVOH mixtures are useful only as gap fillers.

The losses to design elements would be replaced only if desired by the curator for aesthetic reasons. I would use a removable fill that could be carved and finished off the object and then adhered in place. I liked Mr. Zhang's sug-

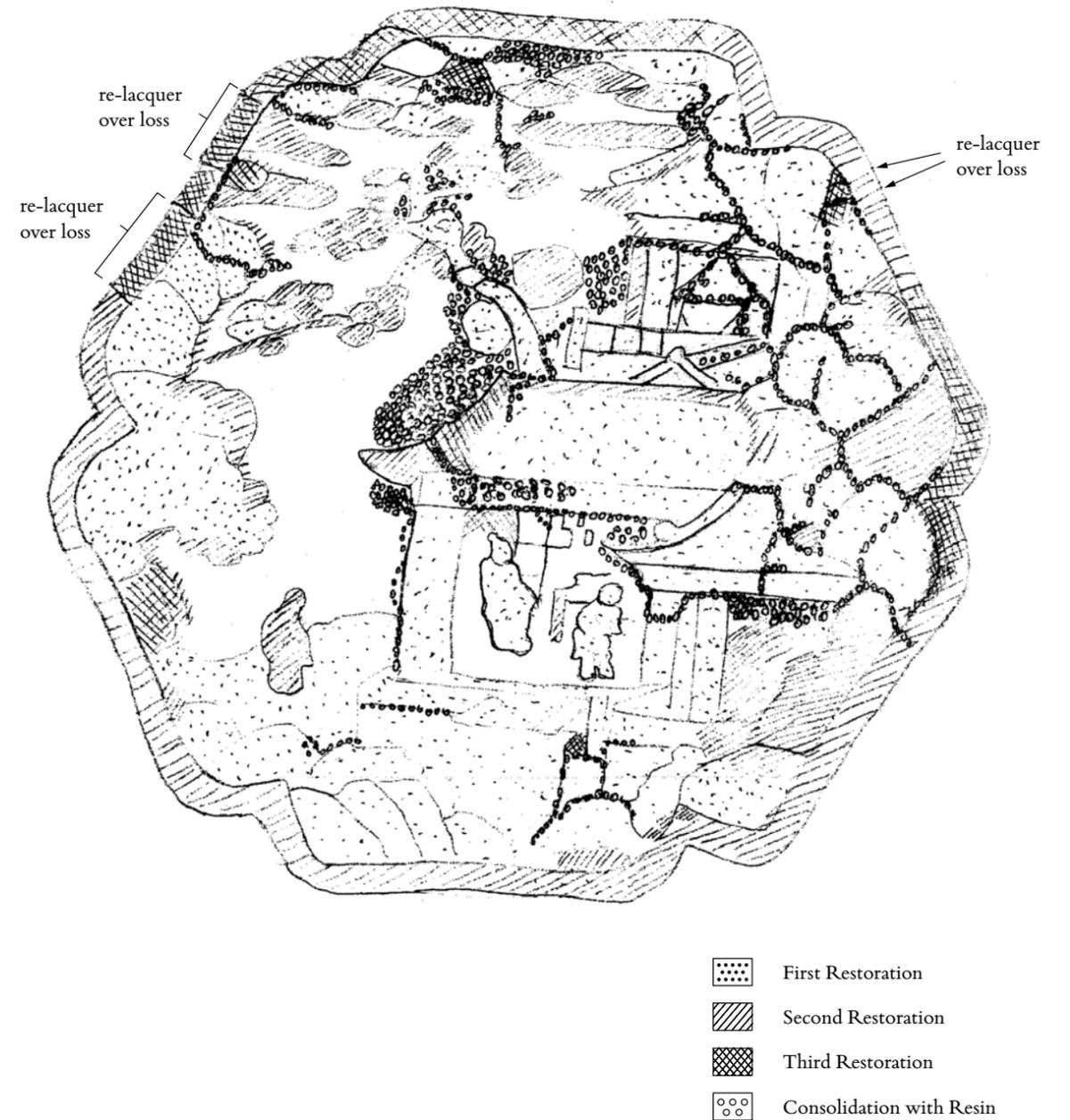


Fig. 4.38. Covered box (B77M24), before treatment.



Fig. 4.44. Box (B77M24), detail of lid during cleaning; the bottom half of this area has been cleaned.

gestion of making silicon rubber casts of similar areas. This would work well for areas of fine background carving on the lid, presuming a reasonable impression could be obtained through an isolating layer such as plastic wrap (polyvinylidene chloride film). Among the surviving high-relief elements there do not appear to be exact matches for the missing carved elements to be cast for replacements. In this case it would be just as easy to model or carve replacements out of tinted, bulked polyester or epoxy, either a custom mixture or a proprietary product such as Milliput.<sup>20</sup> □

#### NOTES

- 1 The wax and resin mixture, originally formulated for lining paintings, is:  
2,000 g unbleached beeswax  
1,000 g dammar resin  
1,500 g paraffin  
500 g gum elemi  
dry pigment added as appropriate
- 2 A Song dynasty (960–1279) lacquer plate in the Freer Gallery, F1967.14, was coated with Simonize paste wax (a commercial product containing silicones and natural and synthetic waxes). The wax has left a milky haze on the surface and attempts to remove it have been unsuccessful.
- 3 A Japanese lacquer palanquin from the Edo period (Arthur M. Sackler Gallery, Smithsonian Institution, S1985.1) underwent conservation in the gallery's Department of Conservation and Scientific Research in 1988. As part of its treatment, a wax coating (a commercial product containing a mixture of synthetic waxes) was applied to the surface. See Jane Norman and Stephen Koob, "Attention to Lacquer at the Freer Gallery of Art and the Arthur M. Sackler Gallery," *Newsletter, The Lacquer Working Group of the International Council of Museums—Committee for Conservation*, no. 4 (February 1994): 5–6.
- 4 Pyrolysis-Gas Chromatography/Mass Spectrometry (Py-GC/MS) of samples extracted from cloths used to clean black lacquer objects was undertaken by the conservation scientist Christopher Maines in 1996. His laboratory reports indicate that, although several fatty acids were detected, peaks indicative of lacquer were consistently absent from the samples.
- 5 Japanese scientists have published the results of research on the structure of lacquer and its degradation as the result of exposure to light, but the mechanisms are still not completely understood. See Ju Kumanotani, "The Chemistry of Oriental Lacquer (*Rhus verniciflua*)," in *Urushi: Proceedings of the Urushi Study Group*, Tokyo, 10–24 June 1985, edited by N. S. Bromelle and Perry Smith (Marina del Rey: Getty Conservation Institute, 1988), 243–51; idem, "Traditional Japanese Urushi Techniques—*Kurome* and *Roiro-shiage*—A Preface of Urushi Cultural Properties Conservation," in *International Symposium on the Conservation and Restoration of Cultural Property—*

- Conservation of Urushi Objects* (Tokyo: Tokyo National Research Institute of Cultural Properties, 1995): 187–209; Chie Sano, "Scientific Research on Urushi in Japan," in *International Symposium on the Conservation and Restoration of Cultural Property—Conservation of Urushi Objects* (Tokyo: Tokyo National Research Institute of Cultural Properties 1995), 211–24; Osamu Watanabe and Katsutoshi Nagai, "Internal Structure and Photodegradation of Oriental Lacquer Film," *Nippon Kagaku Kaishi* (The Chemical Society of Japan) no. 2 (1999): 113–21; idem, "Photodegradation of Lacquer Tree Paint Films and Their External Appearance," *ibid.*, 123–30.
- 6 The basic formula is derived from Dawn M. Wilson, "Paraloid B-72 Infilling Systems for Wooden Artifacts," *Newsletter, The Ethnographic Conservation Working Group of the International Council of Museums—Committee for Conservation* 18 (October 1998): 9–11.
  - 7 Lan Zhang, "The Conservation of a Song Dynasty Lacquer Box," *Newsletter, The Furniture and Lacquer Working Group of the International Council of Museums—Committee for Conservation*, Furniture no. 2/Lacquer no. 5 (April 1995): 12–14.
  - 8 The wax formula used to fill small losses and cracks is:  
38 g carnauba wax  
38 g paraffin wax  
10 g microcrystalline wax (Bareco 145)  
dry pigment added as appropriate
  - 9 The pieces are assumed to be joined with glue or *urushi*, because no dowels or other joinery are discernible. This construction is consistent with other similar Chinese lacquer objects; see B. Milam and H. Gillette, "X-radiography in the Study of Oriental Lacquerware Substructures," *Urushi* 199–226.
  - 10 In X-radiographs one can see only that there is a single layer of textile, but not to which surface it is applied. The textile is, however, visible on the front of the tray in the wide crack and not on the crack on the reverse.
  - 11 Twisted wires were formerly considered a Korean feature, but are now recognized on Chinese and Ryukyuan lacquer objects as well; see H. M. Garner, *Ryukyu Lacquer*, Monograph Series no. 1 (London: University of London, Percival David Foundation of Chinese Art, 1972), 14. James Watt contends that the use of twisted wires diminished in China over time, but persisted longer in the

- Ryukyu Islands; see James C. Y. Watt and Barbara Brennan Ford, *East Asian Lacquer*, exh. cat. (New York: Metropolitan Museum of Art, 1991), 330–31. Michael Knight concurs with this and suggests a sixteenth-century date for this tray.
- 12 Lee Jong, a Korean scholar who visited the Asian Art Museum, described it as Korean and probably early twentieth century (notes on AAM accession record).
  - 13 This coating is understood to be lacquer because its appearance in visible and ultraviolet light is consistent with lacquer and because it is insoluble in a wide range of polar and nonpolar solvents. Both the lacquer and the coarse gray fill material absorb UV light.
  - 14 This ground has a very fine texture, does not fluoresce in ultraviolet light, and is insoluble in a range of solvents.
  - 15 This coating fluoresces a uniform, dull orange color in long-wave ultraviolet light. It visibly overlaps the UV-absorbing restoration lacquer. Brush strokes and fine bubbles are visible in the coating.
  - 16 The identification of this material as lacquer is again based on its insolubility and its appearance in visible and UV light rather than on analysis.
  - 17 They do not appear ever to have matched the surrounding lacquer. The oldest repairs are orange in color, resulting from a thin translucent application of lacquer over a pinkish ground.
  - 18 According to museum accession records, the tray was in Avery Brundage's collection by 1959, but there is no record of when or where he acquired it.
  - 19 The inlay is visible in a photograph taken in 1979 and an X-ray taken in 1986, but was lost by the time the tray was examined in the 1994 condition survey.
  - 20 One conservator achieved good results for fills on a carved lacquer object by casting out a block of pigmented bulked polyester resin, layered to match the colored layers of the original. The block was then carved and sanded to match the shape and finish of the original and glued in place with acrylic resin. See Tessa Jackson, "Conservation and Restoration of a 13th-century Lacquer Dish from the Song Period," in Sophie Budden and Frances Halahan, eds., *Lacquerwork and Japanning*, postprints of the UKIC Conference, London, May 1994 (London: UKIC, 1994), 36–38.



The lid of the black inkstone box is decorated with a raised orange-brown pumpkin and two leaves, one of lead sheet with gilded veins and the other of abalone shell. Where the lid and base meet the edges are reinforced with gray-metal bands. The interior is finished with lacquer with sprinkled metal flake decoration (*nashiji*). It is divided into compartments, one for a now-missing brush. The box still contains a black and gold lacquered inkstone and a cast copper-alloy water container. The maker's signature is painted under the inkstone.

#### *Conservation Record*

This box was accessioned in 1960. In 1982 a small damaged area toward the side of the pumpkin was filled with dental plaster solidified with cyanoacrylate adhesive, carved and tinted with Maimeri paints. A small fragment of mother-of-pearl was replaced, loose areas of inlay were readhered with PVA emulsion adhesive, and the box was lightly waxed.

Subsequent treatments to the box have focused on the corroded lead inlay. In 1993 microchemical tests identified the presence of lead and carbonates in the corrosion products. Corrosion of lead by carbonyl organic compounds, generally from wood products, adhesives or paints, in museum environments typically leads to the formation of basic lead carbonates or lead formate.<sup>1</sup> Formaldehyde itself acts as a corrosive agent only if oxidizing agents, such as hydrogen

peroxide, are also present.<sup>2</sup> In recent studies it has been found that exposure to light can accelerate formaldehyde damage by photo-oxidative mechanisms (another reason to keep the light exposure of this object to a minimum).<sup>3</sup>

In 1997 tests of localized electrolytic reduction were made in a small area of the inlay. Platinum anode and cathode wires were used with a direct current power source. Ethanol and sodium bicarbonate were both tested as electrolytes, with the sodium bicarbonate proving the more effective. Where tested, some areas with thin corrosion films were converted back to dark gray metal but the white pits were not improved. The tests were abandoned as not providing a visual improvement. The surface was cleaned with mineral spirits and with acetone and then coated with microcrystalline wax. In 1998 the lead inlay was treated overall using spot electrolytic reduction, again with a direct current power source and platinum anode and cathode wires. This time the electrolyte was 10% sulfuric acid. Reduction with a sulfuric acid electrolyte forms lead sulfate, which inhibits further corrosion.<sup>4</sup> There was some improvement in the appearance of the lead, but the corrosion within the pits was again largely unaffected. Also there was concern that there were traces of an original brownish coating on the lead (see fig. 5.1) that was being removed by the treatment, so the treatment was stopped. A small sample of the coating was removed for analysis but results were inconclusive.

Fig. 5.01. Inkstone case (*Suzuribako*) (B60M6+), Japan, Edo period, 18th century (inscribed *Shutoho*, active 1751–1763), L. 27.0 cm; W. 23.5 cm; H. 6.3 cm.



Fig. 5.2. Inkstone box (B6oM6+), overall.

SHOSAI KITAMURA WRITES:

This object is a square box with rounded corners (fig. 5.2). The top of the lid is slightly rounded. This inkstone box is an *inrobuta* type, with both box and cover fitted with metal rims (*shinchu fukurin*) around the edges. The metal used for the rims needs to be identified.

The black lacquer exterior has a pumpkin design on the top and the sides of the cover. The fruit and vine are done in *takamakie* and the leaves are lead inlay (*namari-kanagai*) and thick abalone shell. The alloy used for the lead inlay needs to be identified. The fruit and vine are built with *sabi-urushi* coated with yellow lacquer and finally covered with clear lacquer.

In one of the leaves, the imperfection of a thick abalone shell is well-utilized. On the lead inlay (*namari-kanagai*) leaf the veins have been painted in lacquer and sprinkled with gold powder (*tsukegaki* technique). The interior is of rough *nashiji* finish. In the box on the right is a knife and brush holder, on the left is a rectangular yellow bronze water dropper. Under the inkstone is an inscription in clerical style that reads “Shutoho.”<sup>5</sup>

Condition

The substrate appears to be made of joined flat cedar boards. There is no obvious problem with the substrate, but the cover is slightly warped.

The surface was entirely finished in black



Fig. 5.3. Inkstone box with lotus and wagtail design in *makie*. Japan, middle Edo period, 18th–19th century, 21.0 cm x 22.0 cm x 4.0 cm, collection of Shosai Kitamura. Interior before treatment.



Fig. 5.4. Inkstone box with lotus and wagtail design in *makie*. Japan, middle Edo period, 18th–19th century, 21.0 cm x 22.0 cm x 4.0 cm, collection of Shosai Kitamura. Filling a deep crack with *kokuso*.

lacquer (*nuritate shiage*) and on some parts of the *futakazura* are marks from dripping lacquer. Some areas of the foundation layers of the pumpkin show fine cracks, and there are small losses at its border with the black lacquer. The museum records state that a small missing area was filled with “hardrock” dental plaster in 1982.

On the lead inlay leaf is some corrosion and the surface appears powdery. There is a gap between the metal sheet and the black lacquer. Inside the box at some corners, there are some spots on the *nashiji* finish where the lacquer coating has flaked off, in one area exposing the surface of the ground layers.

The bottom of the box shows some abrasion.

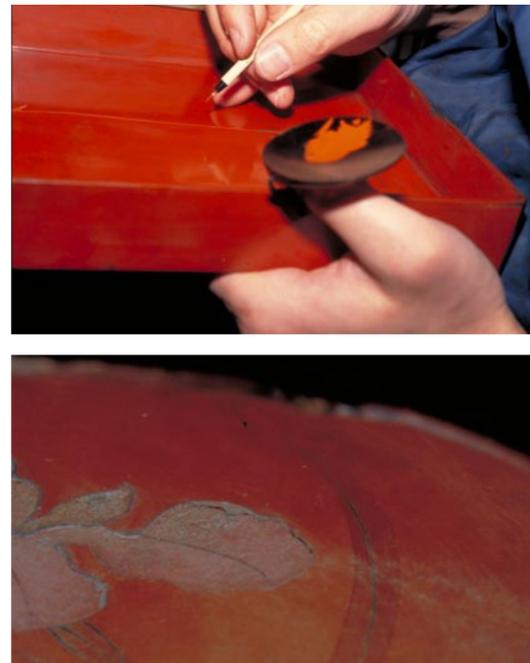
Suggestions for Treatment

It may be impossible to return the bent lid to the original state.

The entire surface should be wiped with a mixture of water and alcohol, using a soft cotton swab, cotton cloth, or paper. The box does not appear to have been waxed, this method should remove most of the dirt. Persistent dirt

may be cleaned with ethanol or alcohol diluted with water. The crack in the pumpkin should be filled and the ground layer around the cracks secured with raw lacquer diluted with solvent. In doing this, any excess lacquer should be removed with soft cotton swabs dampened with solvent. Larger cracks and lifting areas should be consolidated with *mugi-urushi* similarly diluted with solvent. Large gaps may be filled with *kokuso*, shaped with a knife, and painted with lacquer to match the surrounding area. Figures 5.3–5.6 illustrate this process of filling and toning a crack.

The black fill should be coated with black lacquer of the same color and sheen. The repairs to the pumpkin should be coated with brown and yellow lacquer and then coated with clear lacquer. Figures 5.7 and 5.8 show a detail of damaged *makie* on a modern tray before and after the type of treatment just described. Colored lacquer is very difficult to match correctly. Therefore, if it is not aesthetically necessary to add color, simply fill the missing parts with a lacquer ground mixture to stabilize the object and then clean the surrounding surface. The



Top left: fig. 5.05. Inkstone box with lotus and wagtail design in makie. Japan, middle Edo period, 18th–19th century, 21.0 cm x 22.0 cm x 4.0 cm, collection of Shosai Kitamura. Toning the fill with pigmented lacquer.

Bottom left: fig. 5.07. Vermilion lacquer tray with iris design in makie with paper core. Japan, Taisho period, 20th century, 18 cm diameter x 3.0 cm, collection of Shosai Kitamura.



Top right: fig. 5.06. Inkstone box with lotus and wagtail design in makie. Japan, middle Edo period, 18th–19th century, 21.0 cm x 22.0 cm x 4.0 cm, collection of Shosai Kitamura. Interior after treatment.

Bottom right: Detail of damaged makie before treatment. fig. 5.08. Vermilion lacquer tray with iris design in makie with paper core. Japan, Taisho period, 20th century, 18 cm diameter x 3.0 cm, collection of Shosai Kitamura. Detail of makie after treatment.

losses in the nashiji may be secured by consolidating them with raw lacquer, and then filling with lacquer ground slightly lower than the surrounding area and painting with black lacquer. If the repair is too obvious, it could be sprinkled with a nashiji powder that has particles of a similar size, painted with clear lacquer, and when dry, polished a little to even the appearance. As it requires much experience to select the right powder to match the nashiji, the help

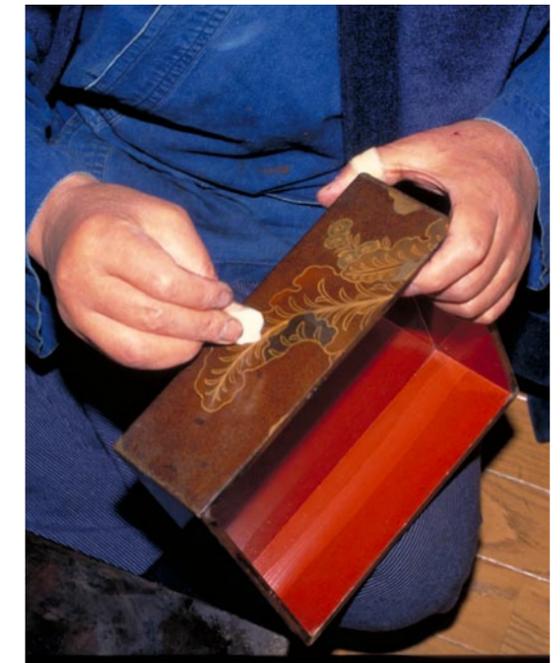
of a skilled specialist is recommended. A metal conservator will be needed to solve the problem of the corrosion of the lead or pewter sheet. A very clear, removable coating may help to retard the corrosion.

To preserve the surface and retard deterioration due to ultraviolet light exposure, the surface should be rubbed with a minute amount of diluted *kiurushi* and soft cotton. Over a long time lacquer deteriorates under ultraviolet



Top left: fig. 5.09. Jubako (lacquer food container) with turnip design in makie. Japan, Edo period, 1750, 22.5 cm x 20.5 cm x 25.5 cm, collection of Shosai Kitamura. Before treatment. Bottom left: fig. 5.11. Jubako (lacquer food container) with turnip design in makie. Japan, Edo period, 1750, 22.5 cm x 20.5 cm x 25.5 cm, collection of Shosai Kitamura. After treatment; note the improvement to surface gloss with *suri-urushi* treatment.

light. An early stage of deterioration shows a loss of sheen and black lacquer turns brownish. At this stage the sheen can be restored with a *suri-urushi* treatment, by which dilute lacquer is rubbed into the surface. (Figure 5.9 shows a lacquer food container (*jubako*) that has lost its sheen. Figure 5.10 shows the procedure for rubbing the surface with dilute *kiurushi* and soft cotton. Figure 5.11 shows the improvement to the surface gloss of the container after the *suri-*



Right: fig. 5.10. Jubako (lacquer food container) with turnip design in makie. Japan, Edo period, 1750, 22.5 cm x 20.5 cm x 25.5 cm, collection of Shosai Kitamura. *Suri-urushi* process.

*urushi* treatment.) With further deterioration, the ground layer may become visible through the lacquer coating and, if the deterioration continues, the surface of the ground layer will crack and the lacquer and ground may separate from the substrate and flake off. Figure 5.12 shows a sample of lacquer that has deteriorated and begun to crack and flake off. The right side of the sample has been consolidated with a thin application of lacquer. Figure 5.13 shows



Fig. 5.12. A sample of badly deteriorated lacquer, viewed from above; the right side has been given a *suri-urushi* treatment, which has infiltrated the cracks and strengthened the surface. (Photo by Dr. Humio Okada).



Fig. 5.13. Photomicrograph showing a thin section of the lacquer sample shown in fig. 5.12; the penetration of the lacquer into the cracks and surface losses is clearly visible on the right (Photo by Dr. Humio Okada).

the same sample in thin section. On the right side one can see the extent to which the *suri-urushi* treatment has penetrated the cracks and strengthened the lacquer.

BARBARA PIERT-BORGERS WRITES:

As a result of my training in Japan, I tend to prefer to use *urushi* in restoring Japanese lacquerworks, because it is an analogous substance to those used in their manufacture. The method has often been described:

- Infiltrate missing areas and cracks with raw lacquer thinned with ligroine.
- Consolidate cracks and flakes with *mugi-urushi* dissolved in ligroine.
- Fill deep cracks and missing areas with *kokuso*.
- Fill fine flaws and coat *kokuso* layer with *sabi*.
- Apply a thin coating of raw lacquer.
- Retouch surface of fill and, if required, recreate decoration.

For the corroded lead inlays the cooperation of a metal specialist is needed.

The present inkstone case was restored in

1982 and given a coating of wax. Such wax coatings can impair or prevent the proper drying of the lacquer used for restoration. As shown in tests I have made on the compatibility of beeswax and *urushi*, it is not the wax as such but possibly the additives and solvents it contains that seem make the materials incompatible. The internal structure of Japanese lacquerwork, a technique developed over the course of millennia, comprises support material, primer and lacquer layers, and refined polishing processes. In the survival of these works of art, the hygroscopic nature of the layers—their tendency to absorb and diffuse moisture—plays a role whose importance cannot be overestimated. Coatings of a different composition and character can destroy this sensitive structure. Wax coatings also have specific disadvantages, among them the tendency to corrode brass particles, to bind dust on the surface, and to be susceptible to moisture and fingerprints. Instead, I would recommend burnishing the surface with *perilla* oil (*E-no-abura*;

*perilla frutescens*) as is done in the final working steps in the manufacture of Japanese lacquer pieces.

The method commonly used in Japan of rubbing raw lacquer into lacquer surfaces (*suri-urushi*) should, in my opinion, be considered as well. For the object discussed here, which is not very old, *suri-urushi* treatment is applicable because there are only minor damages to the surface and the substructure. It can also be used for a great number of inro or for lacquers of the Meiji period. Often very high-quality lacquer is used for this process, with the intention of sealing the fine fissures in the craquelure and preventing the oxidation of exposed metal particles. In the manufacture of new lacquerworks this especially hard and glossy surface may be desirable, but on old, light-damaged surfaces the method should be considerably modified. Although employed routinely in the consolidation of surfaces and the restoration of luster may not be suitable for historical lacquer objects with aesthetically estimated color changes (*koshoku*) and craquelure (*danmon*). Further studies on *suri-urushi* would be useful.

JANE WILLIAMS WRITES:

*Materials and Techniques of Manufacture*

The box was constructed of softwood. It appears to be held together primarily with glue joints, but in X-radiographs faint images of what may be dowels are visible along the edges of the base (see figs. 5.14 and 5.15). There is no evidence of a textile layer over the wood.

The pumpkin is made of at least three carved pieces of wood glued together and applied to the box. X-radiographs show the joints in the substrate of the pumpkin (fig. 5.14), but the wood grain does not show up at any exposure. The wood substrate of the pumpkin could be



Fig. 5.14. Inkstone box (B60M6+), X-radiograph of lid. Technical data: Gulmay X-ray unit (320 kV max.), Kodak Industrex M film, 30 kV, 5 mA, 90 seconds, distance from tube, 36 inches.

Fig. 5.15. Inkstone box (B60M6+), X-radiograph of base. Technical data: Gulmay X-ray unit (320 kV max.), Kodak Industrex M film, 30 kV, 5 mA, 90 seconds, distance from tube, 36 inches.



Fig. 5.16. Inkstone box (B6oM6+), photomicrograph showing wood substrate of pumpkin applied to the lid.

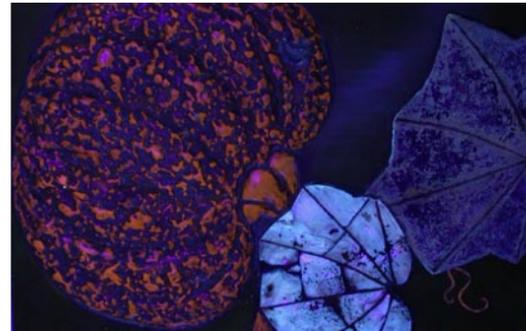


Fig. 5.17. Inkstone box (B6oM6+), lid shown in near ultraviolet light; note the strong orange fluorescence of the pumpkin and its stem.

identified only by visual examination in areas of surface loss (see fig. 5.16). The pumpkin's bumpy texture was applied in *takamakie*, modeled in a dark gray foundation layer. The pumpkin's surface is now coated with a brownish orange lacquer or paint and, in the recesses, with black coating. The interior of the box is finished with a white metal *nashiji*. The exterior is coated with a black lacquer. It appears to have an unpigmented lacquer applied overall as the final coat. This clear layer fluoresces a very dull mustard color in near ultraviolet light and, where it has been scratched or abraded, reveals the black, UV-absorbing lacquer below.

The purity of lead has been found to affect its resistance to corrosion. The presence of other metals in a lead alloy generally provide some corrosion resistance, whereas lead that is purer than 98.5% has been found to be susceptible to corrosion.<sup>8</sup> For comparison to other studies, a minute sample of the lead inlay was analyzed using SEM/EDS. As expected, this very corroded inlay is very pure lead—analysis detected only lead and no traces of other metals.

#### Treatment History

In addition to the treatments of the box that have been recorded, the pumpkin and its stem appear to have been extensively restored and coated entirely with shellac. They fluoresce a bright orange color in UV light (see fig. 5.17). There are a few large fingerprints on underside of the lid that fluoresce the same orange color and are readily soluble in ethanol. The pumpkin was subsequently coated black with a material that absorbs UV light and that was then wiped off the high points to reveal the orange layer below.

X-radiographs do not reveal localized repairs or cracks on the pumpkin that would explain why it was recoated. The only suggestion of repair is that in X-radiographs the very thinly applied ribbon of stem is much more radio-opaque than the thicker base of the stem is. Both are the same color, so the difference in radiodensity is probably due, not to repainting with different pigments, but to the use of a denser fill material in the thin part of the stem.



Fig. 5.18. Inkstone box (B6oM6+), view of interior.



Fig. 5.19. Inkstone box (B6oM6+), detail of surface of pumpkin showing fine cracks through foundation layer parallel to the surface.

#### Condition

The box is structurally stable at this time. The lid is warped and does not sit flush with the bottom when closed. There are a few, long, cracks through the black lacquer surface on the two edges of the lid and base that are perpendicular to the wood grain. The cracks are fine and closed; the lacquer remains well attached to the surface along them. Along the joins with these sides, there are slightly larger cracks on the exterior and interior of the base. The wood and lacquer of the low dividers on the interior are chipped or cracked in numerous locations (see fig. 5.18), probably because the water bottle and inkstone bump against them. The chipping and losses to the blade and brush holder may be from use. There are two open cracks across the surface of the pumpkin. X-radiographs show that the cracks in the lacquer and ground layers have occurred along joins in the pumpkin's wood substrate. Mr. Kitamura noted fine cracks in the foundation

layer of the pumpkin. Further examination showed that these are numerous (see fig. 5.19) and move slightly under pressure, making certain areas vulnerable to surface loss. There are semicircular gouges in the side of box that appear relatively recent. There are scratches throughout the surface and abrasion on the underside and at the corners.

The lead still has patches of compact white corrosion and numerous pits filled with white corrosion. It also has large scratches in the surface that do not appear recent.

#### Treatment

The appearance of the lead inlay remains unsatisfactory. The box has been stored in a metal cabinet since the 1960s. It was removed from its paulownia wood storage box by 1993 and the corrosion does not appear to have progressed since that time, so the corrosion is at this point primarily an aesthetic problem. If the corrosion does become active, it might be possible to stabilize the inlay with repeat-

ed brush applications of a 0.5%–1.0% neutral solution of BTA in ethanol. The perfect solution to removing corrosion in situ on thin lead inlay has not yet been found. Concern about damaging the surrounding or underlying surfaces with cleaning solutions has led conservators to use mechanical means. Conservators at the Victoria and Albert Museum compared mechanical cleaning, using picks, scalpels, and wire brushes, with different air abrasives. They achieved the most satisfactory, least damaging results using the air-abrasive technique and aluminum oxide as an abrasive.

Tracy Power, the former conservator at the Asian Art Museum, felt that air abrasion would leave the surface even thinner and more pitted than before and she chose electrolytic reduction because it would not remove metal and would leave a more corrosion-resistant surface. She also believed that the lead inlay here was thick and intact enough to allow the use of electrolytic reduction without endangering the underlying materials and speculated that it might be possible to achieve better results with more persistence or by changing certain variables such as the concentration or composition of the electrolyte. However, given her lack of success in treating the corrosion pits and the questions raised about a possible original coating, I would conduct further tests on mock-ups before continuing reduction cleaning. I would also want to identify the possible coating, which may well be a thin film of compact, brownish lead corrosion, before pursuing further treatment of the corrosion. I have not identified the “coating” at this time because little of it remains on the surface for sampling. It is also likely to be highly contaminated with wax and lead

corrosion products. At a later date, analysis using a nondestructive technique, such as a laser Raman microprobe, not currently available in the museum, could be pursued. To improve the object’s appearance for display, I would locally tone the remaining white corrosion film and spots with watercolors or pigmented dilute Paraloid B-72. Laser cleaning may be a possibility to even out the surface appearance. Mock-ups of corroded lead could easily be prepared to determine whether this method has potential for this application.

The only treatment of this object undertaken before the move was to reattach the loose fragments from the pumpkin just below and to the right of the stem. The orange brown and black coatings on the pumpkin, at least some of which are probably restoration, were found to be somewhat soluble in water, ethanol, acetone, Stoddard solvent, and xylenes. Xylenes could be used safely if contact with the surface was minimized, so B-72 in xylenes was used as the consolidant. A dilute, 5% solution was used first to consolidate the porous foundation layer, then a 15%–20% solution was used to secure the fragments. The same approach was applied to the spalling surface of the pumpkin. This consolidation was unsuccessful and there was still some movement along the cracks. After confirming that B-72 in acetone could be used safely if the excess adhesive were removed immediately, a second round of consolidation, this time with 15%–20% B-72 in acetone was successful. The slower evaporation of B-72 in xylenes makes it less useful an adhesive than the same resin in acetone, because it permits the resin to penetrate and disperse further into the substrate rather than remain concentrated along the crack.

The box was not treated further due to a lack of time. Because of my lack of experience using urushi, I would not use urushi-based materials, as both Mr. Kitamura and Ms. Piert-Borgers had recommended, in treating this box. Traditional urushi materials, for a conservator very experienced in their use and applied in the manner described, would be appropriate for the treatment of this box. This relatively modern box has sustained damage that is largely mechanical, rather than resulting from the deterioration of the original materials. Therefore, I would not be concerned that the new urushi would be stronger than the original or that distorted lacquer would be permanently secured in a new position. My primary concern would be that the elevated humidity needed to harden the urushi might activate the corrosion of the lead.

Although not using traditional materials, I would generally follow the same approach to treating the localized problems. The applied elements on the lid are all currently stable, but the losses to the lacquer applied around their edges should be filled as a protective measure. I would probably use a pigmented mixture of acrylic resin or polyvinyl alcohol bulked with chalk and kaolin that could be smoothed in place and use a similar mixture to fill the damaged areas on the interior of the box. As Mr. Kitamura suggested, I would be likely to finish the fills on the interior slightly below the level of the surface and leave them a neutral, dark color rather than to try to imitate the nashiji finish. Mr. Kitamura and Ms. Piert-Borgers recommended consolidating the cracks and filling the larger ones, but I would probably not treat them because they appear stable

currently and are not visually distracting. I might reconsider the decision to leave them unconsolidated if the box were to leave the museum, for example, for a traveling exhibition.

The box was cleaned with a soft brush and vacuum, but was not cleaned further at this time. The wax coating on the surface should be removed as much as possible with solvents. I would not attempt to remove the shellac coating from the pumpkin, because its appearance is acceptable and its presence, along with the solubility of its colored coatings in a wide range of solvents, suggests that the pumpkin may be extensively restored. Mr. Kitamura recommended suri-urushi as a final, protective step, while Ms. Piert-Borgers had some reservations about this process. It would seem unlikely to cause any problems for this object and would certainly improve the appearance of its somewhat scratched and abraded surface. However, even without such treatment, I think that the condition of this box is good enough to remain unchanged for the long term in storage and with very limited display in a controlled museum environment.

This object was removed from its custom-made paulownia wood box for long-term storage because of the concerns about the corrosion of the lead inlay. It will be stored wrapped in a prewashed tight-weave cotton cloth on a laminated aluminum and polypropylene tray, so that it can still be moved without being handled. In the new museum it is stored in a metal storage cabinet, which has been made only of materials, including surface finish and gaskets, that have been tested to ensure that they are nonreactive with art materials, including lead. □



Fig. 5.20. Covered box (B62M13).

**C**overed box (B62M13), Korea, Joseon period, 19th century, L.74.5 cm; D. 43.0 cm; H. 16.5 cm. This low, rectangular covered lacquer box is decorated on the top only with bamboo and a plum branch in mother-of-pearl inlay. The copper-alloy hinges and clasp securing the lid and the leaf-shaped fittings reinforcing all joins have punched floral designs.

SHOSAI KITAMURA WRITES:

This rectangular box with *inrobuta* type lid opens upward with brass hinges behind and a metal lock in front. The corners are shaped in the *karadomen* style and fitted with typical Li Dynasty quatrefoil metal pieces. The entire surface is black lacquered and the top of the lid has a bamboo and plum design with medium thin abalone shells.

#### Condition

The substrate of the lid shows some distortion but still fits the box. The entire top of the lid has been re-lacquered and appears brownish because a clear lacquer was applied over a light colored ground. Also the central part shows further re-lacquering in a very discordant reddish-brown color. Losses around the shell expose a brown ground layer.

Abalone shell inlays are lifting and an area of the plum tree is missing.

#### Suggestions for Treatment

To secure detached shells, diluted animal glue should be applied with a brush. If lacquer were used, the shell would turn bluer and would not be harmonious with the other shells. Also, *nikawa* rather than lacquer was used to attach the shell originally. Pressure should be applied until

the glue has dried. When the shell is thick there is a risk of it cracking under pressure. In that case a fill material, such as *tonoko* with animal glue, should be used to fill the space under the shell and secure it in its lifted position.

To improve the mismatched color of the past repair, abrade off the reddish-brown lacquer using charcoal or *gosei toishi*, match the color of the ground layer, and then re-lacquer. The best way to match the color is to prepare sample colors on a test board prepared with the same undercoating that the object has. Even with this method, it is difficult to match the colors completely. This process requires great experience and skill, therefore for this object it is better to leave the surface as it is. However, the area around the shells where the ground layer is exposed needs to be coated with clear lacquer and finished in a similar color to the original.

BARBARA PIERT-BORGERS WRITES:

The box has cracks at the corners of the lid and the back corners are broken and have cracks. The mother-of-pearl inlays are lifting off, soiled and partly lost. There are numerous retouches from previous restorations partly covering the original surface. Executed with Asian lacquer, they have undergone color changes. Partly the original lacquer is peeling off. Because of the irreversible retouches that can only be removed by mechanical means (with a scalpel or by abrasion with charcoal sticks) the object causes some problems. The following steps are recommended:

- Consolidate the cracks with a polyvinylacetate emulsion.
- Lay down flakes with *mugi-urushi* thinned with ligroin (prior tests with polyvinylacetate emulsion or sturgeon glue are recommended but will probably be unsuccessful).
- Fill missing parts with *sabi*.

- Replace the missing mother-of-pearl as well as the loose parts with fish or skin glue.
- Reduce the old retouches by abrasion with charcoal.
- Retouches with pigmented *urushi*.
- Polish the surface with a mixture of *jinoko* and oil using a piece of cotton.
- Apply a *suri-urushi* treatment.i

After removing the paper lining, the mold in the interior can be treated by spraying the surface with isopropanol and vacuum cleaning when it is dry.

JANE WILLIAMS WRITES:

#### Materials and Techniques of Manufacture

The structure of the wood box was not studied with X-radiography, because the coatings (apart from those on the lid) are so thin that the structure is visible. The bottom (probably also the top) and the sides are made from single pieces of wood. The sides are butt-joined and pegged at the corners. The top and bottom were then attached with glue and small wood or bamboo pegs. The bottom was lined with thinner and slightly taller wood that reinforces it and forms an inner rim to help align the lid. The liner is mitered at the corners. The box has copper-alloy hinges at the back and a latch plate at the front. All of the joins were reinforced with copper-alloy corner plates. All of the hardware appears to match in gauge and in the style and quality of their punched and incised floral decoration. Only the undersides of the bottom corner plates are undecorated.

To determine how the surface of the box was finished, cross-section samples were taken from the coatings on the sides and on the lid. The exterior surface was coated entirely with a very thin black layer, applied directly to the wood with no foundation layer. In cross section, two

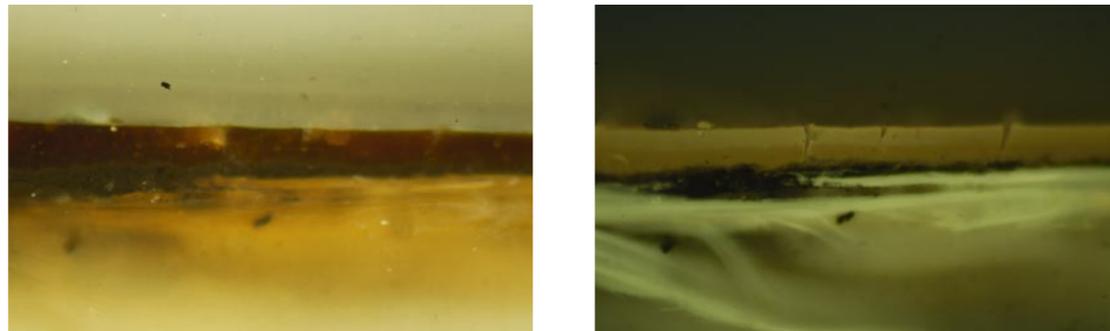


Fig. 5.21. Covered box (B62M13), cross section of layers on lid taken from under shell inlay shown in reflected light (left) and ultraviolet light (right); photo taken at 00x magnification.

unpigmented lacquer layers are visible above the black layer. The mother-of-pearl pieces were adhered directly to these thin layers (see fig. 5.21). There is no evidence in the samples of a nikawa adhesive layer, as Mr. Kitamura had originally suspected. The surface of the lid was brought up to the level of the thick inlay with two ground layers, a thin one containing only finely divided white particles (not yet identified) and a thicker layer that is bulked primarily with kaolin and quartz (see fig. 5.22).<sup>12</sup> The lid gets its brown color from an unpigmented lacquer coating applied over these ground layers.

The interior of the box was lined with paper with a blue-on-blue printed pattern on the front and Chinese characters written in ink on its reverse.

#### *Treatment History*

There is no record of treatment to this object. The lid, however, has undergone extensive and unsightly restoration. Major pieces of the mother-of-pearl have been replaced with new inlay that does not exactly match the original. A couple of replacement pieces do not have incised lines to continue to the incised lines on the neigh-

boring pieces. One replacement can be identified by the visual discordance of its iridescence. There are large, irregular areas where there is a level change in the ground under the overall translucent lacquer (see figs. 5.23 and 5.24), where apparently large losses were lacquered over without the surface first being brought to the same level. In addition, one large patch and several smaller areas were filled and then coated with a pigmented paint or lacquer that does not match the surrounding surface in color, gloss, or translucency (see fig. 5.25). There are four circular patches of fill at the corners of the base, probably representing the placement of previous feet. The box has a heavy, overall coating of beeswax.<sup>13</sup>

#### *Condition*

Gaps have opened at the corner joins of the lid. The top of the lid has shrunk and has exposed the top edges of the sides. The joins do not appear to be unstable, because they are still secured by the dowels and metal fittings.

The element most vulnerable to loss is the mother-of-pearl inlay. The inlay is lifting off the lacquer surface at the area of the tree trunk, the proper left branch, and the two flowers at

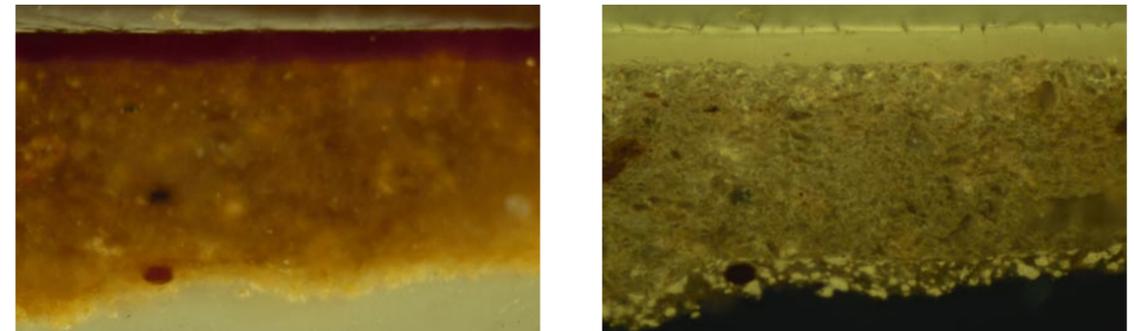


Fig. 5.22. Covered box (B62M13), cross section of layers on lid taken from lacquer adjacent to shell inlay shown in reflected light (left) and ultraviolet light (right); photo taken at 00x magnification.

the center next to the trunk (see fig. 5.24). Inlay has been lost from the tree trunk and from one of the central branches stemming from the trunk. There are scattered horizontal cracks in the lid's thin lacquer coating that generally follow the direction of the wood grain. The lacquer is slightly tented and becoming detached from the surface along some of the cracks (see fig. 5.25). A small piece of lacquer has flaked off one of the large areas of restoration and is sitting loose on the lid.

There are three large oval insect holes, between 0.5 and 0.7 cm wide, on the underside. One of them emerges on the inside of the box in a shallow channel. X-radiography could identify the full extent of the damage. There is no sign of recent insect infestation.

The paper lining on the lid is largely intact, with a larger loss at one corner, but has planar distortions (possibly original) and lifting edges. The lining has been almost entirely pulled off the base. The interior has a musty smell indicating the presence of mold. It is likely that the paper was originally adhered with a pastethat, along with the paper itself, is providing nutrition for the mold. The exterior, particularly the

lid, and interior surfaces are very dusty.

#### *Treatment*

Examination of this object showed it to be not old enough, of high enough quality, or good enough condition ever to be a priority for treatment. It is highly unlikely that it would ever be exhibited. The extent of the damage and restoration to the original also mean that treatment to make it stable and visually integrated would be complicated and lengthy. For these reasons, my approach to treating it was to stabilize it in its current condition. The exterior surface was cleaned carefully with a soft brush and vacuum, using particular caution around lifting lacquer and inlay. The areas of lifting inlay were secured temporarily using wet-strength tissue applied with dots of methyl cellulose; fig. 5.26 shows these repairs. They had enough flexibility to go back flat. The thick wax coating was reduced as much as possible using soft cotton Webril Handi-pads dampened with 1 : 1 Stoddard solvent : ethanol. This combination of solvents was tested and found to be safe for the lacquer and more effective in removing the wax than either solvent used alone. The loose fragment of res-



Fig. 5.23. Covered box (B62M13), lid.



Fig. 5.24. Covered box (B62M13), detail of lid showing lifting inlay and difference in level of ground under translucent surface lacquer.



Fig. 5.25. Covered box (B62M13), detail of lid showing unsightly old fills and cracks in lacquer.



Fig. 5.26. Covered box (B62M13), detail of lid showing temporary repairs to inlay.

toration lacquer was saved in a labeled polyethylene Ziploc bag in the conservation lab sample drawer. The lid was covered with a piece of mat board cut to size to protect it. A storage tray and muslin wrapper were made for the box.

One of the most difficult problems to solve satisfactorily in lacquer work arises when a relatively thin lacquer coating is cracking and peeling away from a thick ground layer. Ms. Piert-Borgers recommends first testing a polyvinyl acetate emulsion or sturgeon glue as the consolidants. I would be hesitant to try aqueous consolidants on this object for two reasons. First, given the thin, relatively translucent surface lacquer, I would be concerned about the possibility of getting a visible tide line from contaminants being carried through the ground layer with the consolidant. Second, it may take a substantial amount of dilute consolidant to harden the thick ground before the lifting lacquer could be readhered and I would be concerned about swelling occurring in the ground from the moisture introduced with the aqueous consolidant. Also, except where the lacquer is tented and no longer has space to lie flat, the lacquer remains flexible enough to lie flat without being moistened. For these reasons,

I would favor a solvent-based resin. I would first consolidate the ground by introducing a dilute acrylic resin in a nonpolar solvent. Because I had found (on an area of abraded, very thin lacquer on B69M52, for instance,) that a thin lacquer surface may darken (because it is saturated) when the adhesive is flowed under it, I would take two precautions that have worked to minimize this darkening. I would pre-wet the area with Stoddard solvent. This was a suggestion made by Mr. Minney for avoiding staining the wood in the consolidation of the Sho Kannon sculpture (B60S420). The solvent saturates the pores and fissures and, because it is not compatible with the adhesive, inhibits the adhesive from penetrating into these areas. The adhesive, then, remains more restricted to the actual gap between the lacquer and ground. Also, I would clamp the area for a few minutes to introduce the adhesive, then remove the clamps for several minutes to allow solvent to evaporate, and then reclamp the area. Allowing some of the solvent to evaporate when the area is not under pressure seems to help prevent darkening from the adhesive.

As Mr. Kitamura and Ms. Piert-Borgers observed, the large unsightly lacquer fills would

have to be removed mechanically, because it would be impossible to mask their opaque, intense color in order to match the translucent brown of the surrounding lacquer. This would be most difficult to do where the opaque restoration lacquer overlaps the earlier lacquer. I did find, however, by testing a small area, that this layer cleaves off the original lacquer and can be removed safely using a polished scalpel and working under a microscope. Once the restoration coatings were removed, the underlying fill or original ground should be left intact. The area should be sealed with a dilute adhesive, such as an acrylic resin, and then brought to the level of the surrounding surface with an appropriate fill material. Because the lacquer coating on the box is so thin and translucent, the fill should be pigmented to match the pinkish beige of the original ground layer. Once the large patches have been filled and smoothed, they can be toned. It would be much easier, and it seems to me, not inappropriate, to use non-*urushi*-based materials to match the surrounding surface. To match the color, translucency, and gloss of the original surface one could, after masking the original with thin

plastic film, use thin layers of acrylic ink or an acrylic resin mixed with light-stable Orasol dyes or pigment applied with an air brush.

The replacement inlay on the lid can be detected, but the new inlay is made of similar shell of an appropriate thickness and is much less obtrusive than the large losses to the inlay. The losses are more noticeable on this box than on others examined for this project because the design is quite simple and bold, consisting of large pieces of shell, and because the losses expose the contrasting dark lacquer under the shell (rather than, as on the chest B61M16+, the white ground under the shell). If one were to try to integrate the surface aesthetically, the losses to the shell would need to be compensated. The restoration would need to match the relatively thick original inlay. If shell of appropriate sheen and texture could be found, it might be used to replace the inlay and the date incised on the reverse as a record of its replacement, in addition to the written and photographic documentation of the treatment. I would also test iridescent mica pigments on a base, such as Plexiglas, polyester film, or a flattened sheet of Milliput, of the appropriate thickness, cut to match the shape of the loss.



Fig. 5.27. Box (B61M16+), overall view.

I discussed with the museum's paper conservator, Debra Fox, the possibility of treating the mold on the interior with an alcohol as suggested by Ms. Piert-Borgers. Ms. Fox felt that the mold problem was unlikely to be improved by brushing the paper with alcohol as long as the nutrients for the mold remained under the paper and the conditions for mold growth were favorable. On her recommendation, the interior was, instead, vacuumed using a vacuum equipped with a HEPA filter and left propped partially open with polyethylene foam wedges to improve air circulation. □

**C**hest (B61M16+). China, date uncertain, L. 81.7 cm; D. 55.5 cm; H. 33.5 cm. This covered chest is made of lacquered wood with inset basketry panels and mother-of-pearl decoration. The top of the lid depicts two birds and plum and camellia trees emerging from a rocky base. This scene is set within a cartouche surrounded by a linked circular diaper pattern. The basket weave on sides of the lid and box are surrounded by the same mother-of-pearl diaper pattern. The bracket feet are covered with vines and have floral motifs between them. The interior of the chest is lined with a damask tex-

tile. The chest has been assigned a Korean and Ryukyuan attribution by different scholars, but is now believed to be Chinese on stylistic grounds.

#### Conservation Record

The chest was accessioned in 1961. There is no record of its treatment prior to or after entering the collection.

#### SHOSAI KITAMURA WRITES:

This rectangular chest with rounded corners has an *inrobuta*-type cover, and carved legs (fig. 5.27). Because the four sides of both the lid and box are made of basket weave, the entire box is probably made of the same material. This can be confirmed by X-raying the object.

On the top of the lid is a cartouche enclosing a fantastic rock, camellia and plum trees, and a flying bird, all in mother-of-pearl. The area around the cartouche is filled with a linked-jewel diaper pattern also in mother-of-pearl. The basket weave on both the lid and box are framed and surrounded with a diaper pattern of linked jewels in mother-of-pearl.

The legs are decorated with plant scrolls with the knot root (*chorogi*)-shaped leaves often seen in Li-dynasty mother-of-pearl decoration. This may have been the reason this piece was previously catalogued as Korean. However, since neither the style of the box nor the shells used in decoration are the same as those in Li-dynasty Korean work, this box should be considered to be Chinese. The interior of the box is covered with gold brocade.

#### Condition

No structural problems are noticed. The box is entirely covered with hemp cloth, applied with either animal glue or starch paste with no lac-

quer. A thick ground layer, a mixture of animal glue and white pigment (*gofun*), was applied, and then another ground layer of *gofun* mixed with a small amount of pine ash was applied on top. Decoration was applied using 0.1-mm–0.3-mm-thick *hegigai* cut into patterns. The top of the lid developed many small cracks and the lacquer is cupped. There is no evidence of missing shells or past repairs. In some areas on the legs and corners of the cover the surface coat is missing. Especially on the legs, the lacquer and ground layers have losses exposing the hemp cloth.

A tip of the mother of pearl plant scroll is missing at the end of one leg.

#### Suggestions for Treatment

Ground layers with an animal glue binder are weaker than those that include lacquer and they deteriorate easily. Lacquer objects with mother-of-pearl designs made up of thin shells usually have a whitish gray ground with an animal glue binder. This light gray ground layer is used to make thin shells appear milky white, and clear lacquer is used as the adhesive for the shell inlay. If the thin shells were applied to a dark ground, they would appear blue. If repairs to the deteriorated animal-glue ground are made with lacquer, the repaired area becomes too strong and might damage the surrounding areas. Also, if black lacquer seeps behind the shells, they will turn blue and will not match the milky white shells. Therefore, to repair this type of damage, animal glue diluted to 5% with water should be used and made to penetrate the surrounding ground layer to strengthen it. If the ground layer is powdery, the glue solution may not penetrate it easily. In such a case the ground layer should first be moistened with a water and alcohol solution, and then a glue solution applied. However, each case needs to be considered carefully as there is some danger that this



Fig. 5.28. Box (B61M16+), detail showing use of bamboo in basketry panels.

method might make a thin lacquer film stretch and wrinkle. Depending on the condition, there may be no other way to repair the ground but with a solvent-based resin such as Paraloid B-72. When the ground layer is secured, build in the missing area with lacquer mixed either with *tonoko* or *gofun*, and then color it with persimmon juice, *bengara* (red oxide), or pine ash to match the color before finishing with clear lacquer.

The only way to treat the fine cracks in the lacquer on the top of the lid may be to allow a very thin solution of either animal glue in water or of Paraloid B-72 to penetrate the cracks. It is impossible to flatten small ripples of cracked lacquer coating by applying pressure.

BARBARA PIERT-BORGERS WRITES:

The entire wooden corpus of the chest was covered with a relatively rough weave textile. Applied over this was a gray primer layer, probably consisting of pulverized stone or brick in a gluten (animal-skin or bone-glue) vehicle. To augment the white of the mother-of-pearl, a white ground was applied over the entire gray primer

surface. The mother-of-pearl pieces were cemented to this layer, the entire surface coated with lacquer, and the mother-of-pearl decoration then exposed.

This particular structure is unprecedented in my experience in restoration. In the objects I have inspected, the mother-of-pearl pieces had been adhered either directly onto the wooden support (as, for instance, in a Namban chest and a Chinese tiered box of the Ming dynasty), or onto the black lacquer (as on objects from Ryukyu and China). An Edo-period saddle showed ocher-colored underpainting in the area of the mother-of-pearl pieces, and a sixteenth-century Korean tray had white underpainting limited to the mother-of-pearl inlays themselves. In the present chest, the entire surface is underpainted in white.

It would be interesting to analyze the fibers, the components of the two primer layers, and the vehicles. A Py-GC/MS analysis might help to classify the chest as either a Chinese or a Korean piece. An analysis of the quantitative and qualitative composition of the lacquer would be desirable and might affect treatment decisions. In this connection, let me refer to a passage in the Koku Yao-Lun quoted by Garner: "Mother-of-pearl inlay. Those made in the past for the Sung Imperial Court were in solid lacquer. Some of them have copper-thread inlays. Those made recently at Chi-chou in Kiangsi are mostly of putty, pig's blood and t'ung oil. They are not solid wares, being easy to make and liable to damage."<sup>16</sup>

The white grounds of Japanese Buddhist statues of the Heian period have been demonstrated to contain chalk, kaolin (white clay), and lead white, which in the fifteenth and sixteenth centuries were replaced by calcium carbonate.<sup>17</sup> A similar gray primer was found on a Chinese table (approx. 1600) with painted, polychrome lacquer decor contoured

with engraved lines filled with gold.<sup>18</sup> When attempts were made to cement and readhere loose flakes, their edges turned up. In general, Chinese lacquers react to moisture with an extreme increase in volume, causing the lacquer finish to curl. Too much water can also activate mold spores. For these reasons we consolidated the lacquer flakes on this table with an aqueous polyvinylacetate emulsion, preceded by a dampening with ethanol. The flakes were covered with moisture-permeable material and blotting paper, and pressed with the aid of wooden mats.

In filling defects in the Chinese table, Lascaux Structura acrylic filler gave good results. Similarly good results were obtained with this material on a Chinese screen with relief decoration in the Herzog Anton Ulrich-Museum, Brunswick. This filling material and the somewhat denser Modeling Paste A acrylic putty were applied after priming the surface with Hydrogrund acrylic primer. Acrylic emulsion paints were added to the filler to match the existing color. We found that this putty is easily cut, carved, sanded, and polished. Retouching was likewise done with acrylic, to which gloss can be added as required. Even *urushi* dries thoroughly on a ground prepared in this way. Although it may seem illogical to retouch a Lascaux ground with *urushi*, this method of filling is elastic and reversible (as Webb has pointed out in reference to another combination of materials—polyvinyl alcohol and calcium carbonate) and precludes the problems engendered by the addition of moisture to the ground layers. Most likely it was these very problems that led in the past to the use of wax-chalk putties (mixture of beeswax and chalk) in the restoration of Chinese lacquer objects.

For the present chest, a detailed investigation of the materials would suggest the adoption of the following procedure:

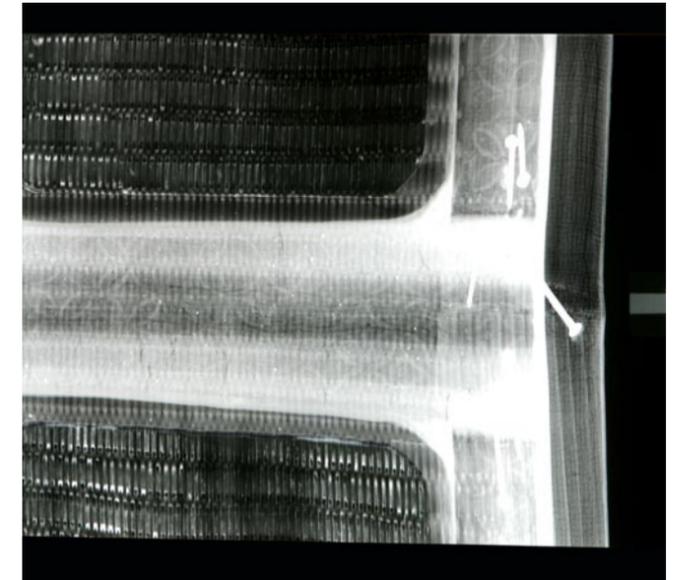


Fig. 5.29. Box (B61M16+), X-radiograph of base corner; the more radio-opaque areas framing the basketry are the wood strips that secure the basketry to the box; joins in these strips are visible near the corner and the image also shows the use of wire nails applied from interior and exterior of box. Technical data: Gulmay X-ray unit (320 kV max.), Kodak Industrex M film, 30 kV, 4 mA, 60 seconds, distance from tube, 36 inches.

- Remove adhering dust with soft brushes.
- Carefully clean the surface with petroleum benzine.
- Consolidate with fish or hide glue.
- Fill, in two steps, using gray heavy hard chalk and white hard chalk in hide glue.
- Retouch with Chinese ink, Chinese lacquer, acrylic colors, or resin color (depending on the training and experience of the restorer).

Or, alternatively;

- Consolidate with polyvinylacetate emulsion.
- Fill with Lascaux Modeling Paste A and/or Structura fillers.
- Retouch with acrylic colors.

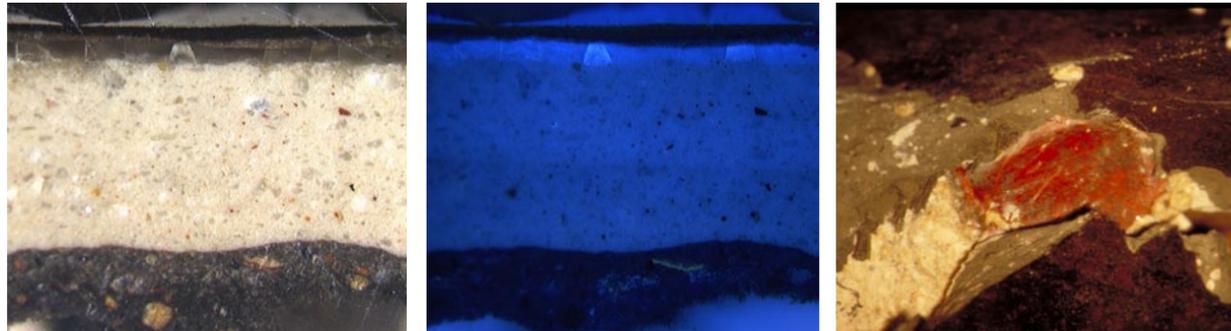


Fig. 5.30. Box (B61M16+), cross-section sample of restoration layers applied to foot above the coarse textile

layer shown in reflected light (left) and ultraviolet light (right); photo taken at 200x magnification.

Fig. 5.31. Box (B61M16+), photomicrograph of foot taken at 25x magnification showing red lacquer underneath later ground and lacquer layers.

#### JANE WILLIAMS WRITES:

##### *Materials and Methods of Manufacture*

Examination of the box in areas of damage and with X-radiography showed that the basketry is supported on wood. X-radiographs of the lid revealed that it is made from multiple planks of wood, glued together with no dowels. It has two thicker crossbraces glued to the underside and dowelled to the sides. A continuous, flat band of basketry made of split bamboo laced over vertical strips of bamboo (fig. 5.28) was wrapped around the sides of the lid and box. The basketry bands are held in place by strips of thin wood (3-mm thick) that overlap it and form oval frames on each side around the basketry. The wood strips are joined near the corners (see fig. 5.29), where they also serve to round the corners of the lid and box.

The same sequence of layers is found on many different areas of the surface (see fig. 5.30). A thin, bright white foundation layer was applied first and over that a loosely woven, plain-weave vegetal fiber textile. Next comes a dark gray ground layer, which penetrates the textile

weave, followed by a cream-colored ground layer. The dark gray ground was identified by FTIR as a mixture primarily of kaolin and protein, and the cream-color ground as a mixture of clay (possibly bentonite) and protein. The mother-of-pearl inlay was glued directly to the white ground, probably with a protein glue. Around the inlay another, slightly lighter gray ground layer was applied to bring the surface level with the inlay. The exterior of the box and the interior edges were then coated with an unpigmented lacquer, which was polished down to reveal the inlay. In hopes of gathering information that might help to attribute the box more securely, small samples of the lacquer were sent to Dr. Tetsuo Miyakoshi at Meiji University, Japan, for analysis by pyrolysis-Gas Chromatography/Mass Spectrometry (Py-GC/MS). The lacquer was identified as coming from *Toxicodendron verniciflua*, the primary source for lacquer in China, Korea, and Japan.

The interior of the box is currently lined with a damask textile that has a repeating pattern of what appear to be fluttering squares of patterned cloth. It has gold-colored silk weft

and a brown cotton warp (selvedges are visible). The design is created by gold silk and, in small areas, metallic silver supplemental wefts. The metallic threads appear to be made by coating paper strips with metal powder. The textile was glued to what appears to be mulberry paper before it was cut out in pieces and glued to the surface.

In addition to the art-historical confusion about this box, both Mr. Kitamura and Ms. Piert-Borgers were interested in and puzzled by aspects of the appearance. The confusion may stem from the fact, realized only in the final weeks of this project, that the box has been entirely resurfaced. The initial examination focused on the construction and the interesting alternating white and gray foundation layers. The focus then shifted to the damaged foot, and the picture became much more complicated. While the crack in the foot was being examined, a tiny fragment of red lacquer fell out; fig. 5.31 shows a view into the crack. The first X-radiographs had been taken of the lid and basketry sections to study their construction and had revealed nothing surprising. Now we took a second round of X-radiographs, focusing on the feet and all of the corners. These X-radiographs showed that the feet were originally much smaller and had a much simpler profile with flat outer surfaces and arched sides, and were covered with red lacquer (see fig. 5.32). Looking at the foot again, I was able to see that the coarse textile layer and overlying ground and lacquer layers were applied over the red finished surface. The current shape of the feet was not carved, as it initially appears, but was built up over the coarse textile in a coarse white foundation material (probably containing lead white, to judge from its radio-opacity) in some places as thick as 1 cm. This white material was covered with the coarse textile layer found elsewhere on the surface, and then the

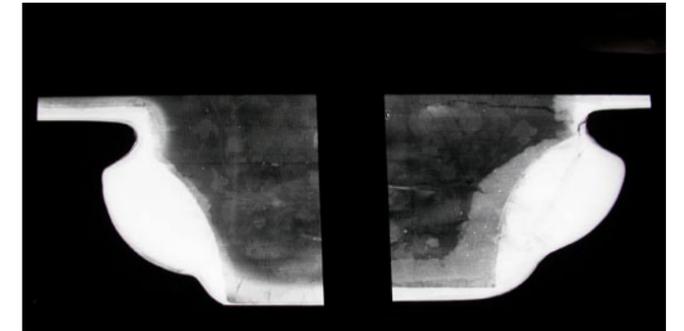


Fig. 5.32. Box (B61M16+), X-radiograph of two of the feet; radio-opaque areas are lead white containing putty applied over the original finished feet to build them up to their current, more baroque shape. Technical data: Gulmay X-ray unit (320 kV max.), Kodak Industrex M film, 30 kV, 4 mA, 60 seconds, distance from tube, 36 inches.

raised borders of the feet were built up in the gray ground layer.

The X-radiographs of the corners (figs. 5.33 and 5.29) revealed twentieth-century 1/2-inch, 1-inch, and 1 1/4-inch wire nails in all corners of the base and none of the lid. The construction of the corners is otherwise the same on the base and lid, and the nails are presumed to be repairs, rather than part of the original construction. It is now more obvious that, where the lid and box meet, the corners of the lid have cracked and are missing lacquer and ground, while the corners of the box are all intact. What is significant about the presence of the nails, however, is that they date the lacquer and mother-of-pearl decoration covering these repairs to at least the beginning of the twentieth century.

Next I wanted to establish whether the central mother-of-pearl design on the lid was part of the restoration work. The sequence of ground layers that overlay the coarse textile on the foot is also visible in damages on the sides of the box and on the lower and upper edges of the

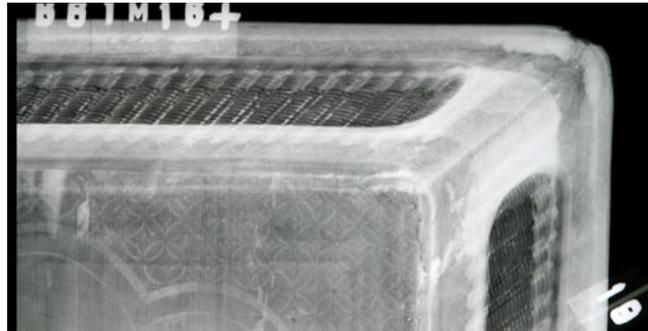


Fig. 5.33. Box (B61M16+), X-radiograph of lid corner; note the absence of dowels or nails in the joints and the way in which the basketry is applied as a band that wraps around the corner. Technical data: Gulmay X-ray unit (320 kV max.), Kodak Industrex M film, 30 kV, 4 mA, 60 seconds, distance from tube, 36 inches.

lid. The central field of the lid has a craquelure throughout, but very few of these cracks are found in the diaper-patterned area outside the central cartouche on the lid. I considered it possible that, although the mother-of-pearl decoration appears very consistent throughout the surface, the central field was older and had been left intact when the rest of the box was resurfaced. This was what I had found on the much smaller Chinese tray (B79M7). One of the larger pieces of mother-of-pearl in the center of the lid has a loss through which I used a pin to excavate all the layers down to the wood. I found in this tiny core section that the layers matched exactly those found on the restored foot. The lowest, bright white ground layer (under the coarse textile) lies directly on the wood in the center of the lid, then, the restoration surface does not cover an earlier scheme.

An earlier scheme was also found on along the damages at the interior edges of the lid where the coarse textile layer ends. The cut edges of the coarse textile on the exterior meet the cut edges of a more tightly woven plain-

weave, blue, vegetal fiber textile applied to the wood on the interior. This textile was covered with a beige ground layer followed by a thin dark lacquer layer that looks more deteriorated than the current surface. On the inside of the lid, this older lacquer appears to be covered with the bright white ground layer then a thin lacquer layer. The damask textile lining overlaps the later lacquer.

#### *Treatment History*

Although it took some time to recognize that all of the lacquer and inlay decoration visible on the box is modern, it was easier to determine that the surface had been subsequently renewed with an overall coat of unpigmented lacquer. This restoration lacquer overlaps the mother-of-pearl slightly and, where it coats the overall craquelure on the lid more thickly, there are pools of lacquer with no fissures (see fig. 5.34). Like other Chinese objects in the collection that have been relacquered, such as the tiered box (B77M21) and the small panel (B83M1), in small areas around the inlay the underlying darker lacquer can be seen to be level with it. The top of the lid has only a translucent, brownish, grimy coating on it that absorbs long-wave ultraviolet light.

#### *Condition*

The wood is in good condition overall. However, one of the feet has a slightly open split through the wood that shows some movement under slight pressure. The basketry has a few broken, missing, and abraded elements, but none that appears vulnerable to further damage or loss.

The same foot that has split has lost the lacquer and ground layers that form its outer lower edge. Another foot has a horizontal rectangular loss to the lacquer near the top corner of the foot. There are a number of smaller chipped



Fig. 5.34. Box (B61M16+), detail of lid showing fine cracking and evidence of relacquering; note pooling of restoration lacquer obscuring craquelure in areas and overlapping inlay.



Fig. 5.35. Box (B61M16+), detail of lid; the left side has been cleaned.

losses to the lacquer, primarily at the corners of the lid where it rests on the base. The lacquer and ground adjacent to some of the losses are cracked and/or lifting. Apart from the chipped areas, the lacquer is in stable, good condition overall, particularly on the sides of the box. The central field of the lid is covered with a network of fine, short cracks intersecting at right angles. There are tiny corners of lacquer lifting along these cracks, but in general at this time the lacquer does not appear vulnerable to loss as the result of the cracking. The lacquer is cracked along the top of the wood strip running below the basketry. This cracking appears to result from the slight separation of the wood from the underlying structure.

The textile lining of the box is badly deteriorated. It has large losses and strips of it are hanging down from the interior surface, particularly that of the lid. The textile has darkened, probably primarily from darkening of the adhesive used to secure it to the box's surface.

The surface of the trunk, particularly the lid, is very dusty.

#### *Treatment*

The surface of the box was cleaned first with a soft brush and vacuum. Before the evidence of resurfacing had been gathered, the solubility of the brownish coating on the top of the lid was tested. Where it coats the inlay it is slowly soluble only in water and insoluble in ethanol, acetone, Stoddard solvent, and xylene. Cleaning tests on the lacquer show that it can be cleaned to a shiny surface by being wiped with a soft cotton cloth dampened with ethanol or Stoddard solvent. This suggests that a thin wax coating may have been rubbed on the lacquer over the brownish coating. With a combination of cleaning the inlay surfaces with tiny swabs, very slightly dampened with deionized water, and wiping the surface overall with soft cotton dampened with Stoddard solvent, the appearance of the lid could be brought to match the color and gloss of the rest of the box (fig. 5.35 shows a small test area that has been partially cleaned. The cleaning process was, however, too time-consuming to be completed during this project.

Before the move to the new museum, limited repairs were done to the most unstable, dangling parts of the textile lining on the interior that were in danger of becoming detached in the move. These areas were readhered by brushing dilute methyl cellulose onto the paper support, letting it dry for a few minutes until it had become tacky, and then pressing the textile lining against it. The area was covered with a thick blotter to distribute the pressure and weighted gently until dry. Silicon-coated Mylar was not used as a barrier below the blotter, because the amount of adhesive used was too minimal to penetrate the thick and already adhesive-saturated textile.

Repairs to the lacquer were not done before the move, because there had been inadequate time to study the manufacture of the box and it appeared both interesting and complicated. The box was instead carefully packed with padding and arrived at the new museum without new damage. After the move, I was able to return to the box and study it further. I was glad, in retrospect, that I had not glued the cracked foot in the rush before the move, because I might not then have realized the extent of restoration on the object.

Consolidating the fine cracks on the lid of this object is a problem that I did not address. As on the Korean box (B62M13), a relatively thin lacquer is cracking and separating from the surface of the relatively thick ground. Preconsolidant is necessary to harden the ground and to prevent whatever adhesive is used to secure the thin lacquer from soaking into the ground rather than staying at the point of separation. The preconsolidant needs to have good penetration to prevent the consolidant from penetrating all the way through the thick ground layer and thus creating areas of different strength and weakness within the ground. As Mr. Kitamura and Ms. Piert-

Borgers have pointed out, urushi would not be an appropriate choice because it was not used in the original ground layer. It might be excessively stronger than the original binder and it would darken the color, which was carefully manipulated to emphasize the color differences between the shell inlay and the dark lacquer. Some of the potential risks for this object associated with the use of aqueous adhesives were discussed by both Mr. Kitamura and Ms. Piert-Borgers. I would be likely to test an acrylic resin first, one of Mr. Kitamura's suggestions for this box, in the manner I described for the cracks on the Korean box (B62M13). I think it unlikely, however, that it would be possible to get enough adhesive into the very fine, tented cracks to secure the lacquer successfully. For this reason I would concentrate consolidation efforts on areas where there has been some loss or the lacquer is cupped enough to allow some access. □

**T**iered box (B77M21), China, Yuan-early Ming dynasty, 15th cent. CE, H. 19.8 cm; W. 20.0 cm; D. 20.0 cm. This two-tiered, lidded, food container is square with indented corners (fig. 5.36). It is covered with black lacquer and mother-of-pearl inlaid decoration. The top shows scholars standing in a building in a garden setting. The four uppermost levels on the sides all have decoration set within ogival panels surrounded by a linked pattern. The decoration within the panels shows, from top to bottom, floral scrolls, birds, figures, and animals. The lowest level on the sides is covered with flower scrolls. The foot is decorated with a tortoiseshell pattern. The edges of the box are all reinforced with twisted wire.

#### *Conservation Record*

The box was accessioned in 1977. There is no record of its treatment in the museum.



Fig. 5.36. Tiered box (B77M21), after treatment.



Fig. 5.37. Tiered box (B77M21), lid shown in raking light, before treatment.

SHOSAI KITAMURA WRITES:

The four corners of this two-tiered, covered container are sharply inverted. On the top of its lid is an architecture and figure design, and sides of the lid and the container have bird and figure designs in cartouches, all in mother-of-pearl.

*Condition*

Although there is no structural damage, the lacquer coating is lifting from the ground layer, and the lacquer surrounding all the mother-of-pearl on the exterior is cracked and tented (see fig. 5.37). The ground layer visible in damaged areas is brownish, and the appearance of the cracks suggests that the ground contains some lacquer. The interior has a thick coating of previous relacquering and has developed long and deep cracks in the coating. These cracks may originate at the ground layer.

*Suggestions for Treatment*

If black lacquer is used as a consolidant around the mother of pearl, lacquer may penetrate under the shell and turn it bluish, no longer matching the milky white shells nearby. Therefore, it would be better to use animal glue diluted with water to consolidate lifting layers. As described for the panel (B83M1), moderate moisture should be added to cupped layers to soften them and then the correct amount of pressure added. However, if too much moisture is introduced, the coating may stretch, therefore, a careful test should be made before starting the treatment. Where it is difficult to secure the lacquer, it may be necessary to use a clear, solvent-based resin. Large, deep cracks and areas of missing lacquer around mother-of-pearl may be filled with a mixture of lacquer mixed with tonoko and then coated with black lacquer. Cracks in the coating on the inside of the container may be filled with raw lacquer diluted with solvent and the coating may be readhered with *mugi-urushi*, adding proper pressure. Areas that are difficult to reattach can be secured by simply filling underneath them with *sabi-urushi*.

BARBARA PIERT-BORGERS WRITES:

The present tiered box shows the damage typical of a finish structure that has been destroyed by a later relacquering. In the interior of the box we find relatively wide cracks that render the wooden construction visible (see fig. 5.38). In the area of the large board these cracks run across the grain and, at the smaller, glued cross-board, the cracks first run across the grain and then curve to the glue joint. The exterior surfaces seem likewise to have been coated with a hard, glossy urushi layer. Here we see several vertical, gaping cracks, some of which curl or cup upward at the edges. The mother-of-pearl



Fig. 5.38. Tiered box (B77M21), interior before treatment.

inlays are grimy and lacquered over. Missing inlays have been imitated in lacquer painting, and lacquer losses painted over in large areas. This piece evinces all the disadvantages of an inexperienced restoration with Asian lacquer. The damage is worsened by the irreversibility of the measures.

The final lacquer layer inside the box will probably have to be retained. The retouchings and overpaintings on the outside surfaces and mother-of-pearl decoration can be partially removed, but by mechanical means only. A sharpened bamboo stick or a scalpel with a ceramic blade might be used to expose the mother-of-pearl inlays and flake the paint layers off. In certain areas, pointed pieces of charcoal or soft wood dipped in charcoal powder could be used to polish or burnish the lacquer surface.

Sturgeon glue is effective in consolidating

mother-of-pearl decoration. It has to be kept in mind, however, that mother-of-pearl may regain color and change from a pale white to its original iridescence. This effect may not be desired by curators or collectors. An infiltration of this glue might perhaps permit the raised cracks and flakes to be flattened and adhered. In Western restoration shops, electric spatulas or warmed mats are often employed. To my mind, this is an additional and unnecessary source of risk. The crucial thing is to apply sufficient pressure, as is the case when consolidating by using *urushi* and the *shinbari* method).<sup>24</sup> To re-adhere the flakes inside the box, sturgeon glue is suitable, as is polyvinylacetate.

As described for the small stand (B77M13), the consolidation of Chinese lacquers with *urushi* can lead to problems. A Chinese plate from the Ming dynasty was consolidated in

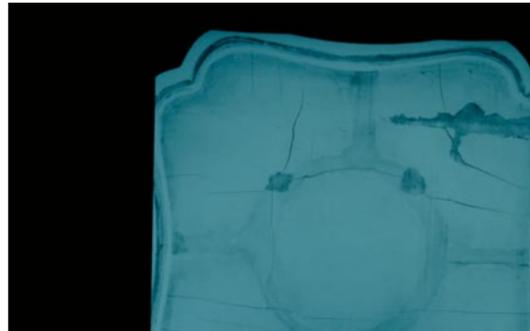


Fig. 5.39. Tiered box (B77M21), X-radiograph of middle tier. Technical data: Norelco X-ray unit (150 kV max.), Kodak Industrex M film, 45 kV, 6 mA, 60 seconds, distance from tube, 36 inches.



Fig. 5.40. Tiered box (B77M21), detail of corner, before treatment, showing use of red lacquer lines on old restoration to imitate inlay pattern.

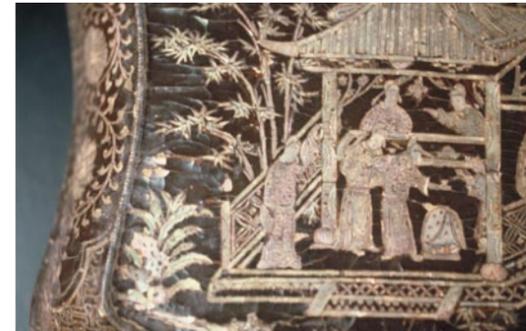


Fig. 5.41. Tiered box (B77M21), detail of lid, before treatment.



Fig. 5.42. Tiered box (B77M21), detail of lid, after treatment; the treatment consolidated the ground and readhered the lacquer to the ground, but the lacquer remains cupped; the effect of mechanically removing restoration lacquer is particularly visible in the trees at left.

the traditional Japanese manner: infiltration by brush or injection of mugi-urushi dissolved in ligroin, and pressed with damp compresses. The lacquer has remained stable and well adhered to this day. However, problems resulted from the length of time that the lacquer surface remained damp because mugi-urushi takes so long to dry. The surface developed mold and its color changed. Fortunately, these changes occurred on a re-lacquered surface. The consolidation process had to be repeated innumerable times. The cause lay in the fact that much of the textile layer had little contact with the wood core and the finish, which contributed to an increase in absorbency. Lee has pointed out similar problems, and found a direct relationship between the tensile behavior of the textile layer and the resulting (typical) cracks. As a result, when dealing with protein-vehicle grounds, I tend to avoid urushi infiltration and to dispense with “full saturation” when using synthetic resins as well.

#### JANE WILLIAMS WRITES:

##### *Materials and Methods of Manufacture*

The box was constructed from strips of wood that were glued together (in X-radiographs there is no evidence of pins or dowels). X-radiographs show that the flat parts of the lid and bottom tray are each made of two parallel strips of wood with rub joints. The middle tray is composed of three parallel strips of wood with rub joints and a fourth perpendicular strip butt-joined to the others, a structure that has been widely observed in X-radiographs of Chinese lacquer objects from various periods. In the X-radiograph (fig. 5.39) one can see that this tray originally was compartmented, with a central circular compartment surrounded by four equal-sized sections. The shallow divider walls were originally secured with glue and two pegs (the filled holes are visible in the X-ray). The sides of the box are separate strips of bent wood glued at the corners.

The wood was then coated with a grayish

tan ground layer. Fibers are visible in the first, coarser ground layer. Not enough are visible and the X-radiographs do not help to determine whether these are loose fibers or a textile layer. At least one fine, grayish tan ground layer with no fibers or visible inclusions was then applied. With the extensive relacquering, it is not possible to tell whether the thin, small pieces of mother-of-pearl and double strands of strip-twisted copper-alloy wire were adhered directly to the ground or to a layer of lacquer. The box was then given at least one coating of dark brown lacquer. When the lacquer dried it was ground and polished down to reveal the inlaid shell and wire. The mother-of-pearl inlay has incised detail. As Garner notes, on such thin, fragile inlay it would have been easier to incise the pattern after the inlay had been secured in position.

##### *Treatment History*

The box has had multiple restoration campaigns. Examination in ultraviolet light does not help to

differentiate the different restorations—in UV light the surface of the box looks very uniform and nonfluorescent. The entire surface has been thickly recoated with a translucent, unpigmented lacquer. This layer was then chipped off the surface of most of the inlay (jagged outlines from this process are visible around the inlay), but in several locations the inlay remains partially obscured. At some point subsequent to this, the interior was completely recoated with a more orange shade of red lacquer. At a later date, a few isolated losses in this red coating were filled with a brighter red lacquer. All of the edges have been recoated with black lacquer. Large losses to the lacquer at some of the corners on the sides were also filled with a beige material and coated with lacquer that is blacker than the surrounding surface. The mother-of-pearl inlay patterns were reproduced on the surface of the fill with red lacquer (see fig. 5.40).

##### *Condition*

The wood structure of the box is in good, sta-



Fig. 5.43. Tiered box (B77M21), detail of corner, after treatment; cracks in the old restoration and losses have been filled; mica pigments mixed with acrylic inks were used to simulate inlay pattern on large loss, but the pattern was not recreated on smaller losses.

ble condition, but the lacquer surface is cupped throughout and pulling away from the wood in several locations. The worst area of lifting is on the lid, to the proper right side of the pavilion (see fig. 5.41). The separation is occurring in the weaker ground layer. The lifting and cupping appear related to a thick restoration lacquer having been applied over the weaker, thinner original lacquer and ground layers. Minor losses to the lacquer, the shell inlay, and the wire throughout (the wire has been largely obscured by restoration—losses to it are discernible mainly in X-radiographs) have been noted on diagrams.

The lacquer fills on the box remain stable, but do not match the original surface in color or gloss. Their surfaces are somewhat uneven and are higher than the surrounding lacquer. They also overlap the original around the edges of the losses.

The surface of the box is dusty and somewhat grimy. The grime is particularly noticeable as a sticky, grayish layer obscuring the mother-of-pearl inlay.

#### Treatment

The surface was cleaned first with a soft brush and vacuum. This was done carefully and gently and areas with loose lacquer or inlay were avoided. The brush was used to lift the loose dust from the surface and the vacuum nozzle was held inches away from the surface to collect the dust without pulling off loose original material.

The effect of different solvents (water, ethanol, acetone, Stoddard solvent, and xylene) on the surface grime and on the lacquer itself was tested. The lacquer was found to be insoluble in all of the solvents. The surface grime was best reduced with deionized water. The surface was then cleaned with small cotton swabs and deionized water. The swabs were dipped in water and then rolled over an absorbent cotton pad to remove most of the moisture.

The first step in treating the unstable lacquer was to determine whether the cupping and distortion could be relaxed at all. I tested localized humidification, as described by Marianne Webb in her book, suspending a dampened cotton pad a couple centimeters above the surface using a plastic container with the bottom removed. This had no effect on the cupped lacquer. Tests using the heat of a warm spatula over silicon-release Mylar also had no effect. The restoration lacquer appears to be too thick for the cupping to be relaxed with the mild measures I tested. It may be that heat or humidity applied at higher levels or for longer than I was comfortable with would have had an effect. The humidity and heat applied to the surface in my tests were not able to penetrate the thick surface lacquer to address separation and distortion occurring in the ground layer. I found that the moisture introduced with an aqueous adhesive could be effective in relaxing these distortions, which were particularly pronounced on the lid, without having an adverse effect on the lacquer or ground. The thickness of the re-

stored lacquer layers that makes them difficult to relax also makes them more resistant to the adverse effects of moisture that Mr. Kitamura had warned of, such as stretching or color change. I tested protein adhesives before aqueous synthetic emulsions or dispersions, because the protein adhesives will affect future treatment less. The large molecules of emulsions or dispersions can change the way the ground absorbs solvents. Isinglass was tested before rabbit-skin glue because I have used it successfully in the past, and because once it is dissolved it can be used at close to room temperature, which limits the heat to which the original materials are exposed and makes it easier to maintain the working concentration of the adhesive. Because isinglass worked well in my tests, the ground in lifting areas of lacquer and inlay was consolidated with 5% isinglass in deionized water. The consolidant was flowed in with a small brush. The area was pre-wetted first with ethanol applied with a small brush, to reduce the surface tension and increase the penetration of the consolidant. A thicker, 12% solution was used to adhere lifting lacquer and inlay. The lacquer was held in position with a combination of padded clamps and *shinbari*.

After consolidating the inlay in an area, I carefully removed the restoration lacquer over the mother-of-pearl inlay, working under a binocular microscope and using a Beaver miniscalpel blade that had been polished using Micromesh abrasive sheets to remove any irregularities in the blade edge that could scratch the inlay. A sharp blade does pose the risk of scratching the surface and in many cases a thin tool formed from Plexiglas or another hard plastic might be used more safely, but I found that, in this case, the thinness and sharpness of the blade gave me more control in removing the restoration lacquer. The blade was held at a low angle and, in lifting the restoration lacquer, I avoided contact between the blade and shell as much as possible. The cupping of the res-

toration lacquer also made it easier to get under the edge of the lacquer without risking scratching the inlay. Figs. 5.41 and 5.42 show a detail of the lid before and after treatment—the removal of restoration lacquer from the inlay is particularly noticeable on the trees.

Because the existing lacquer-based fills are stable they were left in place. Where they overlapped the surrounding surface, they were reduced with a scalpel and then the residual fill could safely be removed from the lacquer with a swab slightly dampened with deionized water. The fills were reshaped using small sanding tools, and smoothed with sandpaper and then Micromesh. Before the losses were filled, the surfaces of the exposed ground or wood were sealed with dilute B-72 in acetone to provide a separation layer between the new fills and the original. Also, my experience has been that sealing the loss makes the fills adhere better. The larger loss to the lacquer on the bottom and the smaller isolated losses were filled with a mixture of 6% PVOH in water and 1 : 1 calcium carbonate : kaolin. Even the smallest losses were filled to protect the edges of the cupped remaining lacquer from further damage and loss. The fills were smoothed as much as possible with a steel spatula dampened with ethanol. The larger fills were then sanded with successively finer Micromesh up to 12000 grit. The fills were painted with Rowney FW Acrylic Artists' inks. Several coats of ink were used to build up the color in thin smooth layers on the larger fills. This was not visually necessary for the smaller (1/8-inch) fills. On the largest fill dry mica pigments were mixed with the ink to replicate the mother-of-pearl pattern (see fig. 5.43). Acrysol WS-24, diluted from the stock solution with deionized water until it could be brushed out smoothly, was added to the final coats of ink to add gloss. The Acrysol made the surface harder and made it possible to sand with fine-grit Micromesh between the last coats. □



Fig. 5.44. Panel (B83M1), after treatment.

Panel (B83M1), lacquer panel, China, Ming Dynasty, 1368–1644, L. 40.1 cm; H. 33.1 cm; W. 0.9 cm. The object is a flat, rectangular panel decorated on the front with mother-of-pearl inlay (fig. 5.44). The background of the central field depicts a scholar or official seated in a pavilion and being attended to by servants. Meanwhile, a delegation, including one person on horseback, from an encampment tucked behind rocks and trees, is greeted at a gate in the foreground. The inlay on the one of the tree trunks is inscribed “made by Xiao Guan from the west of the

city” (see fig. 5.45) and one of the visitors bears a book inscribed “sacred mandate,” identifying him as a messenger from the emperor or a mythic god. A design field depicting peony scrolls on a background of floral medallions frames the central scene. It has twisted wire borders around the central field and the outside edge. The lacquered back of the panel is undecorated.

#### Conservation Record

The panel was accessioned in 1983. There is no record of its treatment.



Fig. 5.45. Panel (B83M1), detail showing inscription on inlay; old inpainting to simulate mother-of-pearl inlay is visible on the tree trunks at left.



Fig. 5.46. Panel (B83M1), reverse; note cracks following edge of central panel and mitered framing pieces.

#### SHOSAI KITAMURA WRITES:

The presence of the cracks in the lacquer surface following the joins suggests that this rectangular decorative panel has a wood substrate with a central panel fitted with four side panels. The front is framed with a decorative border of peony scrolls and linked floral medallions. The border has two rows of inlaid twisted silver-colored wire along its interior perimeter and one row along the outside edge.

The back of the panel is covered with cloth and finished in tamenuri technique leaving brush marks. Judging from this coating method, the panel must have been a tabletop, cabinet door, or box top. Usually a screen or a divider is decorated on its back, therefore this piece was not originally made for such purpose.

The decoration is finely executed using medium thick yakogai (*Lunatica marmorata*) shell. The deeply incised lines on the figures' faces, the strong and thick undercoating, and the decorative style of the linked floral medallions show the characteristics of works dating from the first half of the Ming dynasty.

#### Condition

The substrate shows some distortion. The reverse has cracks through the ground layer following the joints (see fig. 5.46). The mother-of-pearl appears stable; some shell inlay is, however, missing and there is evidence of previous replacements.

#### Suggestions for Treatment

It is impossible to flatten the distorted wood substrate. Raw lacquer diluted with solvent should be flowed into the cracks on the back to stabilize the ground layer. Large cracks and lifting areas can be filled with *mugi-urushi* diluted with solvent and then pressed carefully to reattach lifted areas without cracking them. Since the lifting lacquer is rather thick, it may not be possible to flatten it completely. If, however, moistening a small area softens the lacquer, it may be possible to flatten it to some extent. Moisture could be applied by placing a piece of soft, damp paper directly on the area or by placing the object in a high humidity, airtight container. Either method requires close monitoring of the state of the coating.

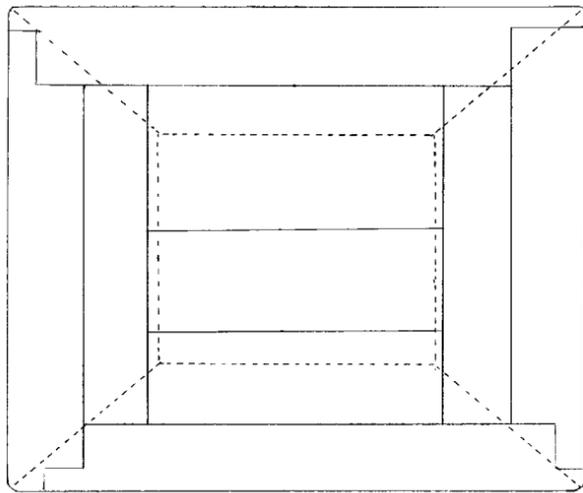


Fig. 5.47. Diagram of joins in panel (B83M1); the solid lines represent the joins in the front panel and the dotted lines, the joins in the back panel.

Some experimentation would be needed to determine whether the distortion of the lacquer can be improved. If the lacquer cannot be flattened, the distorted lacquer may be left as is. The cracks can be filled with *sabi-urushi* applied with spatula and the excess cleaned off. Surface dirt and any foreign matter may be cleaned off with alcohol.

BARBARA PIERT-BORGERS WRITES:

The most obvious damage to this lacquer screen decorated with mother-of-pearl and twisted metal wire comprises shrinkage cracks in the lacquer and the concomitant formation of flakes and fissures. The mother-of-pearl inlays are grimy and partially overpainted. The back of the piece has been completely relacquered.

A restoration procedure similar to that prescribed for the tiered box (B77M21) is recom-

mended. Another possibility would be the use of fish glue, such as that made by the Kremer company. This glue produces very solid elastic bonds and is used by colleagues in Germany to adhere metal and tortoiseshell inlays and is reported to be very strong.

JANE WILLIAMS WRITES:

*Materials and Methods of Manufacture*

The tray appears initially to be constructed from five glue-joined pieces of wood, one central rectangle framed by four narrow panels that are mitered at the corners, as Mr. Kitamura observed. However, through cracks in the lacquer on the edges, the back, and the front, one can see the wood structure. It appears that the panel may be composed of at least two layers of wood and the joins occur in different places in the two layers (see fig. 5.47). X-radiographs show that the central panel on the front consists of three horizontal planks surrounded by vertical and horizontal framing strips, all butt-joined. The back panel consists of five pieces of wood: a single central plank (smaller than the front central panel) flanked by four mitered strips. The front and back surfaces were covered with a layer of plain-weave textile before the lacquer ground layers were applied. Two coatings of a coarse, brownish gray ground, the second layer slightly finer, came next (see fig. 5.48). FTIR identified bone black and a lacquer binder in the ground layers. The sample illustrated in fig. 5.48 shows that the mother-of-pearl inlay pieces were applied to the ground when it was wet—the inlay sinks into it. Wire borders consisting of a single, flat (square-section) wire flanked by twisted pairs of wire were applied to the surface. There are two rows of this border around the central field

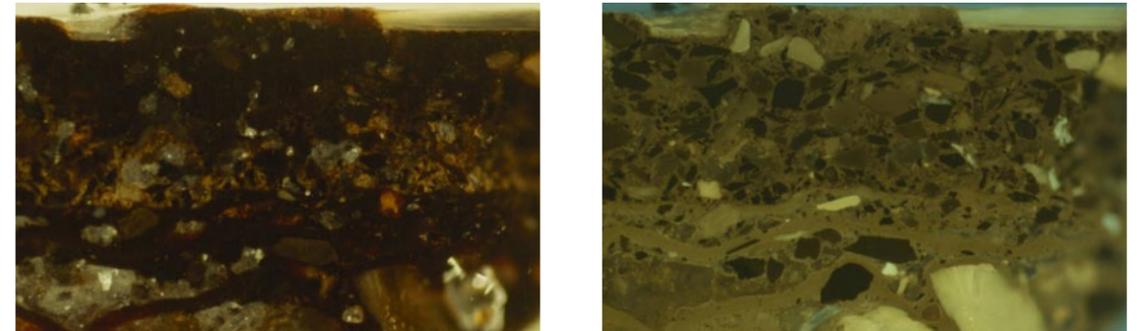


Fig. 5.48. Panel (B83M1), cross-section sample of surface layers on front of panel shown in reflected light (a) and ultra-violet light (b); photo taken at 100x magnification; note how thinly the lacquer is applied and how the inlay pieces are embedded in the upper ground layer.

and one around the outside edge. The wire was identified as copper-alloy because of its brassy color and because it has green copper corrosion products on its surface in many locations. A lengthwise seam is visible in several areas of the twisted and flat wire, suggesting that the wire may be folded or strip-drawn. Lacquer was applied to bring the surface level with the inlay. When the lacquer layers had dried, the surface was abraded and polished to remove the lacquer over the inlay, leaving the lacquer flush with the inlay. The level of the original lacquer is visible around the leaves of the willow tree and the peonies at the top toward the proper right side.

*Treatment History*

The panel has been relacquered overall. Some of the relacquering on the front obscures inlay. The two wire borders around the central field have been submerged by relacquering. There are also thick deposits of lacquer on the back-ground near the center and toward the proper left side. In UV light the fluorescence of these

patches is greener than the surrounding lacquer surface, but still very dull. The back and edges have been recoated overall with a lacquer that fluoresces a warmer color than the lacquer on the front in UV light. A cross section from the reverse of the surface layers directly on the textile show two schemes of applied ground and lacquer that are completely unrelated to those on the front surface (see fig. 5.49). The unusual laminated structure of the panel and the difference in the surface layers on the front and back raise the possibility that the wood back panel is not original to the object, but was applied later to reinforce it.

There are numerous pieces of replacement inlay (see, for instance, the replacement pieces on the horse and figure next to it—fig. 5.50), which differ from the original. Most are similar in thickness to the original inlay, but the replacement pieces on the horse are substantially thicker. The incised lines are sharper and clumsier on the replacement pieces. The color of the original inlay is warmer—it probably has a thin coating of lacquer or another material over it.

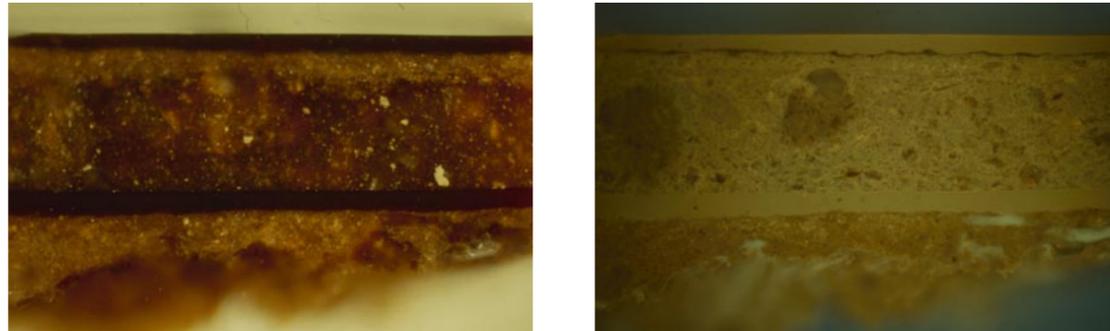


Fig. 5.49. Panel (B83M1), cross-section sample of surface layers on front of panel shown in reflected light (left) and ultraviolet light (right); photo taken at 200x magnification; two separate campaigns of applied ground and lacquer layers are visible and have no relationship to the layers found on the front panel (see fig. 5.48).

A white fill material was used to fill the largest area of loss where vertical and horizontal cracks meet in the upper proper right of the central field. The fill has been painted with black paint that absorbs UV light. Missing inlay here and in other locations across the panel (see fig. 5.45) has been simulated with gold- and silver-colored paint that also absorbs UV light.

#### Condition

Separation is occurring between the layers of wood. This separation is visible through cracks in the lacquer on the sides at the upper right and upper and lower left corners. Under gentle pressure there is slight movement between the layers.

Gaps have opened between the wood of the central panel and the top and right framing members on the front (fig. 5.51). The wood along the vertical gap moves slightly under gentle pressure. The separation has caused large cracks in the lacquer; the vertical crack is larger and more open. There is cracked and distorted lacquer along the crack and a loss to

the lacquer where the two cracks meet. Gaps between the central panel and framing members on the reverse have caused cracks in the lacquer on the reverse. While the cracks along the vertical joins (where the wood grain of the joined planks is perpendicular) follow the direction of the join, the cracks along the horizontal joins (where wood grain is parallel) are diagonal. Apart from these cracks, the lacquer is largely stable. There are fine cracks throughout the front surface, mostly perpendicular to the grain of the wood.

There are lifting or unstable pieces of inlay throughout the panel. Most of the larger pieces of inlay are lifting or have losses. The mother-of-pearl comprising the fan and umbrella near the center buckled because the edges of the inlay remained adhered to the surface while the wood support shrank. They are highly tented and vulnerable to being snagged or crushed. This buckling seems to have occurred primarily in one direction; the shrinkage of the wood in the central panel was primarily perpendicular to the grain.

There is a layer of white wax on the surface.



Fig. 5.50. Panel (B83M1), detail; the replacement mother-of-pearl is particularly noticeable on the horse and the figure beside it; note also the buckled and lifting mother-of-pearl on the shield and umbrella.

The wax is thickly deposited in recesses and in the cracks. The front surface of the tray is very dusty. Fingerprints and a sticky residue are visible on the reverse.

#### Treatment

The first step, even before cleaning, was to consolidate the lifting or loose inlay. This was achieved by flowing dilute (10%–15%) B-72 in acetone under the inlay with a very small brush and then covering it with Cerex (a spun-bonded nylon web), blotter paper, Plexiglas, and small lead-shot weights. This consolidation did not visually alter the color of the inlay. By applying gentle pressure to the tented inlay after introducing the adhesive under it, I was able to push it closer to the surface. It is not completely flat again, but is less vulnerable and is secured with adhesive.

The separation between the layers of the wood could be closed under gentle pressure. The thickest solution of B-72 in acetone that could be injected here, about 25%, was introduced between the layers. The area was then clamped until the adhesive had dried. Ani-



Fig. 5.51. Panel (B83M1), detail in raking light, before treatment, showing crack and distortion along wood join.

mal glue was not used to secure the wood as I was concerned about controlling the flow of moisture through the layers and cracks. The consolidation worked the first time in one location and had to be repeated once in the second area.

The loose lacquer along the edges of the cracks was consolidated with dilute B-72 in acetone. To stabilize the movement between the joined planks and layers, the crack was filled with a pigmented mixture of B-72 in acetone bulked with a mixture of 1 : 1 glass microballoons : Whatman CF-11 fibrous cellulose powder. To disguise the misalignment of the surfaces on either side of the crack, it was filled to slightly below the surface level.

On examining this panel, the curator, Michael Knight, said that, if it were to be displayed, he would want to remove the replacement mother-of-pearl inlay, particularly that on the horse. The restorations that were done with bronze or mica powder paint, while not perfectly executed, are less obtrusive and could be left. □



Fig. 5.52. Screen stand (B77M31), after treatment.

**S**creen stand (B77M13), China, 19th-early 20th century, L. 39.7 cm; W. 19.5 cm; H. 22.5 cm. The object is a black lacquer stand for a small Yuan-dynasty lacquer panel in the museum's collection. It has red foliate finials and red rectangular inset panels with cutouts (fig. 5.52).

#### Conservation Record

The stand was accessioned with the lacquer panel in 1977. There is no record of its treatment.

SHOSAI KITAMURA WRITES:

On the bifurcated carved legs is a crossbar with a groove in which to place a decorative panel. This was probably used as the stand for a mother-of-pearl decorative panel.

#### Condition

No damage is noted in the structure. Visual examination suggests that the ground layer con-

tains lacquer. There are cracks in the surface lacquer along wood joins. Some areas have flaking lacquer.

#### Suggestions for Treatment

The entire surface should first be cleaned with alcohol, then fine surface cracks should be filled with raw lacquer and larger cracks with *mugi-urushi*, both diluted with solvent. Deeper large cracks should be filled with *kokuso* and shallower ones with *sabi-urushi*, which, because it has the finest particle size of any of the ground materials, is used for the shallowest fills and to finish the surface of coarser ground materials. The fills should be shaped and finished with a coating of similar black lacquer.

BARBARA PIERT-BORGERS WRITES:

After my training in Japan in 1982, I favored the practice of infiltrating Chinese lacquers, too, with *mugi-urushi* dissolved in ligroin to consolidate flakes, building up missing areas with *sabi*, and retouching with *hidori-urushi*. Based on my experience with Chinese lacquers with protein-bound grounds, however, I would not recommend introducing dissimilar materials into the primer and lacquer structure. Thus it is inappropriate to use *urushi* to consolidate lacquer objects with grounds having a protein binder. I also generally avoid using dammar and synthetic resins on such objects. However, in certain circumstances, solvent-based resins are the only consolidants that can be used safely.

For the present stand, which is basically stable, I would suggest a consolidation with sturgeon glue. Depending on the sensitivity of the lacquer surface, the flow properties of the glue might be increased by adding the wetting agent Agepon or by a preliminary moistening with ethanol. Repair or retouching is not recommended, as the damaged areas

impair the overall aesthetic impression of the piece only minimally.

JANE WILLIAMS WRITES:

#### Materials and Methods of Manufacture

The stand is constructed of carved wood elements held together with glue and wood dowels. The surfaces, particularly the joins, were covered with a layer of blue plain-weave textile. Next, a brownish gray ground layer was applied, followed by black lacquer. The lacquer and ground layers were not analyzed, because resources for analysis were limited and it was not felt that it would change treatment decisions. A rectangular inset panel on both sides was coated with a red paint or lacquer.

#### Treatment History

There is no record of treatment to the stand. Significant losses occurred at some point to the decorative, carved aprons on both sides of the crossbar, leaving the curved shapes truncated and asymmetrical. The stand has been entirely relacquered since that damage occurred; the surface lacquer continues over the losses. Some losses to the lacquer and ground have been painted with lacquer that does not match the color of the original surface and was applied directly to the wood. Cracked lacquer at both ends was re-adhered with what appears to be PVA emulsion glue. This adhesive swells and is partially soluble in acetone. The lacquer on the outside top half of one of the circular end elements was re-adhered in this campaign. The lacquer was forced down against the wood, which had shrunk significantly, so that the edges of this lacquer fragment are not aligned with surrounding lacquer. The adhesive was sloppily applied and dripped onto the lacquer surface around the repairs. More recently, losses to the lacquer were paint-



Fig. 5.47. Diagram of joins in panel (B83M1); the solid lines represent the joins in the front panel and the dotted lines, the joins in the back panel.

ed out, directly on the wood, with a black paint that is soluble in water and acetone.

#### *Condition*

The wood has a small vertical split near the top of one vertical support member. A gap has also opened along a vertical join in the same area.

The lacquer surface is cracked in many areas, particularly on the four circular elements at the ends. The cracking is worst here because the shrinkage of the wood has left a shell of unsupported lacquer, which is vulnerable to damage in handling. The relative thinness of the lacquer application and thickness of the soft ground layer also have contributed to the fragility of this layer. Lacquer is also cracked and lifting along the joins in the wood.

There are insect exit holes in the bottom of the feet. When the object is handled, dry frass falls from these holes. A desiccated insect casing is stuck to the underside of the horizontal center piece.

The red paint on the inset panel exhibits a type of stable cracking that usually forms when a thin coating is applied over a thicker coating that has not thoroughly dried. The thin coating may have been a dark wash, because the red surface has an even, grayed, dirty appearance when compared with red paint newly exposed by lacquer losses. Since this stand appears to have been made in modern times for the display of an older panel, a coating may have been applied to give the red panel an aged appearance. Distinct from this gray wash is a heavy overall layer of



Fig. 5.47. Diagram of joins in panel (B83M1); the solid lines represent the joins in the front panel and the dotted lines, the joins in the back panel.

surface dirt. Unlike the darkened surface of the red paint, the dirt comes off readily if a dry swab is rolled across the surface. There is a fine spattering of a white paint on the stand's surface.

#### *Treatment*

This object was not treated before the move as it appeared to be stable enough to be moved safely. However, since it had evidence of previous insect damage, it was sealed in a double polyethylene bag during the move so that it could be monitored for any insect activity. After one year it was unwrapped and there was no evidence of new activity.

The surface was cleaned with a soft brush and vacuum and then with cotton swabs or pads dampened very slightly with deionized water.

The surface was wiped with soft, dry jersey immediately afterward. The cleaning removed substantial grime, leaving the lacquer glossy and translucent, rather than dull and dark gray. The cleaning did not affect the dirty appearance of the red paint, suggesting that there is an applied grayish wash on its surface. The open split and gap in the wood structure were glued with 30% B-72 in acetone and then clamped.

Two small flakes of lacquer became detached from the circular elements during the move. The flakes were reattached using 15%–20% B-72 in acetone, after preconsolidating the ground with 5% B-72 in 4 : 1 acetone : ethanol. Although this stand was not a curatorial priority for treatment, the decision was made to consolidate the lacquer and fill losses on it, because it has had a history

of surface loss from the same areas and is still actively flaking. Also, because of its small size and the simplicity of its construction, its condition problems could be addressed without taking much time away from other objects. Some areas of flaking lacquer required consolidation before they could be cleaned. The lacquer was consolidated using the same materials as were used for the detached flakes. To prevent future damage, gaps between the lacquer and wood, where the wood had shrunk and left the lacquer unsupported, were filled with a mixture of dilute B-72 in acetone, 1 : 1 kaolin : calcium carbonate, and dry pigments. This mixture was chosen because it has more adhesive strength than a PVOH-based mixture or a proprietary gesso. The same mixture, but with less adhesive so that it could more easily be smoothed and sanded was used to fill losses to the lacquer. The fills were not deep enough to need a coarser bulking agent such as glass microballoons. The fills were smoothed and shaped as much as possible with spatulas dampened with solvent and were then sanded with sandpaper and Micromesh, with care being taken to avoid abrading the surrounding lacquer. Rowney FW water-based acrylic inks were used to tone the new fills and to adjust the color of the mismatched old lacquer fills. Figs. 5.53 and 5.54 show the fills before and after toning.

Because there are no plans to exhibit the stand, no effort was made to reconstruct the missing parts from the carved aprons on the crossbar. If desired, these could be easily recreated in a soft wood, surfaced to match the original, and adhered in place. The stand was wrapped in washed cotton muslin and returned to storage in its custom-made paulownia wood box. As a precaution, the stand and its related lacquer panel and paulownia box were enclosed again in a sealed polyethylene bag and they will be fumigated in the museum's new carbon dioxide bubble when it is operational. □

## NOTES

- 1 Norman Tennent, James Tate and Linda Cannon, The corrosion of lead artifacts in wooden storage cabinets, *SSCR Journal*, 4:1 (February 1993), 8-11.
- 2 Michele R. Raychaudhuri and Peter Brimblecombe, Formaldehyde oxidation and lead corrosion, *Studies in Conservation* 45 (2000), 226-232.
- 3 Raychaudhuri and Brimblecombe, 229.
- 4 Ibid. and Lorna Green, A re-evaluation of lead conservation techniques at the British Museum, in *Proceedings of the International Restorer Seminar*, Veszprem, Hungary (1989), 121-130.
- 5 Robert Organ, *Corrosion and Metal Artifacts*, NBS Special Publication 479, 136.
- 6 According to Meiko Nagashima of the Kyoto National Museum, there was an *inro makie* maker by the name of Mizutani Shutoho, contemporary to Ogawa Haritus, whose *inro* include one in the shape of an old ink stick. One of his works has the same inscription and "84 years old" indicating his long life, although his birthplace and date of death are not known. Takao, You. "Kinsei makieshi meikan," *Kobijutsu Ryokusyo* 20, July 1996, p.107.
- 7 Turpentine, petrol, camphor oil, benzene, N-hexane, ligroin, toluene or mixtures of these may be used as the solvent.
- 8 See Kitamura Shōsai, "Die Restaurierung alter japanischer Lacke," in Kühnenthal, ed. *Japanische und europäische Lackarbeiten*, 68.
- 9 V. C. Sharma, Uma Shankar Lal and Tej Singh, "Method for Stabilization of Leaded Bronzes Affected by Corrosion of Lead," *Studies in Conservation* 48 (2003), 203-9.
- 10 Diana Heath and Graham Martin, "The Corrosion of Lead and Lead/Tin Alloys Occurring on Japanese Lacquer Objects," in John S. Mills, Perry Smith and Kazuo Yamasaki, Eds., *The Conservation of Far Eastern Art*, Preprints of the IIC Kyoto Congress, 19-23 September 1988, (London: International Institute for Conservation of Historic and Artistic Works,) 137-141.
- 11 In contrast to the uncorroded lead which does not fluoresce, areas that appear to have a compact, brown coating have a very similar warm color in long-wave ultraviolet light to the areas covered with white lead carbonate corrosion.
- 12 These were identified as the major components of the ground using FTIR spectroscopy.
- 13 A surface scraping was taken from one of the cross-section samples of the lid and analyzed by FTIR spectroscopy. In addition to an esterified wax (such as beeswax), gypsum was detected. There were several unidentified absorptions in the spectrum.
- 14 Li Dynasty mother-of-pearl designs almost always feature peony scrolls made using abalone shells.
- 15 See Noriyasu Niimura/Tetsuo Miyakoshi, „Identifizierung fernöstlicher Lacküberzüge mittels Pyrolyse-Gas-Chromatographie/Massenspektroskopie,“ in Kühnenthal, ed., *Japanische und europäische Lackarbeiten*, 123-134; Yukio Kamiya/Tetsuo Miyakoshi, „The Analysis of Urushi by Pyrolysis Gas Chromatography and Mass Spectrometry,“ in Kühnenthal, Michael, ed. *Ostasiatische und europäische Lacktechniken*, München, Bayerisches Landesamt für Denkmalpflege, 2000, 107-120.
- 16 Sir Harry Garner, *Chinese Lacquer*, (London: Faber and Faber, "1979), 212.
- 17 Gunhild Gabbert, *Buddhistische Plastik aus China und Japan*, (Wiesbaden, Franz Steiner Verlag, 1972), 502.
- 18 Monika Kopplin, *Ostasiatische Lackkunst. Ausgewählte Arbeiten*, (Münster, Museum für Lackkunst, n.d.), 114-15.
- 19 Rudolf Gunter Diesinger, *Ostasiatische Lackarbeiten sowie Arbeiten aus Europa, Thailand und Indien*, (Braunschweig, Herzog Anton Ulrich-Museum, 1990), 139.
- 20 See Marianne Webb, *Lacquer*, 88.
- 21 The textile has, on average, eight warp and eight weft threads per centimeter. It was applied to the wood with the warp thread aligned with the wood grain. The fiber was sampled and examined using polarizing light microscopy and comparison to known samples. The fibers were flattened in cross-section and 20-50 microns wide. They had horizontal striations, but these could not be confirmed to be nodes. While clearly a vegetal fiber and not cotton, the fiber could not be firmly identified as a bast fiber, as Mr. Kitamura had suggested.
- 22 In retrospect it now seems apparent that, despite the mechanical damages to the lid edges and feet, the mother-of-pearl and lacquer are unusually intact and uniform.
- 23 The fiber was sampled and examined using polarizing light microscopy and comparison to known samples. These fibers were somewhat finer, 20-40 microns wide, than those from the exterior and less obviously flattened in cross-section. Like the fiber from the exterior, they had horizontal striations that could not be confirmed as nodes. So, similarly it is a vegetal fiber and not cotton.
- 24 See Hiroshi Kato, "Die Restaurierung von Exportarbeiten mit Tierleim und *Urushi*," in Kühnenthal, ed., *Japanische und europäische Lackarbeiten*, 83.
- 25 Lee, *Oriental Lacquer*, 37.
- 26 Billie Milam and Helene Gillette, "X-ray Radiography in the Study of Oriental Lacquerware Substructures," in *Urushi*, Proceedings of the *Urushi* Study Group, Tokyo, 10-27 June 1985, N. S. Bromelle and Perry Smith, eds., (The Getty Conservation Institute, 1985,) 199-226; and M. Webb, *Lacquer: Technology and Conservation*, 15.
- 27 Sir Harry Garner, *Chinese Lacquer*, London: Faber and Faber, 1979, p. 211.
- 28 Suzuki, a visiting Japanese lacquer artist, when examining this object said the re-lacquering of the interior looked as though it had been done in Japan in the late 19<sup>th</sup> century.
- 29 Webb, *Lacquer: Technology and Conservation*, (Oxford: Butterworth-Heinemann, 2000,) 79.
- 30 Folded wire is formed by hammering a rectangular rod into a solid 'C' shape. To make strip-drawn wire, a strip of metal foil is drawn through a series of holes of decreasing diameter and curls in on itself to make a hollow tube. Judith Swaddling, Andrew Oddy and Nigel Meeks, "Etruscan and Other Early Gold Wire from Italy," *Jewellery Studies*, 5 (1991), 7-21.

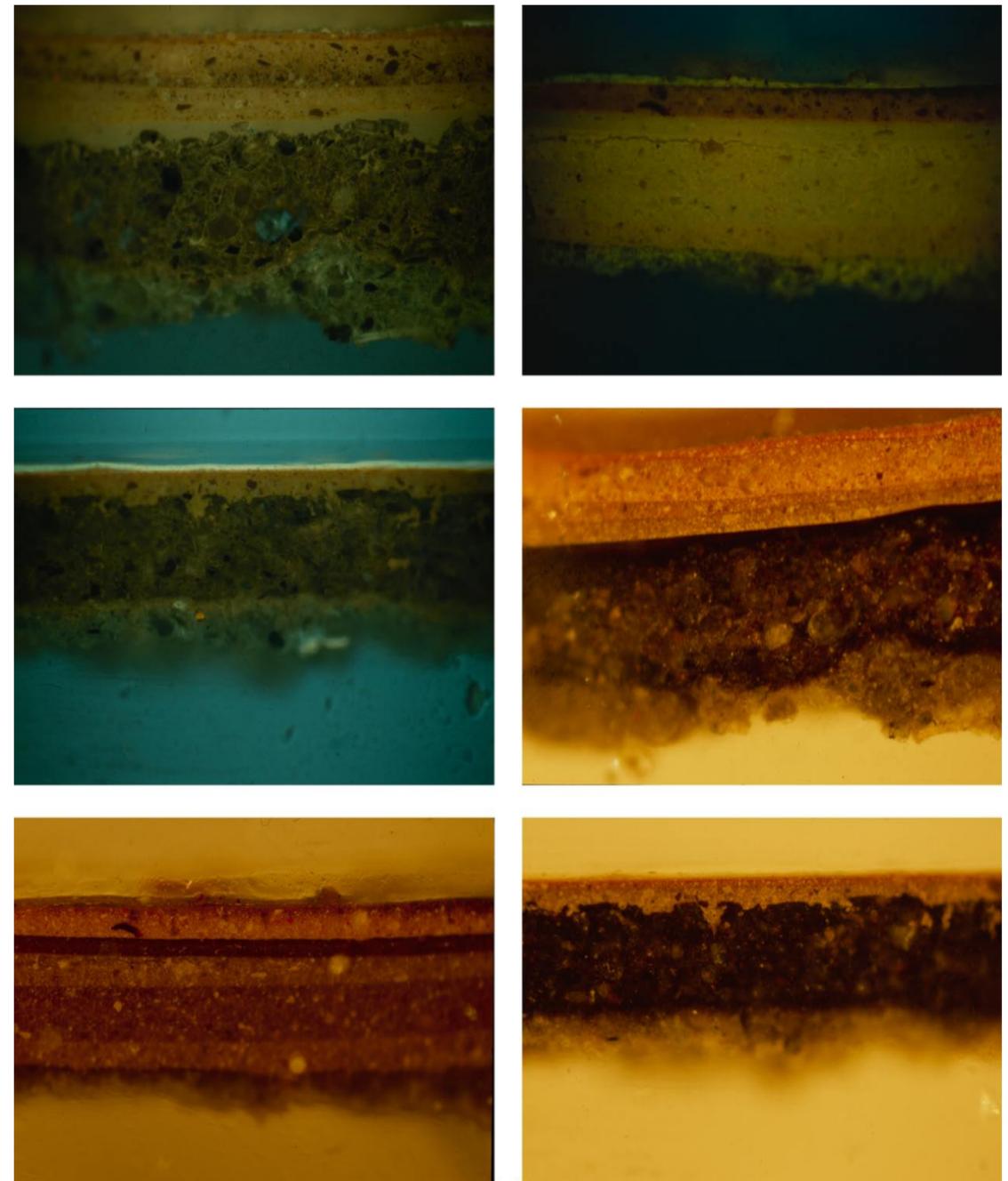


Fig. 6.26. Chart showing cross sections of lacquer layers from different parts of lacquer chair (B69M54a).



## 6. Case Studies: Covered Box, Cabinet, and Chair

*The four objects in this section provide some excellent examples of the debate between conservation and restoration. In many cases the problems demonstrated by one piece apply to those following and will not be repeated each time.*

**C**overed Box (B60M292), Korea, Joseon period, 19th century, H. 28.0 cm; W. 45.5 cm; D. 31.3. This rectangular box is covered with black lacquer and mother-of-pearl inlay. The lid is hinged and secured by a fish-shaped lock that is not contemporary to it. The motifs depicted on the lid within a rectangular inlay frame include two circular designs known as the “seven treasures,” two swastikas, two scrolls, two rattles, two rhinoceros horns with jewels and ribbons, a fan, a crane, a peony, and four trigrams. The front depicts a tiger, a crane, and a magpie among trees and rocks. Two trigrams flank the lock. The back shows phoenixes among trees and rocks. The sides of the cabinet show bamboo. The sun, moon, and clouds are represented on the sides of the lid. The original metalwork is simple and undecorated. The interior is lined with pink paper and has a more recently made shallow tray.

### *Conservation Record*

The box was accessioned in 1960. The only records of its treatment in the museum state that it was dusted, cleaned, and lightly waxed in 1970. A fragment of inlay was readhered with cyanoacrylate adhesive at this time.

HELENA JAESCHKE WRITES:

### *Condition*

This simply made box, like so many lacquered objects, shows the effects of storage, at some stage in its history, in inappropriate conditions. The lid has warped, with the upper surface curving away from the sides (fig. 6.1). Splits in the surface of the lacquer have cupped and tented, indicating shrinkage of the wooden carcass (fig. 6.2). In addition, the surface network of finer cracks suggests a weakness within the lacquer itself. In such a case, the first stage of the treatment would normally be to stabilize the object by placing it in a controlled environment of between 50% and 55% RH (relative humidity) at 20°C for as long a period as possible, three months being a likely minimum. The object should be monitored frequently to observe any changes. If the warping and shrinkage are observed to be reducing, the object should be left in the controlled environment until no further dimensional changes are observed. This object has been stored for several decades in a stable environment of approximately 55% RH, so it seems likely that this process of stabilization has already taken place. However, care should be taken to monitor the object when it is brought to the conservation laboratory for treatment. It is not unknown for storage facilities that are generally kept at stable temperature and humidity levels to have small areas where the conditions fluctuate or differ from the overall levels.

Fig. 6.1. Box (B60M292) overall view.

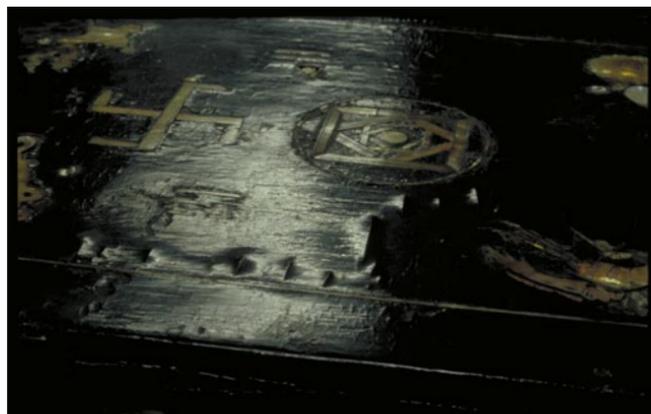


Fig. 6.02. Box (B60M292), detail of lid showing tented cracks in lacquer and faint orange-peel texture characteristic of lacquer that failed to dry properly.

For example, areas near access points such as doorways or ventilation hatches may have small but frequent fluctuations and areas in corners or at the top or bottom of shelving units can form microclimates where the air is not readily exchanged with air in the rest of the storage area.

#### *Suggestions for Treatment*

Any areas in immediate danger of damage or loss should be noted and, if necessary, protected by appropriate first-aid remedies. For example, if any areas of lacquer or inlay threaten to become detached, they might need to be secured with a minute piece of facing tissue secured with a very small quantity of an appropriate adhesive or gently supported with a pad of an inert material that will allow for further expansion or contraction but will protect the piece from flexing too much. Only if it is unavoidable should facings be applied directly to the surface of the lacquer. Tapes with a pressure-sensitive adhesive should be avoided unless the conservator is absolutely sure that no further damage will be caused when the tape is later removed. Many lacquer objects

show the unfortunate effects of temporary repairs effected in the past with self-adhesive tape, where the adhesive has pulled some of the weakened lacquer away from the surface.

The choice of an adhesive is defined by the several principles. Ideally the adhesive should be transparent and colorless, although a certain amount of color may be acceptable in some circumstances provided it does not change with age. It must be as stable as possible, with a neutral pH when applied and after aging. It must not cross-link, gain or lose strength, become embrittled, expand, or shrink, and should retain its qualities for more than a century. It should not release any harmful compounds when it is freshly applied or while it ages. Very few natural adhesives and only some synthetic compounds can fulfill these criteria. An archaeological conservator would not use natural materials such as fish glue or plant gums, not only because they are insufficiently stable, but also because they could cause confusion in the future. After several decades it may become impossible to determine when a natural material was applied, which may lead to incorrect analysis and interpretation of an object. Such a misleading situation, although completely unintentional, should be avoided wherever possible. Suitable synthetic adhesives include a range of copolymerized acrylic resins, such as Paraloid B-48N and B-72, copolymers of ethyl methacrylate and methyl acrylate,<sup>1</sup> the long-term stability of which is enhanced by the use of two similar compounds, which act as mutual plasticizers, instead of volatile or degradable plasticizing agents. These copolymers have been tested and shown to be Feller Class A compounds, having a high degree of stability for a hundred years or more and have been used extensively in the conservation of archaeological and historic items as well as works of art for more than thirty years. Since 1978 the author has

found Paraloid B-72 to be suitable for use with lacquer and similar items and would list this as the first choice for an adhesive, a consolidant, or a coating in most circumstances. (Throughout this discussion, solutions are calculated by percentage of the weight of the resin added to a volume of solution. For example, a 5% solution is made by adding 5 grams of resin to 100 ml of solvent or 50 g of resin to 1 liter of solvent.)

The choice of the adhesive will also be influenced by the reaction of the object to the solvents in which the adhesive is dissolved. The lacquer itself, inlays, or other applied decoration may react with certain solvents and occasionally the exposed substrates may also be sensitive. Careful testing must be carried out before any chemical is applied to the object. Acetone, toluene, p-xylene, petroleum distillates such as Stoddard solvent or a mixture of some of these solvents have proved suitable for use with adhesives on most lacquer objects. On occasion, ethanol has been used in a solvent mixture, although few synthetic adhesives will dissolve in ethanol alone. Paraloid B-72 is most commonly used in solution in acetone, toluene, and p-xylene or a mixture of these. If acetone is suitable for use with the object, it would be the author's first choice, because it is the least toxic to the conservator.

Pieces that have become detached should be thoroughly documented, with careful notes being made of their original location and orientation, and kept in a well-documented place until they can be reattached. Great care must be taken to note on the record of the object the place where the fragments are temporarily stored and on the record of the fragment the location and identity of the object. A safe area should be designated the storage of such fragments.

The next stage is to examine the object thoroughly and to document any unusual areas or parts requiring special care or treatment. Micro-

scopic examination will be required for many areas of the surface and it may be useful to examine the object under ultraviolet light. X-radiographs of the box will also be of great value in determining the details of the construction and subsequent treatment as well as enabling the conservator to design the best methods for repairing and supporting damaged areas. One advantage of the many splits and breaks is that it should be possible to locate minute samples that can be removed and used for analysis without noticeable loss. A fragment as small as 1 millimeter in diameter, which is almost completely detached, is sufficient for a polished cross section that will provide a great deal of information about the manufacture of the item, particularly when viewed by transmitted light.<sup>2</sup> It may also be possible to determine and record details of the methods and materials used in the manufacture of the object that are not normally visible, such as the species of wood or bamboo in the structure, textile or paper applied as reinforcement to the base structure, and the ground layers. The opportunity of examining the interior of the object exposed by damage or deterioration is very valuable and should be used as thoroughly as possible.

At first glance the box appears shiny and attractive, but closer examination reveals the presence of a considerable amount of dirt, both outside and in. Numerous areas of restoration and retouching obscure the original surface. Around the tail of the tiger on the front of the box there is an area of small white spots that could be the residue from an earlier treatment, a deterioration product, or even the remains of microbial activity, probably fungal. Earlier records note the apparent presence of foxing on the paper-lined interior. Where possible before cleaning the box, attempts should be made to establish the nature and origin of the dirt. If it can be ana-



Fig. 6.3. Box (B60M292), detail of back side before cleaning test; old white fill material is visible along gap in lid.

lyzed, this should be carried out before cleaning begins. Samples of the dirt and debris removed from the object should be kept and labeled with the area of origin. Dirt from the interior should be sampled and stored separately from that on the exterior.

The first stage of cleaning would be to vacuum the surface carefully using either a small handheld vacuum of the type used for cleaning cameras or computer equipment or a vacuum with variable suction and a small nozzle, while protecting the inlays and any damaged areas of lacquer with a finely perforated guard to prevent them from being loosened. As with all damaged lacquer surfaces, great care must be taken to ensure that the edges of broken or lifting areas do not become snagged by fibers and

broken off. Any modern labels that have to be detached should be documented and preserved as part of the object's history.

Cleaning the surface of the lacquer will require careful testing with a range of cleaning solutions using different methods of application. Cotton wool, for example, is sufficiently abrasive to leave scratches on many lacquers. Softer Japanese papers, small pads of chamois or silicon rubber, or a clean fingertip may be more appropriate for applying a cleaning solution. If a silicon rubber pad or fingertip are used to apply the cleaning solution and to move it gently across the surface, a small piece of absorbent paper or lint-free cloth can then be gently pressed against the surface to absorb the solution and any loosened dirt. In some cases the surface is so fragile

that cleaning solutions must be applied with a soft watercolor brush and removed with another clean brush, without rubbing the surface at all. Newly developed cleaning cloths with microfiber surfaces may be useful for removing some of the dirt and debris from the surface, although, as mentioned before, great care will have to be taken at the edges of breaks and inlays. The surface of test areas will need to be examined under a powerful microscope to check for any scratching, abrasion, or loss of surface before the chosen method is applied. Very small swabs or pads should be used for cleaning, so that only a small area is obscured at any time. The object is to remove disfiguring and potentially harmful grime but to leave the lacquer unaltered. In many cases the lacquer surface has begun to deteriorate and small amounts of deterioration products may be removed by the cleaning method, leaving a slightly pitted or cracked surface that appears dull. Careful examination of the debris removed will often enable the conservator to distinguish between the dirt, which frequently appears gray or even black in color, and the lacquer deterioration products, which are usually yellow, orange, or a warm brown in tone. The removal during cleaning of any colored material matching the color of the surface should, of course, be treated with great caution. On occasion this may reveal the presence of a more modern retouching of the surface, but extreme care must be taken to ensure that no original material, either lacquer or painted decoration, is being removed.

Solutions of nonionic detergents in aqueous and alcohol-based solvent mixtures may prove suitable, but great care will have to be taken not to allow any to penetrate splits in the surface or to creep under inlays. Some forms of lacquer are extremely sensitive to moisture and may discolor if aqueous solutions are used. Even after thorough testing, one small area should be



Fig. 6.4. Box (B60M292), detail of lid showing evidence of previous repairs.

treated at a time and carefully observed for any signs of change. Some lacquers that are sensitive to the presence of water, but which are disfigured by dirt that cannot readily be removed by other solvents, may be treated using very minute amounts of a cleaning solution composed of water and a miscible solvent that evaporates more rapidly. This minimizes the amount of water in contact with the lacquer and shortens the period of exposure as the more rapidly evaporating solvent encourages the swift removal of the water molecules. (Whenever water is mentioned, it is assumed that distilled or deionized water would be selected. Tap water frequently contains dissolved substances that may damage the lacquer or leave marks on the surface when it evaporates.) The general rule of conservation, to do the least possible to the object, governs the testing of cleaning agents. If the dirt can be satisfactorily and safely removed by a solvent or a mixture of solvents without the use of further additives such as detergents, chelat-

ing agents, or other reagents, this would be the method of choice. It is only after the simplest method has been tested and found to be insufficient that the conservator moves on to the next, slightly more complex, method or reagent.

Various grades of petroleum distillate such as turpentine substitute (known in Europe as white spirit) or Shellsol T can be used to remove traces of oily dirt. Some wax-based cleaning agents such as CRP (Cleaning, Reviving and Polishing compound) have been used successfully on lacquer, but are not recommended in this case because the surface is so disrupted. These are generally mixtures of wax, softened with white spirit, which are applied to the surface with a soft tissue or a fingertip. After a few minutes the wax is removed with a swab containing a small amount of white spirit, bringing with it some of the dirt, and leaving a thin wax coating on the surface. This is sometimes removed with further swabs of white spirit or left to protect the surface. This type of cleaning agent can be useful, particularly for cleaning lacquer that has oily grime or dirt on a surface with little or no deterioration. The thin layer of wax that is left behind can then provide protection against handling, dust, and pollutants and is sometimes used for lacquer in a domestic environment.

The lacquer layer is not very thick and any foundation seems rather skimpy. Care must be taken to distinguish between the original lacquer and the many areas of repair. These are particularly noticeable along the edges of the box, where accidental damage has led to small crushing injuries, and around inlays.

It is possible that an area of white in a crack alongside the hinges reveals the existence of a repair using a white gapfill (fig. 6.3). This should be tested and, if necessary, removed. The area of loss should then be coated with a suitable barrier material and a more appropriate gapfill applied

as detailed below. If an earlier gapfill is stable and benign, it may be better to leave it in situ and improve its surface finish rather than cause further stress to the object by removing it. In many cases, part of the inlay has been lost and a repair has been rather crudely effected by applying small pieces of mother-of-pearl in the area of the loss, with little or no attempt to recreate the missing design elements (fig. 6.4). A dark paste, probably a mixture containing lacquer, has been applied to the area to act as a bed for the new mother-of-pearl fragments and seems to have been smeared over the original inlay, which has been carefully carved from a thicker shell and decorated with incised lines to emphasize the design. Another ethical dilemma arises here. The shell fragments used in the repair detract from the appearance of the box and make the interpretation of the original design difficult. Yet the repair forms a part of the history of the piece. In many cases it is possible to determine the shape and design of the missing original inlay with some certainty. In some areas it appears that damage to the original lacquer has been repaired by applying the paste and inserting some mother-of-pearl fragments even though there does not appear to have been any inlay in the area previously (see, for instance, the area on the lid next to the peony in fig. 6.4). The conservator (in discussion with the curatorial department) will need to assess the relative value of the repair and decide whether there is any reason to suspect that it may be so old, so unusual, or in some other way so important that it should be retained. Otherwise it would seem likely that it should be sufficient to record the old repairs thoroughly, to remove them as carefully as possible, and to keep them in a safe, well-documented archive. It could be argued that one of the repairs should be retained in situ (in a discreet area or in an area where the missing

design is unclear) for future generations, provided this is thoroughly documented. Where the repair paste has been smeared on the original inlay and is to be removed, care must be taken not to remove the original lacquer that was applied to the incised decoration. This lacquer is shown very clearly in the area of the stripes on the tiger. Some of the original inlay has a yellow appearance that may prove to be an application of a transparent layer of lacquer or a varnish, but is more likely to be a surface effect of the shell. Before filling any gap, the cleaned areas of loss should first be protected with a thin application of a suitable inert compound (such as a 10%–15% solution of Acryloid B-72 in acetone or another suitable solvent) before being gapfilled. This coating acts as a barrier layer and also enables insoluble gapfill materials to be removed at a later date without resort to powerful solvents or to mechanical removal that could risk damage to the surrounding original material.

Sometimes it is appropriate to fill an area of loss by casting a gapfill, shaping it, and attaching it when hard. Where the lacquer is so thin, as on this box, it might be better to tint a resin or paste gapfill to a suitable color, apply it directly to the box, and shape it in situ, taking great care to avoid obscuring or damaging the edges of the original material around the area of loss. As well as protecting the surface of the area of the loss with a barrier layer of Acryloid B-72 applied in a suitable solution, it may be advisable to protect the surface of the box around the area to be filled. This could be undertaken with plastic wrap, aluminum foil, silicon-coated release paper, or Mylar polyester film. Silicon-coated polyester film has the advantage of being transparent, allowing the conservator to monitor the area under treatment throughout the process. If necessary, a small amount of low-tack spray-on adhesive may be applied to the barrier film, af-

ter careful testing to ensure that it causes no loss when held against the object and removed. The area where the adhesive was in contact with the object must be cleaned afterward to remove any traces of adhesive residue.

Experiments will determine the most appropriate gapfill for this object, but some of the materials that could be tried include acrylic resins mixed with an inert filler such as glass microballoons, tinted polyester resin, or fine epoxy putty. Great care must be taken to protect the area surrounding the loss from any inadvertent contact with the gapfilling material. Once tests have determined the most suitable material, a large amount should be prepared, colored to match the original. A small amount of this, sufficient for one area to be treated, should then be catalyzed and applied to the area of loss while it is still pliable. Sufficient gapfill material must be catalyzed to fill the entire surface of the area of loss, as joins between areas of gapfill material are usually readily discernible. If preferred, the area of loss, after it has been protected by a barrier layer, can be further isolated from the gapfill material by the application of plastic wrap, although care must be taken to prevent the film from forming wrinkles at the edges, which would distort the shape of the gapfill. When the gapfill material has set, it can be lifted out of the area of loss, finished, and then attached to the object with a small amount of a suitable adhesive such as a viscous solution of Paraloid B-72 in acetone. The plastic wrap is used only to enable the gapfill to be removed from the object; it is not retained.

The surface of the gapfill can then be modified by polishing with polishing compounds or very fine abrasive compounds in order to increase or decrease the gloss to match the luster of the original. Grades of wet-and-dry corundum papers ranging from 400 to 2000 grit, Flex-

igrit films, and Micro-mesh cloths can be used to smooth and polish the surface, followed by fine chrome polishes such as Solvol Autosol and metal polish wadding such as Duraglit Silver grade. The surface of the gapfill must be cleaned with a suitable solvent to remove all traces of abrasive or polishing compound.

Polyester resin is available in different grades, some of which are suitable for use when the outer surface is exposed to air, as in the case of casting a gapfill in situ. In Europe a low-styrene environmental grade of polyester has proved suitable for gapfilling in situ. This can be tinted with small quantities of polyester paste pigments so as to match the surface while retaining some translucency. The resin will set in 20 minutes, leaving a slightly dull surface. This can then be polished to match the luster of the surrounding lacquer using fine polishing compounds or fine grades of Micro-Mesh abrasive cloths. Great care must be taken not to abrade the surrounding lacquer surface. If necessary, paint or varnish can also be applied to the gapfill. Acrylic inks, such as Daler-Rowney FW Acrylic Artist's Ink have proved to be more amenable than acrylic paints since they have a transparent medium and more finely ground pigments. They can be diluted and applied in several layers and modifiers can be added to adjust the drying time and final luster. They can also be polished gently after they have dried. Fine dry pigments from artists' suppliers or acrylic inks can also be used to tint solutions of Paraloid B-72, which can also be polished to a high gloss when dry. This tinted acrylic resin can be applied to the surface of a gapfill to match or could be applied in layers to build up the thickness of the required gapfill. It is difficult to achieve a flat smooth surface when building up layers in this way and increased drying time must be allowed between

the applications of layers of Paraloid B-72 as the thickness of the gapfill increases.

Fine two-part filled epoxy putties such as Milliput have proved useful for gapfilling, particularly where the gapfill must have considerable strength or where a particular shape is required. This has included the repair of lacquered feet and carved items, corners, and areas around hinges. The area of loss is protected with an application of a barrier film of Paraloid B-72 in a suitable solvent. When this is hard, a sufficient amount of the putty is mixed, applied to the area of loss and shaped as much as possible before the epoxy hardens. Milliput is available in white, terracotta, silver, or a yellowish gray. Although the terracotta can prove a useful color for gapfilling some objects, the white has the finest texture and is preferred for gapfilling areas with a very smooth surface. The putty can be shaped and smoothed with tools dipped in water while it is still pliable and it hardens considerably within an hour. After allowing it to harden thoroughly for several hours, preferably overnight, the shape can be further modified by cutting, sanding, or drilling. The surface can then be smoothed using grades of wet and dry corundum and polished to a high gloss before applying an acrylic ink to match the surroundings. As with the polyester, an extra barrier of plastic wrap could be applied to allow the gapfill to be removed easily for the final shaping and surface treatment before it is attached to the object with a small amount of adhesive.

By forming the gapfill in situ, it should be possible to recreate the missing mother-of-pearl inlay first, then float in another gapfill to mimic the missing lacquer. In this case, small pieces of epoxy putty could be shaped to form the missing elements of mother-of-pearl and attached in the correct place in the area of loss using a small

amount of adhesive. A liquid gapfill such as tinted polyester resin could then be applied to the gap, flowing it around the replacement pieces to give an effect that closely matches the original. The use of luster varnishes should enable the mother-of-pearl repair to give the impression of the original from a distance whilst being clearly detectable on close examination. This is another vital principle for the museum conservator.

The paper lining of the box appears to have been made by attaching a thin layer of pink pigmented paper with a pattern of plants to a base of thin card taken from the pages of a catalogue, apparently printed in Japanese. The porous surface of the pink layer may be easily damaged by pressure, will almost certainly absorb grease if handled with bare hands, and may stain if treated with an aqueous solution. Dry cleaning methods, such as the use of a small amount of a very soft powder cleaning agent, may be all that can be used safely. Testing will establish whether it is necessary and possible to clean the paper with small amounts of a solvent-based solution or a mixture of a solvent (such as ethanol or acetone) with a dilute aqueous cleaning solution (such as distilled water with a small amount of a nonionic detergent and possibly a small amount of sodium hexametaphosphate).

Before any decision can be made about its treatment, the paper will need to be identified to determine whether it is original to the piece or forms part of its later history. If it obscures an earlier lining, the conservator will have to determine if the earlier lining can be wholly or partly revealed and whether that will aid or hinder the interpretation of the object. Both the original and subsequent linings form part of the object, though it may be possible to assign different values to them. If an earlier layer is present, but is damaged and fragmentary, it may be better to retain the later lining, revealing the presence of

the original either by documentation, including a possible reconstruction of the original appearance of the item, or by removing a small area of the later lining. This may not be a suitable option if the later layer is substantially complete. Great care must be taken at the edges of any area being treated, as these are particularly vulnerable and may have sustained greater damage than the more protected areas.

Where some of the paper lining has lifted, it may be necessary to reattach it to prevent further damage. As always, careful testing will be necessary to enable a suitable adhesive and method of application to be chosen. Water or solvents may cause the pink color of the paper to dissolve or migrate or may cause staining, leaving a tidemark as they dry. In such a case, it may be preferable to apply small pieces of adhesive as a dry film, which is then activated using a minute amount of solvent applied underneath the paper, or the tip of a heated spatula, taking care not to leave pressure marks. Testing will enable the conservator to determine if there is any risk of leaving a mark on the surface of the paper from the spatula or of a permanent color change from the exposure to heat. Some papers exhibit a small change in color that is temporary, returning to the original color as the area cools to room temperature. Suitable adhesives may include an aqueous paste of a cellulose compound such as carboxy methyl cellulose or ethyl hydroxyethyl cellulose or a solvent solution of Paraloid B-72. Paraloid B-72 can be formed into a dry film or proprietary brands of dry-film adhesive such as BEVA 371 (a mixture containing a high proportion of poly (ethylene/vinyl acetate) copolymer can be purchased. B-72 is the most stable of these compounds and would be the first choice where possible.

The treatment of the box itself may well entail some work on the carcass. Although it may

be tempting to try to persuade the lid to return to its original shape, any pressure to flatten the curvature will set up further stress within the object and could lead to more splitting and greater damage. At best, it might be sensible to introduce a small amount of an adhesive solution, such as a 5%–20% solution of B-72 in acetone or a similar suitable solvent, into the split to prevent further opening. The broken bamboo dowels in the lid may also be repaired using this adhesive.

It may be possible to re-lay the lifting edges of the lacquer by allowing a viscous solution of adhesive such as a 15%–25% solution of B-72 in acetone or similar suitable solvent to flow underneath. Care must be taken not to apply too much pressure as the lacquer may become distorted or even break away. The gentle application of a heated spatula may help the lacquer to return to its original position but great care must be taken not to mark the surface. Small patches of silicon-coated release paper or Mylar polyester film or Teflon-coated cloth may help to protect the surface during treatment. If there is any sign of softening during treatment, the barrier material should be kept in situ until the surface has hardened and only then carefully peeled away.

The metal lock, which appears to be a lacquered or varnished copper alloy, should also be examined to determine if it is entirely original. Wear patterns on the front may indicate whether it is the original or has been added from another piece. It may be tempting to neaten the appearance by minimizing the difference between the dark varnished surface and the brighter worn areas, but this would disturb the integrity of the piece, making it harder for the viewer to see this evidence of wear and interpret the item. The metal should be examined thoroughly for signs of active corrosion and, if necessary, treated. In the unlikely event that it requires stabilization, it should be treated locally, because removing it

from the box is likely to cause significant stress to the surrounding lacquer. If it is copper alloy, it may be possible to degrease it with local applications of denatured alcohol (known in the United Kingdom as industrial methylated spirits or IMS) or acetone, and then paint on a solution of 3% benzotriazole in IMS. After twenty-four hours the surface can be gently brushed with IMS and allowed to dry before a protective coating of an acrylic lacquer is applied. The hinges should be examined and treated similarly. If it appears that the metal is stable and is unlikely to corrode in future, the metal parts may be left untreated. If it is felt that the metal is actively corroding, or if the stability of its environment cannot be relied on, it would be preferable to stabilize and coat the metal at this stage.

JANE WILLIAMS WRITES:

#### *Materials and Methods of Manufacture*

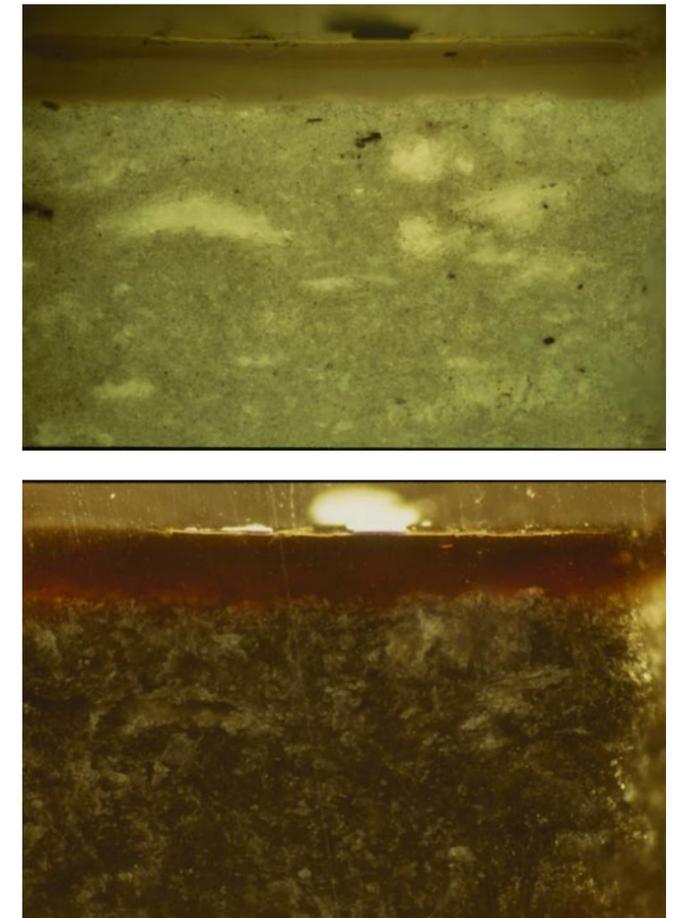
The sides of the box were made from single pieces of wood joined at the corners with dovetails. The lid and base were glued and pegged on with bamboo dowels, which are visible where gaps have opened along the joins. The lid is held to the box with simple, undecorated copper alloy hinges at the back. The plain lock plate at the front of the box, while of the same basic shape as the hinges with curved and indented corners, is of a much thinner-gauge copper alloy than that of the hinges. The box has a copper alloy dragon and carp lock that has been described as modern on the accession card for the box. That it is not original to the box is supported by its difference in style and form from the latch hardware; moreover, the wear patterns on the latch plate do not correspond to a lock of this shape. Mother-of-pearl pieces were cut and adhered to the surface and designs were incised in their surfaces. The inlay appears to have been applied

directly to the wood—where there are losses to the inlay the bare wood surface, and no preliminary coating of lacquer, ground, or textile, is visible. The wood was coated with a dark gray ground and then coated with unpigmented lacquer. The ground layer was not analyzed, but its autofluorescence in UV-violet light (see a cross section from the lid—fig. 6.5) is very distinct from that of the lacquer above it, suggesting that the ground does not have a lacquer binder.

#### *Treatment History*

This box was extensively restored before being accessioned by the museum. X-radiographs were very helpful in clarifying the extent of damage and location of repairs (see figs. 6.6 and 6.7). The box sustained extensive insect damage. Small (approximately 2 mm in diameter), scattered, roughly oval exit holes are found throughout the box, with extensive tunneling in localized areas such as the upper back corners. These damages were covered with fills that are more radio-opaque than the surrounding areas and were then coated with lacquer. Fills that have the same appearance as these in X-radiographs and are also coated with lacquer are found surrounding much of the inlay on the lid (see, for instance, area at the center of fig. 6.4). This suggests that mechanical damage to the lid was repaired at the same time as the insect damage. The concentration of the fills around the inlay further suggests that at least some of the inlay was replaced in this restoration. One loss to an inlay cloud on the back of the lid was filled level with the surrounding inlay and relacquered in this campaign, with no attempt to recreate the missing inlay.

The next restoration was done on the lid only, where an attempt was made to fill the gaps between the top and the back side of the lid with a white gesso or plaster (fig. 6.3). Fur-



Top: fig. 6.05a. Box (B60M292), cross-section sample of surface layers shown in reflected light and ultraviolet light; photo taken at 200x magnification.

Bottom: fig. 6.05b. Box (B60M292), cross-section sample of surface layers shown in ultraviolet light; photo taken at 200x magnification.

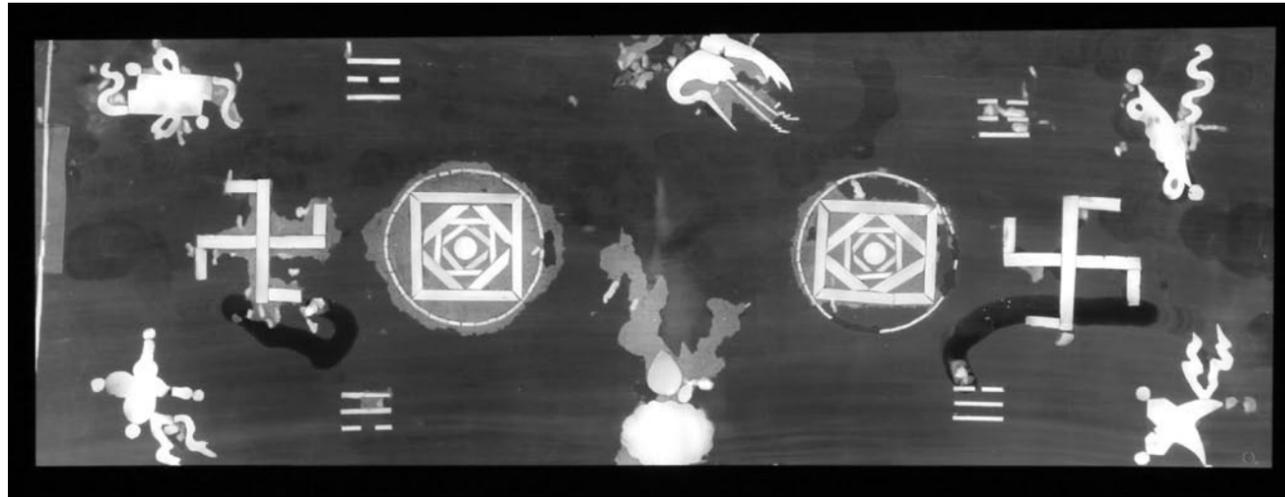


Fig. 6.6. X-radiograph of lid, Box (B60M292); large (1-cm diameter) insect tunnels are visible, as are lacquer repairs, particularly at center. Technical data: Norelco X-ray unit (150 kV max.), Kodak Industrex M film, 35 kV, 4 mA, 90 seconds, distance from tube, 36 inches.

ther examination showed that the white specks that Ms Jaeschke noted on the surface near the tiger are the same material. The white fills were coated with a dark paint and the entire lid was coated with shellac.<sup>3</sup> The shellac is responsible for the yellow tone that Ms Jaeschke noted on the inlay.

Sometime after this, additional insect damage occurred to the lid only, which is riddled with frighteningly large tunnels. The sequence of damage and repair was determined because the shellac coating does not continue over the insect-damaged areas. The size of the tunnels (0.5–1 cm wide) suggests that the damage is from the larvae of a beetle in the *Cerambycidae* family, which can remain in the larval stage, digesting wood, for between two and ten years.<sup>4</sup> The tunnels pierced the exterior lacquer only in a few isolated holes, and must have originated on the uncoated interior, now masked by the paper lining, where it would have been much easier

for the insects to enter the wood. These insect holes are marked by the use of odd fragments of shell to fill them (fig. 6.4). The same bits of shell were applied to the wing of one bird on the lid where inlay is missing. As noted by Ms Jaeschke, a dull, dark gray material that absorbs long-wave ultraviolet light acts as a bed for these fragments and is smeared onto the lacquer surface around these losses. The same material has been smeared over and around one inlay bird on the back of the box.

While some pieces of inlay are likely to have been replaced because fills now surround them, it is more difficult on this box than it was on other objects, such as the Chinese panel (B83M1) or tray (B79M7), to identify replacement inlay from original inlay by differences in the thickness of the shell or the quality of the workmanship. This is primarily because the shaping and incising of all of the shell is quite crude. Only two teardrop-shaped pieces of inlay on the lid

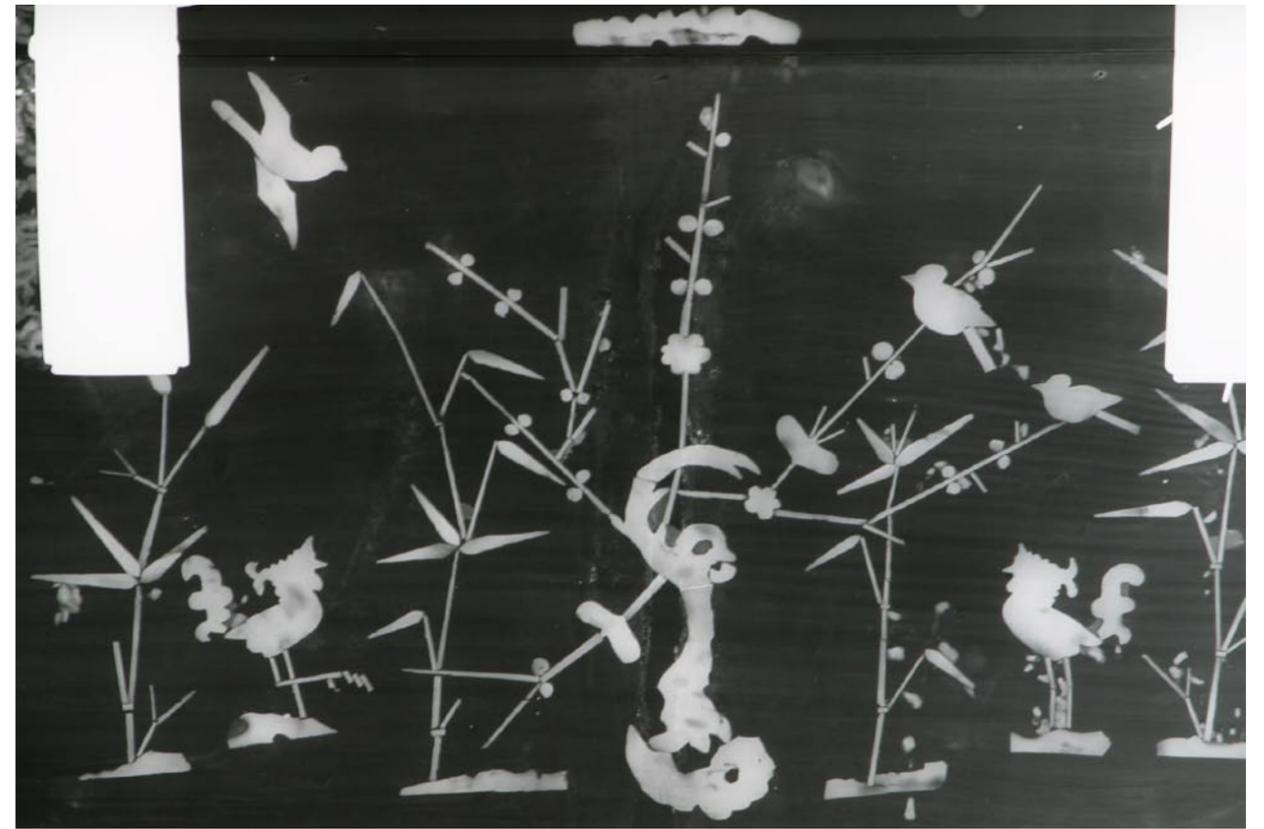


Fig. 6.7. X-radiograph of back, box (B60M292). Technical data: Gulmay X-ray unit (320 kV max.), Kodak Industrex AA film, 25 kV, 4 mA, 60 seconds, distance from tube, 36 inches.

can securely be identified as replacements. They lack the shellac coating and do not relate to the peony next to them. The phoenix on the back that is smeared with the dark fill material also lacks the shellac coating (see fig. 6.8), but it is otherwise consistent with the other inlay, so it may simply have been reattached.

X-radiographs reveal a channel cut for a central vertical partition (see fig. 6.6). The channel stops below the top of the box, so that it could accommodate a tray the size of the current one, which is probably not original to it. The wood

shows no signs of wear and has a very fresh-looking, shiny brown finish. The box is lined with pink paper that is not original to it, given the extent of the insect damage to the interior that it covers. It also clearly overlaps the shellac coating. The pink paper is printed with a repeating landscape pattern, applied over thin card from a printed Japanese catalogue. The printing includes kanji and hiragana characters as well as Roman numerals. This combination of printed script was not commonly used in Japan before the end of World War II.



Fig. 6.8. Box (B60M292), back side.

The hinges do not appear to be original to the box. The difference between the gauge of the hinges and latch plate was previously noted. Also, the impression of a slightly differently shaped hinge plate is visible in the surface coatings alongside one hinge. The hinges overlap original inlay pieces and relacquering, but antedate the shellac coating, which overlaps their top edges. The bottom of the box has four domed copper alloy feet. The lacquered wood surface on center of the bottom is worn, suggesting that the box probably did not originally have feet. The copper alloy pins on the top half of one of the back hinges were replaced at some point with iron nails.

#### *Condition*

The wooden top and bottom of the box are warped and separating from the sides. The widest gap, of approximately 1.5 mm, has opened along the top front edge. The dovetail joints on the sides have moved slightly with dimensional changes in the wood.

There are scattered losses to the inlay, but no areas that currently appear immediately vulnerable to further damage. On the lid restoration lacquer can be identified by the absence of the fine craquelure visible elsewhere on the surface. In these areas a few isolated, larger cracks perpendicular to the wood grain are slightly tented and move under gentle pressure. There have



Fig. 6.9. Box (B60M292), detail of back side after cleaning test.

been no losses to the inlay since the last restorations and the inlay currently appears to be stable. The lacquer surface is somewhat dusty and grimy, particularly on the lid. The surface has dulled and has hazy, grayish areas, which are particularly pronounced on the sides. There is loose dirt and debris on the interior. The paper lining on the interior is slightly worn around the top edge where the inner tray rests. The lined card has warped away from one side and the paper has one tear behind the front lock. The bottom paper has some foxing. The iron replacement pins on the hinge are now rusted. There are self-adhesive tape labels on the bottoms of the box and interior tray.

#### *Treatment*

There are no plans to exhibit this box and it has no areas that are currently vulnerable to further damage, so given the limited time for treatments before the move, the emphasis was placed on preventive measures. To avoid placing stress on the lacquer and wood at the center of the top and bottom panels, no attempt was made to close the separations along their joins to the sides. If the box were to be exhibited and a curator wanted to fill the gaps for visual reasons, I would choose a readily compressible and removable fill mixture or even a piece of fine-celled polyethylene foam that could be trimmed to fit the gap, tacked in place with minimal adhesive,

and toned to blend in with the surrounding surface. The only unstable lacquer on the box—the slightly tented cracks in the restoration lacquer on the lid (see fig. 6.2)—was also left untreated. While the cracks move slightly under pressure, they are tightly closed with no detaching areas along them. The lacquer surrounding the existing small losses remains stable, and so these areas did not require consolidation or filling before the move.

The box was prepared for the move and storage in the new museum by cleaning the interior and exterior with a soft brush and vacuum. As Ms Jaeschke suggested, the debris from the interior was collected and saved in a labeled polyethylene bag in the lab's sample drawer. The exterior of the box was wiped with dry soft cotton jersey and then wrapped in prewashed cotton muslin. Over this wrapping, a layer of one-quarter-inch polyethylene foam and then a layer of archival mat board were tied to the lid with cotton twill tape to cushion it and to apply gentle pressure to it. This support will inhibit further warping of the wood and protect the lacquer on the lid.

The old repairs and surface coatings were left in place. However, a cleaning test was done on the back to assess the condition of the underlying lacquer and to determine whether the dull, hazy surface appearance could be improved (to compare the surface before and after cleaning, see figs. 6.3 and 6.9). The sides of the box have a dull warm fluorescence in long-wave ultraviolet light that I originally attributed to a thin coating of the shellac that was applied thickly to the lid. Of the solvents tested, ethanol and Stoddard solvent were the only ones to have an effect on the surface. A combination of the two in equal parts was most effective in removing the surface coating that now appears to be a thick applica-

tion of pigmented wax. For future analysis, I saved a representative group of the swabs used to remove the wax coating in the test area. The dull fluorescence of the surface in ultraviolet light remained unchanged after cleaning, and can now be attributed to the restoration lacquer, rather than to shellac. For confirmation a small area known to have the shellac coating was cleaned and examined in ultraviolet light. The brightly fluorescent shellac came off readily in ethanol, exposing the much duller fluorescence of the restoration lacquer below.

It was striking to me that I had not detected this heavy pigmented wax in close examination in visible and ultraviolet light. Samples for analysis had been taken from the top, which appeared to be the most heavily restored part of the box. The cleaning test also revealed the reason for the application of pigmented wax—the poor quality and condition of the restoration lacquer. The restoration lacquer has numerous fine pits, where bubbles had been trapped in the lacquer and burst when it was polished. There are larger streaks and losses where it separated from the original lacquer in polishing. After finding this, I reexamined the rest of the surface and found many areas with the orange-peel texture (see fig. 6.2) characteristic of lacquer that did not harden properly—probably because the lacquer was applied too thickly. It is also possible that the humidity in the drying cabinet was too high. In this circumstance the surface of the lacquer dries too quickly and inhibits the rest of the layer from drying.<sup>5</sup>

If this box were to be exhibited, it would be a challenge to improve its marred and pitted appearance. The two main possibilities would be to remove the restoration lacquer or to coat it again. I did a small test with a polished miniscalpel and magnification to see whether the resto-

ration lacquer could be lifted and peeled off the original surface. I found that, despite its drying problems, what remains attached of the restoration lacquer is well adhered to the original lacquer with no separation layer between the two. It would be impossible to remove it mechanically without damaging the original surface. The only way to remove it would be to polish it off with charcoal or another abrasive, but this process, too, is impossible to do without removing at least some of the original surface. And, if the original lacquer is very thin or is cupped, it would be easy to polish right through it. It looks as though it would be possible to even the surface somewhat by toning or adding gloss to pitted areas with a tiny brush, and that this might produce better results than covering it completely with another coating. As damaged and poorly applied as the restoration lacquer is, it is glossier overall than the pigmented wax, and has the additional advantage of still looking like lacquer.

Unlike other objects, such as the inkstone box (B62M18) with shellac coatings, this object is one for which I would not hesitate to remove the shellac in preparation for display. The coating is applied only to the lid, where it unevenly coats the inlay and gives the shell a very different color from the inlay elsewhere.

Another aesthetic problem for this box are the repairs with random shell fragments. I would consider removing the shell fragment repairs only where they protrude above the original surface layer, and leave the rest as evidence of its history. However, because the shell fragments, particularly where they are applied to areas that did not have inlay, detract from the original shell inlay design, I would cover them with an appropriate fill material, toned to harmonize with the surrounding lacquer. Ms

Jaeschke's recommendation of pouring polyester resin into the loss that has been sealed with acrylic resin has the appeal of requiring very little sanding. However, I have never used polyester for fills on lacquer, and would be hesitant to use such a hard material. Although it could theoretically be removed by solubilizing the acrylic resin barrier layer, my preference for museum objects is to use fill materials that are at least slightly softer than the original surface. Of the fill mixtures suggested by Ms Jaeschke, I would be most likely to choose a bulked acrylic resin, but would probably be more likely to choose the PVOH-based fills I have found easy to work with on other objects.

The only visually disturbing loss to the inlay is the one to the crane's wing to which shell fragments have also been applied. To better compensate for this loss, the replacement would need to match the thickness of the relatively thick inlay on the box. Because the missing fragment is large, it would need to match the surrounding inlay well or it would be more noticeable than the loss. If shell of appropriate sheen and texture could be found, it could be used to replace the inlay and the date could be incised on the reverse as a record of its replacement. On objects, such as the panel (B83M1), with very small and very thin inlay, the appearance of inlay can be more easily approximated by toning with iridescent pigments applied directly to the inlay bed. For this object, I would test iridescent mica pigments on a base, such as Plexiglas, polyester film, or a flattened sheet of Milliput, of the same thickness as the shell cut to match the shape of the loss, as Ms Jaeschke had suggested. Like Ms Jaeschke, I prefer to replace missing elements so that the losses and fills are not noticeable when the object is on display, but can be detected easily upon close examination. □



Fig. 6.10. Inkstone cabinet (B62M18), after treatment.

*Inkstone Cabinet (B62M18).* Korea, Joseon dynasty, 19th or early 20th century, H. 29.3 cm; W. 45.5 cm; D. 31.3 cm. This rectangular cabinet (fig. 6.10) has a divided top compartment, with two flat inset covers, for an inkstone and brushes and a compartment below this with a single drawer for paper.<sup>6</sup> Near the bottom of the squared legs is a shelf supported by stretchers with attached brackets. It is decorated with abalone inlay on a black background. The interior surfaces are red. Each cover has a central Shou (longevity) character surrounded by peach sprays and cranes in clouds. The sides of the compartments are decorated with camellias, bamboo, grape vines, pheasants with camellias, and fish in water below a tree branch. The legs are decorated with scrolls and the lower brackets with flowers.

#### *Conservation Record*

The box was accessioned in 1962. The only conservation treatment on record for it states that it was dusted, cleaned, and lightly waxed in 1970.

HELENA JAESCHKE WRITES:

#### *Condition*

This item, like the previously discussed box, B60M292, has shrunk over time, as evinced by the strip of unlacquered wood surface of the lower shelf that is now revealed along one side. This piece shows more evidence of physical damage than does the previously discussed box and the lacquer may be thinner and more brittle. Numerous small chips are missing, as is some of the inlay, though the situation does not appear to have been complicated by extensive repairs. As the storage conditions have been controlled in recent years, it seems likely that this change took place some time ago. A careful watch should be maintained however, to make sure that the piece is dimensionally stable after it is moved to the conservation laboratory for treatment.

#### *Suggestions for Treatment*

The initial regimen of examination and sampling described for B60M292 should be followed. Before cleaning it should be determined whether the green residue in the drawers forms evidence for the use of the piece and, if so, the residue should be retained. A small area of a red substance, possibly paint, on the exterior will also need to be assessed before a decision is made to attempt its removal. Some areas where inlay is missing appear to have a red foundation (see fig. 6.11) and the red substance may be related to this or may represent evidence of an earlier repair. If the red substance is recent and extraneous, it may be possible to remove it mechanically using the tip of a polished scalpel blade,<sup>7</sup> making sure that no leverage is applied that could indent the underlying surface. The surface should be cleaned with a vacuum where it is safe and suitable to do so. Following testing, further cleaning should be possible. Great care will be needed to avoid catching the protruding edges around breaks. Consolidation with a suitable acrylic resin such as Acryloid B-72 in acetone or a similar suitable solvent, may be needed, followed by protection of the surfaces of the areas of loss and the application of a suitable gapfill as described for B60M292.

The wooden structure of the box, known as the carcass, may require treatment including the securing of splits with adhesive such as a viscous solution of Acryloid B-72 in acetone or a similar suitable solvent and possibly the replacement of missing areas. An inert stable material such as Plexiglas can be used to manufacture a replacement for the missing left rear bracket. If it is considered preferable to indicate the presence of a replacement, clear Plexiglas could be used, otherwise an opaque black could be chosen to render the replacement less noticeable. Plexiglas is relatively easily cut with a handsaw and can be smoothed to a fine polish with wet and dry corundum papers, followed by a chrome polishing cream such as Solvol Autosol. Alternatively,



Fig. 6.11. Inkstone cabinet (B62M18), detail; note use of red ground layer applied overall prior to application of shell inlay and use of gray ground layer to fill around shell inlay before applying lacquer coating.

a gapfill medium such as fine epoxy putty could be used to form a replacement as detailed for B60M292. This could then be attached using a small amount of a suitable adhesive such as a viscous solution of Acryloid B-72 in acetone or a similar suitable solvent.

#### JANE WILLIAMS WRITES:

##### *Materials and Methods of Manufacture*

This inkstone box is simply constructed. The stretchers and framing for the large drawer are tenoned into the square-sectioned legs. The underside of the shelf and the interior of the side panels are beveled on all sides to fit into slots on the stretchers and legs. Curved decorative brackets were glued to the stretchers. The drawer is constructed with butt-joints, currently secured with wire nails. The drawer is pushed open by means of a simple hole cut in the base of the drawer chamber. The base board for the top drawers is glued to the top of the legs and walls of the large drawer chamber. Its edges extend beyond the sides to form a simple molding. The walls of the top drawers are mitered and glued.

Each drawer lid is made of a smaller panel laminated to the underside of a larger panel to create a border on three sides that can rest on the outer edges of the drawer top without sliding around. The small and large panels were made by gluing wood strips across both ends of a thin board. On the larger panel the main board is slotted into the crosspieces.

Losses to inlay and lacquer on this box reveal more clearly than on any of the other mother-of-pearl inlaid boxes the sequence of the surface decoration. There is no evidence of textile or paper layers on the surface. The first layer on the surface is a red ground. Ms Jaeschke noted this layer, but did not have a chance to determine whether it was original or related to a repair. With examination under magnification this layer can be found throughout the box. In cross section (see fig. 6.12) it can be seen to consist of three separate applications, identified by analysis as red clay and calcium carbonate in a protein binder, each application containing successively more binder and fewer mineral inclusions.<sup>8</sup> These red ground layers are soft and somewhat sticky—the final application served as the adhesive for the mother-of-pearl. The red clay appears to have been added to the ground to give the shell a warmer color. Once the shell was adhered in place, linear designs were incised in the shell surfaces and then a gray foundation layer was applied to bring the rest of the surface close to the level of the inlay (fig. 6.11). This layer is bulked primarily with charcoal and clay, and also has a protein binder.<sup>9</sup> Finally the surface was coated overall with thin layer of unpigmented lacquer and then polished to expose the inlay again. Some of the inlay remains partially or totally submerged in the lacquer layer, which would usually be considered evidence of relacquering. However, the cross sections taken from the lid (see fig. 6.12) and side show a single application of lacquer.

A red coating was applied rather sloppily to the interior of the top drawers and lid, the

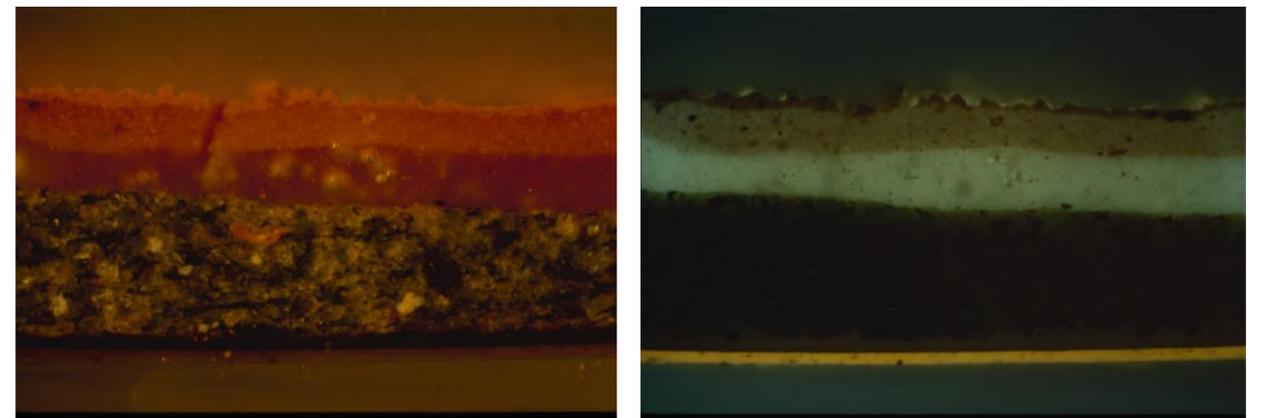


Fig. 6.12. Inkstone cabinet (B62M18), cross-section sample of surface layers shown in reflected light (left) and ultraviolet light (right); photo taken at 200x magnification.

sides and interior of the large drawer and to the lower shelf. This coating covers both the wire nails and the split mended with a strip of paper in the large drawer, and initially was believed to be associated with repairs. However, the coating is clearly overlapped by the single, original lacquer coating on the box's exterior. While further study would be needed to confirm this, the presence of the wire nails in the original construction would place its origin no earlier than the end of the Joseon period, which ended in 1910.

##### *Treatment History*

The box has an overall coating of shellac.<sup>10</sup> It is not clear why or when the coating was applied, because the lacquer appears to be in good overall condition. What appears to be an emulsion glue (it is viscous and cloudy gray and fluoresces a milky white in near ultraviolet light) is visible in the joints of the top drawers and one of the brackets. The glue repairs postdate the shellac coating. After the coating was applied, a dull, powdery material was smeared into losses along joints in the top of one lid.

##### *Condition*

The proper left rear bracket under the stretcher had broken off and is missing. A split opened toward the back of the panel supporting the top drawers, apparently due to shrinkage of this panel and its restraint by the pieces glued to it. The emulsion glue repairs between this panel and the drawers were made after the split. There is also a split along the proper left end of the rear molding of the bottom shelf. This split occurred because the molding was adhered to the shelf by an overall paint coating and the shelf shrank. The shrinkage of the shelf has loosened it. Its resultant movement exposes unpainted wood at the sides of the shelf.

The few places that the lacquer layer is flaking away from the wood substrate are on its lid. The flaking relates to losses and movement at the wood joints and along the inlay, rather than to deterioration of the lacquer. There are lacquer losses around molding, edges, and seams of the top drawers related to the structural damage and repair to the drawers. There are minor, isolated losses of inlay:

The lacquer on the top is lighter and browner

than the almost black lacquer on the sides of the box, evidence of light damage to the surface. Otherwise the lacquer does not have fine cracks or other evidence of deterioration, even under magnification, perhaps another indication of its relatively recent manufacture. While microfissures may be obscured by the shellac coating, they remain visible through the shellac coating on other objects, such as the Korean box (B60M292). The surface is somewhat dusty and has colored residues on the surfaces that were described by Ms Jaeschke.

#### *Treatment*

The surface of the box was cleaned with soft brushes (the loose dust being collected into a vacuum), and then with dry cosmetic sponges. Debris from the interior of the drawers was retained in carefully labeled polyethylene bags, as suggested by Ms Jaeschke. The surface looked good after dry cleaning. The decision was made, influenced in part by time considerations, to do no further cleaning with aqueous solutions or solvents. The shellac and wax layers are lightly and evenly applied, and do not appear to be causing problems, so they were left on the surface.

The split in the panel supporting the top drawers cannot be repaired without reversing the emulsion glue repairs to this area. The split is hardly visible from the exterior, where it goes through the panel's edge. If the box remains in stable environmental conditions, the split should not increase in size. If the split were repaired, the box would still need to remain in a stable environment or a new split might open up elsewhere. For these reasons, the split was left as it is. The split in the lower molding closes easily and was repaired. Hide glue was used as the adhesive because it gives a tighter joint between wood surfaces than B-72 does. Silicon-coated Mylar was inserted under the molding during treatment to prevent the adhesive from adhering the molding to the shelf again and preventing its free movement. The shelf was wedged

at the corners with small pieces of balsa wood to prevent it from sliding too freely.

The actively flaking lacquer on the lid was consolidated by first hardening the ground with 5% B-72 in xylene and then adhering the lacquer with 15%–20% B-72 in acetone and clamping it until dry. Because they are not very noticeable or vulnerable to further damage, the losses to the lacquer and inlay were not filled at this time. The missing bracket was not replaced at this time. If it were to be replaced in the future, I would be likely to fabricate the replacement from a softwood, rather than Plexiglas as Ms Jaeschke suggested, because it is easier to work and more sympathetic to the object. An acid-free mat board cover held on by a band of acid-free tissue was made to protect the lids and to secure their movement. The box was wrapped in prewashed cotton to protect it in handling and from light. □

**C**abinet on Stand (B65M31), Korea, modern, with decoration in the style of the Joseon period, Height including stand 119.5 cm, width 95.5 cm, depth 38.8 cm. This tall cabinet has seven drawers and three doors concealing ten more drawers (fig. 6.13). Kumja Kim, the curator of Korean art at the Asian Art Museum, has noted that this arrangement of drawers and doors is unusual in Korean furniture. It has a separate stand with cabriole legs and curved stretchers. It is coated overall with a deep red lacquer sprinkled with metal flakes coated to look golden. The decoration is applied in a combination of red, green, and yellow rayskin, twisted and flat copper alloy wire, abalone, and tortoiseshell.<sup>11</sup> The decoration on the exterior of the large doors is of paired phoenixes. The interior of the large doors and the exterior of the smaller door depict a Taoist taeguk motif (an interlocking design derived from the Chinese yin-yang symbol)<sup>12</sup> surrounded by trigrams and, on the smaller door, bats. The top has a pair of phoenixes among



Fig. 6.13. Cabinet (B65M31), shown with the doors open.



Fig. 6.14. Cabinet (B65M31).

stylized flower vines. The sides show the same stylized flowers rising on vines from small tortoiseshell vases. Smaller taeguk motifs, florets, gourds, flattened diamonds, and circles in rayskin fill smaller fields. Many of the copper alloy hinges and other fittings and all of the drawer handles have been replaced. The ones that appear to be the oldest and most carefully made have punched and cutout designs of swastikas, flowers, and other motifs.

#### *Conservation Record*

This cabinet was purchased from F. Caro in 1965. The only record of treatment was to the stand in 1986. The stand was structurally unsound at that time. The joints were coming open at the corners and causing surface damage. PVA emulsion was used to set all the wood joints and to reattach the lacquer. Lifting twisted wire inlay was reattached with cyanoacrylate adhesive. Losses were inpainted with Maimeri paints (pigments in resinous gum).

HELENA JAESCHKE WRITES:

#### *Condition*

This stunning object has multicolored lacquers, mother-of-pearl, rayskin, metal flake, and copper alloy wire inlay giving the appearance of cloisonné (see fig. 6.14), and copper alloy mounts and fittings. Like the other objects examined, the cabinet shows the signs of shrinkage of the carcass and some loss of lacquer surface as well as of tenting and voids beneath.

#### *Suggestions for Treatment*

After the same initial regimen of examination, sampling, and monitoring for stability, suggested for B60M292, it should be possible to proceed with a cautious program of testing and cleaning, again following the steps recommended for B60M292. Wherever possible it would be preferable to treat the copper alloy fittings in situ to avoid disturbing the lacquer during their removal. A few are so distorted that they may need to be removed so that they may be gently returned to their original profile. Some may benefit from gentle cleaning with a fine glass-bristle brush to remove hardened deposits, taking care not to scratch the surface or abrade original coatings. Particular care will be needed when attempting to reshape lifted areas of lacquer that include

the copper alloy wire as the wire may become detached from the lacquer when flexed. It may be necessary to introduce an adhesive such as a 10%–20% solution of Acryloid B-72 in acetone or a similar suitable solvent at the edges and allow it to flow underneath the area, and then apply an even pressure using a flat surface, such as a heavy glass tile. A small piece of silicon-coated polyester film or paper or Teflon-coated cloth may need to be placed over the area to be weighted, to prevent excess adhesive from sticking to the pressure pad. Several attempts may be necessary to persuade the lifted surface to return to its original position. In some areas it may be better to accept a certain amount of distortion than to risk further stress or damage. If it is not possible to introduce adhesive under some of the lifted areas, it would be better to allow the area to remain slightly bowed than to puncture an intact area of lacquer. Areas that cannot be flattened down and that appear too fragile to be left unsupported can be strengthened by introducing a viscous solution (15%–25%) of Acryloid B-72 in acetone or a similar suitable solvent into the void. This can then be followed by a 10%–15% solution of Acryloid B-72 in acetone or a similar suitable solvent with sufficient glass microballoons or fumed silica added to form a mixture that is fluid enough to be injected into the void but dense enough to form a substantial gapfill when hard. The gapfill mixture can be tinted to match using dry artist's pigment or acrylic inks, such as Rowney FW acrylic ink. These should be mixed with the glass microballoons or fumed silica and allowed to dry. They can then be mixed with the Acryloid solution. This method prevents the water in the inks causing the acrylic resin to gel when added to the solvent solution. Since it would be almost impossible to remove such a gapfill in future, this should be used only in areas where the object is



Fig. 6.15. Cabinet (B65M31), detail of surface loss showing grain of hardwood framing.

at risk of further damage if the distorted area is left unsupported. Areas of loss may be gapfilled as described for B60M292. If possible the wood of the carcass should first be documented and identified from the grain revealed (see fig. 6.15).

JANE WILLIAMS WRITES:

#### *Materials and Methods of Manufacture*

Examination showed that the cabinet was constructed in the twentieth century from a combination of new wood and reused parts from older furniture. Although it quickly became apparent that it if were an early nineteenth-century cabinet, it had been extensively altered and probably rebuilt, it took some time to make sense of its construction. The framing of the cabinet front, including the supports for all of the drawers except for those behind the large doors, appears reasonable for a nineteenth-century Korean cabinet. It is done with a hardwood and has tight, neat mortise-and-tenon joints. The finish on the framing raised questions—the nashiji finish was applied directly to the wood of some



Fig. 6.16. Cabinet (B65M31), X-radiograph of drawer front; note presence of metal in holes for an earlier handle and current use of wire nails in the joints. Technical data: Gulmay X-ray unit (320 kV max.), Kodak Industrex AA film, 25 kV, 5 mA, 60 seconds, distance from tube, 36 inches.



Fig. 6.17. Cabinet (B65M31), detail of side panel; the pinkish restoration follows a horizontal crack along a crossbrace where the panel is pieced.

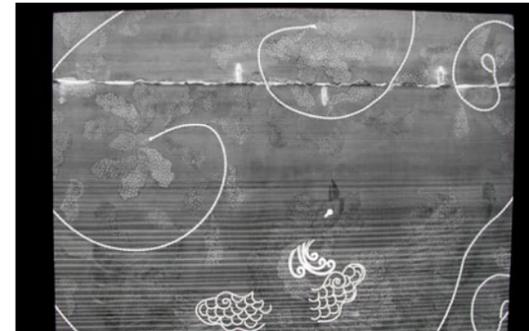


Fig. 6.18. Cabinet (B65M31), X-radiograph of lid; note discontinuous nail holes along joint in wood. Technical data: Gulmay X-ray unit (320 kV max.), Kodak Industrex AA film, 25 kV, 5 mA, 60 seconds, distance from tube, 36 inches.

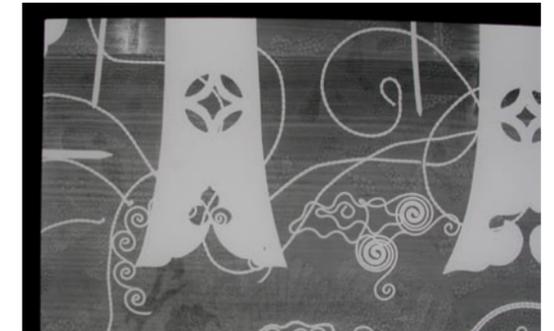


Fig. 6.19. Cabinet (B65M31), X-radiograph of large door; note discontinuous nail holes along wood joints and current use of wire nails in these joints. Technical data: Gulmay X-ray unit (320 kV max.), Kodak Industrex AA film, 25 kV, 5 mA, 60 seconds, distance from tube, 36 inches.

of the drawer supports, rather than to a ground layer as is typical and is found elsewhere on this cabinet—but was considered to possibly date to a restoration. All of the drawer fronts, except those behind the large doors, are made of the same hardwood. They were carved to have a raised central panel for the wire and rayskin decoration, and their interior top edge is beveled. As evidence of some age, the drawer fronts retain holes, covered on the exterior by surface decoration, from previous, smaller drawer handles. The placement of the previous, smaller handles would have interfered less with the decoration than the current handles do. In X-radiographs (see fig. 6.16), traces of metal are visible in some of the old holes. The X-radiographs also reveal twentieth-century wire nails in the drawer joints, but these could be from repairs.

After the locks had been opened and all of the drawers removed, the examination of the inside raised more questions. The entire inside of the cabinet is covered with a dark stain that appears to be freshly applied. The softwood drawer backs have the same dark stain and show

no evidence of wear, though again it would not be surprising to have drawer backs replaced in an extensive restoration. The interior supports are softwood and held together with glue and wire nails, rather than more complex joinery. The construction of the drawers and supports in the compartment behind the large doors different from and more haphazard than the rest of the cabinet, which first suggested that the cabinet did not originally have drawers in this compartment. This compartment makes use of reused timbers from older furniture in some of the panels and drawer fronts. The drawer fronts here are also the only ones made from softwood, show no evidence of previous handles, and differ stylistically from the others.

Determining whether this is a pastiche or an extensively reconstructed cabinet, then, depended on whether the panels with the major design fields (door, sides and top) were made for this cabinet. Another possibility considered was that this is a new cabinet incorporating some older decorated panels. The side panels and doors were not made from single panels, but in-

corporate crossbraces. This method of construction, presumably on the doors intended to reduce warping, does a poor job of creating a solid panel for decoration. Cracks have opened in the surface of the decoration along these joints (see fig. 6.17). The interior surfaces of the side panels cannot be assessed because they have been lined with newer wood panels. The back panel also appears new. The liners and the back are crisply and crudely swan, unworn and unoxidized. The top panel, identified as pine,<sup>13</sup> is the only panel with beveled ends and a worn, dark blue paper lining, lending support to the possibility of its having some age. X-radiographs taken of the top panel and the large doors (see figs. 6.18 and 6.19) provided the final proof that the cabinet is a modern assemblage. The X-radiographs showed that the decoration on these panels, too, was applied to pieces of wood reused from another object or objects. What looks like a crack in the paper lining and wood of the top is actually a joint between two pieces of wood that were not originally joined. Nail holes are visible on one side of the joint and not on the other (see

fig. 6.18). The large doors show the same reuse of wood from another object (see fig. 6.19). The wire nails visible in these X-radiographs are now understood as part of the modern assemblage.

Because it makes use of *urushi*, abalone, and traditional Korean metal fittings, the cabinet was probably made in Korea. Part of what made it difficult to accept that the cabinet was a completely modern assemblage is that the decoration is of a higher quality than that of the construction of the cabinet. The rayskin and metal wire phoenixes and flower scrolls on the top, sides and large doors are graceful and consistent with the decoration on the two cabinets referenced in note 11.<sup>14</sup> Because the details of the inlay are so similar to other Joseon dynasty cabinets, the possibility remains that the rayskin pieces were reused from a piece of furniture that was beyond repair.

Similarly, questions were raised by an examination of the surface decoration. On the decorated surfaces, a layer of plain-weave cotton textile was first glued to the wood.<sup>15</sup> The metal wire and inlay appear to have been glued di-



Fig. 6.20. Cabinet (B65M31), detail of front surface showing metal wire and rayskin inlay applied to the textile underlayer.

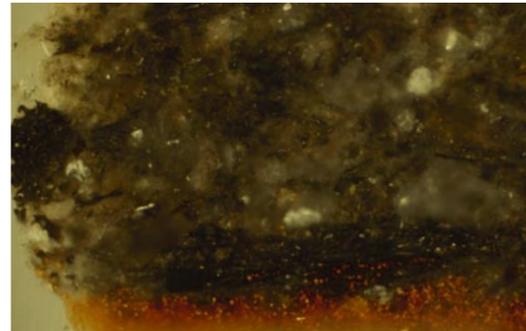


Fig. 6.21. Cabinet (B65M31), cross section of surface layers shown in reflected light (above) and ultraviolet light (facing page, left); photo taken at 200x magnification.

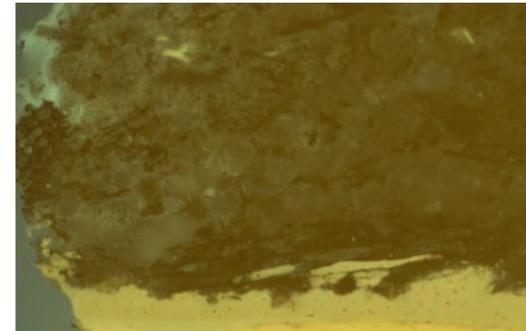


Fig. 6.21. Cabinet (B65M31), cross section of surface layers shown in reflected light (facing page, right) and ultraviolet light (above); photo taken at 200x magnification.



Fig. 22. Removal of mold from interior drawer of cabinet (B65M31), using adhesive.

rectly to the textile (see fig. 6.20). Drawn wires were used—one of the wires lifting from the surface on the stand was clearly formed with a drawplate.<sup>16</sup> Tortoiseshell inlay appears only on the cabinet sides and the interiors of the large doors. On the sides and one of the doors it appears to have paper behind it, but on the other door the plain-weave textile is clearly visible behind the shell. The rayskin inlays are colored yellow, green, and red—the colorants were not analyzed.<sup>17</sup> In X-radiographs of the small door, it looks as though the bat-shaped rayskin inlay pieces have been repositioned.

While its structure is the same as that of the other drawers with hardwood fronts, the decoration on the lower drawer does not match the rest. This was initially attributed to restoration and has yet to be explained. Its surface is the only place where the flat metal wire scrolls are made of doubled wire. The phoenixes here are the only asymmetrical pair—one with a tail of wire scrolls, and the other of wire and abalone. These are the only phoenixes on the cabinet to use abalone for the heads and bodies, rather than

rayskin. The only other abalone pieces are the irregular shapes next to the phoenixes on the large doors.<sup>18</sup>

While the structure was being assessed, the surface decoration was being studied from cross-section samples. The simplicity of the layering is more consistent with a modern fabrication, than with a nineteenth-century cabinet that has undergone extensive structural repair. The stratigraphy was the same in the cross sections taken from different sites where there were not obvious restorations (fig. 6.21> shows a representative cross section). After the inlay was adhered to the textile, a coarse gray ground layer was applied to bring the surface close the level of the inlay surfaces. Of the samples examined for this project, this ground layer most closely resembles the gray ground on the Korean inkstone box (B62M18); both have a protein binder and are bulked with charcoal and light-colored clays. The ground layer on this cabinet was unique in those examined for this project in also containing brass flakes. Over this, the only layers are a red pigmented lacquer layer, followed

by a nashiji layer. The nashiji layer, also unique in this project, was composed of lacquer containing aluminum filings.

There are a variety of problems with the metal fittings on the cabinet. It was initially assumed that at least some of the hardware could have been replaced in a restoration. Two different styles were used for the current drawer handles: a simple curved handle for three drawers and bat-shaped handles for the others. Handles have been placed in the middle of the large doors, an unusual feature for doors that have large decorative lock plates. The lock plate on the smaller door appear to have been cut down from a decorative circular plate. The lock plates have good-quality punched surface decoration, both depicting plum blossoms surrounded by Buddhist symbols. The fittings reinforcing the joints are of varying quality and designs. Some have cutout swastikas and others lozenges, both with punched floral designs. There are two distinct levels of quality among the fittings with swastikas and three among those with lozenges. The top front corner brackets are of the higher

quality swastika variety. The back half of the proper left one has been replaced with undecorated metal sheet. The corner braces on the back edges have no punched decoration. A circular brace, rather than the flat corner brace to be found at front bottom corners, was erroneously placed at the lower back corners.

While a highly decorative object, the cabinet is not an honest construction and incorporates new and reused timbers and metal fittings. Differences in the execution of the decoration in different places suggest that the rayskin inlay may have also been re-used.

#### *Treatment History*

The cabinet underwent a more superficial, though not light-handed, restoration, probably in the West. In this restoration a dark pink fill was applied to losses along the edges and along gaps that had opened at joints in the decorated panels (see fig. 6.17). A large crack and loss to the back panel was glued and patched with new wood in this repair. The fills were surfaced with dark red paint, sprinkled with fine white me-

tallic powder (traces of this powder are found throughout the interior of the cabinet). The interior of the small door appears to have been surfaced in this restoration as it has only paint and metallic powder on its surface, rather than the lacquer and inlays of the larger doors. The metal powder, traces of which are found settled in crevices throughout the interior of the cabinet, was applied liberally to many parts of the surface, and then the entire surface was coated with shellac.<sup>19</sup> The shellac coating is found on the interior drawer fronts and continues under the hardware, suggesting that the hardware was all removed for this restoration.

#### Condition

The cabinet is currently structurally stable. The surface layers, however, are lifting and flaking off in a number of areas. Along the edges and on some of the joins, most of what is lifting is the fill and paint from the European restoration. The lacquer decoration is tented and cracked due to continued movement and shrinkage along joins in the wood substrate. Fig. 6.17) shows such damage to the pieced side panel). There is blind cleavage, where a larger area of the lacquer and ground are bulging out from the surface, in one area on the lower left side and in a corner of one drawer front. On this object the lacquer and ground have stayed well adhered to each other, and have become detached at the join between the ground layer and the wood or textile support. Several of the metal fittings are bent and distorted, particularly one at the lower back corner that has the wrong shape to be used as a base corner plate. The copper alloy wires are lifting from the surface in a few areas. The coatings on the surface have dulled. A small cleaning test on the reverse with ethanol seemed to remove a wax coating before dissolving the shellac coating to reveal the glossy, harder, in-

soluble red lacquer layer sprinkled with metal flakes. The surface of the cabinet, which was stored uncovered for many years, is dusty. A liquid dripped in two of the drawers has developed spots of white mold growth (spores are clearly visible with magnification).

#### Treatment

Once it was determined that the cabinet is a modern pastiche, the decision was made to not treat it. The only treatment undertaken was to remove the mold from the interiors of the drawers. On the advice of the museum's paper conservator, Debra Fox, to contain the spread of the mold spores into the air, the mold was lifted from the surface using wads of a tacky, dried adhesive<sup>20</sup> wrapped around tweezers to form a wand (see fig. 6.22). The drawers were then cleaned using a vacuum equipped with a HEPA filter and wiped with cotton Webril Handi-pads moistened with isopropanol. Custom Tyvek covers (as shown for the chair in fig. 6.36) were stitched for the cabinet and its base. □

**C**hair (B69M54a), China, early Qing dynasty, approx. 1650–1750, Height 101.6 cm; seat 66.0 x 48.6 cm. This object is one of a pair of Chinese lacquer chairs from the early Qing dynasty (fig. 6.23). The decorative scheme over most of the chair consists of an orange brown background lacquer that has been incised to outline a design of scrolls and floral motifs. Traces of gilding are apparent in the incising, a technique known as qiangjin, and a polychrome lacquer technique has been used for the flowers. The once elaborately colored garden scheme on the seat depicts peonies, birds, and butterflies.

Research into the object revealed that the cresting rail, two of the spindles and the arms have been replaced. The front of the cresting rail is emblematic, displaying a central Shou



Fig. 6.23. Lacquer chair (B69M54a), after treatment.



Fig. 6.24. Lacquer chair (B69M54a), proper right view before treatment; note losses down edges of legs.

character representing longevity, and the back is a pictorial scene of peonies and dragons.

#### *Conservation Record*

The chair was donated to the De Young Museum in 1959. At that time, many cracks with elevated edges and losses of lacquer were noted. The chair became part of the Asian Art Museum collection in 1969. A report made on its condition in 1986 for a loan noted filled and tinted repairs overall, some of which were chipped exposing white plaster. These were toned at that time, so any new damage could be distinguished.

HELENA JAESCHKE WRITES:

#### *Condition*

This piece is one of a matching pair with an unusual asymmetric design in red and brown lacquer. There appear to have been several phases of repair, most using a powdery white gapfill (resembling plaster of Paris) that has been painted to match (fig. 6.24). Any examination of this item should be carried out in conjunction with the matching chair.

#### *Suggestions for Treatment*

Again, the choice and extent of the treatment will depend on the assessment of the nature and importance of the repairs. If they are to be retained, the repairs themselves may require consolidation with a solution of an acrylic resin such as Paraloid B-72 in acetone or a similar suitable solvent (as described for B60M292) to protect them from further loss. It may be necessary to explore small areas of the repairs to discover whether they obscure a damaged original surface or whether they were applied to the bare surface of the foundation or the wood carcass. If they are to be removed, they will need to be documented and the material removed kept for reference, as described for the repair inlays on B60M292. Mechanical cleaning with a polished scalpel may be sufficient to remove the rather powdery gapfill, possibly followed by cleaning with swabs of a suitable cleaning solution. Distilled water and acetone have both proved useful in the past for removing plaster of Paris, but any solution used must be tested on the area carefully before use. The surface of the remaining lacquer appears considerably worn and may require very careful cleaning to ensure that no traces of what remains of the original surface are removed.

Once the object has been cleaned, it may be necessary to introduce a consolidant under the edges of the remaining lacquer to prevent further

loss. The lacquer appears to have poor adhesion to the wood carcass, though this may have been exacerbated by the stress applied at certain points when the chair was in use, most noticeably on the front stretcher, which appears to have been used as a footrest (fig. 6.25), the legs, joints, and edges. In addition, there are numerous parallel splits in the lacquer on the seat of the chair, which may have been caused by the flexing of the seat panel in use, possibly followed by later shrinkage of the wood. A solution of Paraloid B-72 in acetone or a similar suitable solvent should be introduced under any areas that are threatening to become detached. Care must be taken to ensure that the consolidant does not cause changes in the appearance of the lacquer, which is both thin and light colored, and that excess is not left on the surface of the lacquer after application.

Areas that require gapfilling should be protected with a barrier layer of Paraloid B-72 in acetone or a similar suitable solvent and gapfilled as described for B60M292. Painting the gapfill to match will require considerable judgment and skill, as the original decoration is very worn. It may be decided that an even coating of a color that matches the general color of the surrounding area would be preferable to any attempt to recreate the missing areas of the painted design. If the gapfill is to be painted to match the design, it may be necessary to build up the color in very light applications using a small pad of sponge, chamois, or similar material to dab on diluted acrylic ink. The surrounding surface may be protected with plastic wrap, silicon-coated paper, or Teflon-coated cloth while the coloring is being applied.

ROWAN GEIGER WRITES:

#### *Materials and Techniques of Manufacture*

A detailed examination of the manufacturing techniques and materials of the chair revealed that the original sections of the chair include



Fig. 6.25. Lacquer chair (B69M54a), before treatment; note the brown shiny surface and wear on front stretcher.

the legs, back stiles, stretchers, seat, and five of the seven back spindles. These areas show a consistent style of construction, decoration, and materials. Analysis of a wood sample taken from the bottom of one of the feet revealed that the timber is walnut (*Juglans* spp.).<sup>21</sup> The construction techniques were not elaborate. Simple square-section timber was jointed with square-shouldered blind mortise-and-tenon joints. The seat has a frame-and-panel construction with mitered corners to the frame and the panel set in with a groove. The seat is further supported by a center rail running front to back, which is

attached to the seat frame with a mortise-and-tenon joint. The seat aprons serve both decorative and structural purposes and are joined, with tongue and groove, to the underneath of the seat and into the legs. They are completed with decorative spandrels, which are attached to the chair in the same manner. The wide cresting rail is supported by seven round turned spindles, which are connected to the cross rails by means of mortise-and-tenon joints. The cross rails have been shaped to form the arched tops and bottoms. The simplicity of the construction is presumably due to the fact that the joints were purely structural. Being covered with lacquer, they served no decorative purpose. The joints are not strengthened by dowels and therefore an adhesive, probably a protein glue has been used to secure the jointing.

Damage to the edge of the seat allowed the original treatment of the timber to be observed with a stereomicroscope. The grain of the wood had been filled with an orange brown material (as yet unidentified) and a sealing coat of black lacquer applied over this. A white plain-weave textile was applied to the black lacquer coating. X-radiographs show that the textile was applied extensively across the chair except over the arms and their supports.

Cross-section samples then confirmed the stratigraphy of the upper lacquer layers. Two grounds were applied in the original scheme, as can be seen (fig. 6.26) under reflected light. The lower thicker ground was applied directly to the cloth to fill the weave and appeared brown gray in color with large clay particles loosely bound in a blue white fluorescent binder. FTIR identified quartz and gypsum in a protein binder. It has been noted that Chinese lacquer pastes or grounds often included some of the following:

deer antler ash, cow horn ash, porcelain ash, bone ash, pig's blood, calcined clam shells, and ground dried lacquer.<sup>22</sup> A second ground was applied over this. It appears as a dense black ground with smaller particles tightly bound in a black material that fluoresced a dull mustard yellow in ultraviolet light. FTIR analysis again identified quartz and gypsum in this layer, and strongly suggested the presence of lacquer.

Two, and in some places three, pigmented lacquer layers appear on the original sections of the chair. These are similar in thickness. The identification of mercury and arsenic in these layers strongly suggests the presence of vermilion and orpiment, and that the pigment content was roughly half clay and half red and yellow pigments. FTIR spectrometry identified lacquer as the binder. This appeared to fluoresce a yellow brown color under ultraviolet light.

The decoration of the legs, rails, and spindles is applied into the uppermost pigmented layer of the chair. The scheme is predominately black green scrollwork which is interspersed with delicately colored flowers. Much of the original color has been abraded away, and this is particularly noticeable on the seat where virtually no colored lacquer except the background remains. The traces that do remain suggest that a color palette of green, blue, light brown, and yellow were used, and that the colors were built up in layers to give the flowers depth (see fig. 6.27). The abrasion of these colors and presence of the background color under the scrollwork suggest that these details were painted onto the surface (polychrome lacquer).

After the decoration had been painted on, further definition was given by incising around the edges and filling the recesses with gold, a technique known as *qiangjin*. Garner has

described this technique as lacquer mixed with orpiment and applied to the incisions.<sup>23</sup> Gold leaf is then pressed into the recesses and the excess removed. However, on this chair the gold is powdered and is mixed with a yellow pigment. Because the incising overlaps the flowers in places, it clearly was performed after the painting.

#### *Treatment History*

Helena Jaeschke observed that several phases of repair had taken place to the chair. This was in fact the case and we discovered six phases of restoration. This included major structural changes including replacement of the arms, two of the back spindles and the cresting rail.

#### *Scheme 1*

The first scheme was replacement of the cresting rail. This was executed in lacquer suggesting that the treatment was performed in Asia, probably before the twentieth century.

X-radiographs and analysis of cross sections provided the evidence for this restoration. The cresting rail was more radio opaque than the rest of the chair indicating that a different timber or surface coatings had been used. We also found on the X-radiographs outlines of old mortises that had been filled with wood (see fig. 6.28). Two of these were at the top of each stile; suggesting that a rail crossed at this point and the stiles had been cut down. Two further former mortises appeared at the junction of the first and second lobes of the cresting rail suggesting that this piece of timber was taken from an existing object and lacquered to match the scheme of the chair. Furthermore, attachment of the cresting rail to the stiles was by means of two ferrous metal (2.5 inches/64 mm) cut nails driven rather than the common cabinet making techniques found elsewhere on the chair.

Analysis of the cross sections from this area

supported the structural evidence. Samples taken from both the front and back of the cresting rail revealed a stratigraphy that differed from the original (see figure 6.26). The most immediate of these being that there was only one ground present, a brown loosely bound layer similar to the protein based grounds of original sections of the chair. The black ground bound with lacquer was not present. Above this, the first four pigmented lacquer layers contained a simple mixture of arsenic, sulfur and calcium, indicative of orpiment/and or realgar mixed with calcium based white. This was elementally different from the mixture of aluminum, silicon, potassium, calcium, iron and arsenic found in samples on the legs.

#### *Scheme 2*

At a later stage, the arms and two of the back spindles were replaced, and repairs to the cresting rail and legs were performed. All repairs were executed in lacquer indicating that they took place in Asia.

Cleaning the Western coatings and toning from the chair revealed that the appearance and condition of the arms and their supports was quite different from the original sections of the chair and from the cresting rail. The arms appeared in a relatively good condition with few losses to the surface, and the lacquer was noticeably redder in color from the orange brown tones of the rest of the chair. In addition, the scroll work was executed in black lacquer as opposed to green, there was no gilding present in the incised lines, and the execution of the scroll and flower decoration was stylistically different (compare figures 6.29 and 6.30).

X-radiographs showed further differences in that the arms were more radio opaque than other parts of the chair, and the timber had a more pronounced grain. Furthermore, no cloth layer was visible, and the incising appeared finer

Fig. 6.26. Chart showing cross sections of lacquer layers from different parts of lacquer chair (B69M54a).

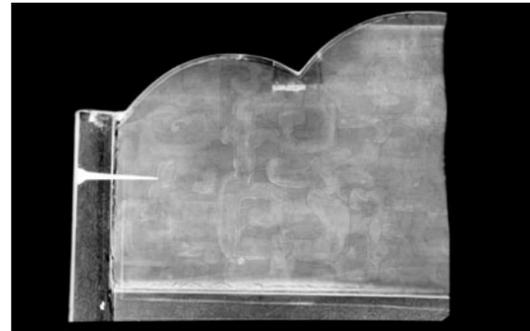


Fig. 6.28. X-ray of cresting rail on lacquer chair (B69M54a), showing use of handmade ferrous nails. Technical data: Norelco X-ray unit (150 kV max.), Kodak Industrex AA film, 45 kV, 5 mA, 120 seconds, distance from tube, 36 inches.



Fig. 6.29 Lacquer chair (B69M54a), detail of scrollwork from legs showing original decoration.



Fig. 6.30. Lacquer chair (B69M54a), detail of scrollwork from replaced arms.

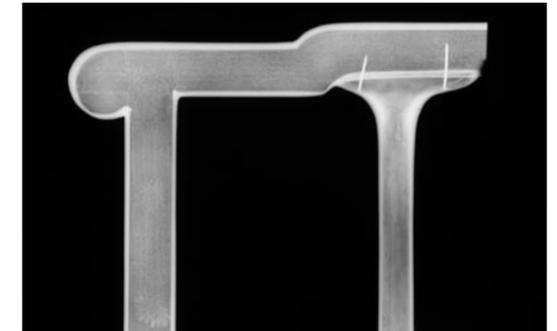


Fig. 6.31. X radiograph of arm on lacquer chair (B69M54a); note fineness of decoration. Technical data: Norelco X-ray unit (150 kV max.), Kodak Industrex AA film, 45 kV, 5 mA, 120 seconds, distance from tube, 36 inches.

than the original work (see fig. 6.31). The theory for replacement was confirmed later by the cross sections. Mounted samples from the arms (fig. 6.26) showed many more layers than the samples from the legs, and there were strong elemental differences between the samples. SEM-EDS results also suggested a heavier use of vermilion and orpiment content to clay particles compared with the legs.

In a similar manner, two of the back spindles (nos. 3 and 4 from the proper left side) share characteristics with the arms rather than the remainder of the back spindles, and were also deemed replacements. It is likely that removal of the original spindles was due to serious damage, however quite how this could have occurred to only two of the spindles is unknown. Reasons for removal of the arms is also unknown; damage is a possibility, however since this same change has occurred on both chairs in the pair, it is also possible that the arms were changed in an attempt to update the chair, or make it more fashionable.

SEM-EDS results highlighted that in addition to replacing the arms, restoration lacquer

layers were also applied to the legs and cresting rail. We found materials from the top layer of the original arm scheme had also been applied over the original leg scheme. In addition, they had been applied over the original scheme of the cresting rail, strongly indicating that the arms and cresting rail campaigns occurred at different times and that the cresting rail was the earlier restoration.

#### *Scheme 3*

The third restoration was an application of pigmented lacquer to the cresting rail and arms. SEM-EDS found barium and zinc present in this layer suggesting that lithopone was used on the upper surface. Since this material is considered a late nineteenth century pigment, it can be considered that this restoration occurred at that time. Due to the use of lacquer, this represents the third and last Asian restoration.

#### *Scheme 4*

This scheme represents a restoration of the joints of the arms and replacement spindles.

After removing the overpaint and toning layers it became clear that there was a considerable amount of damage around these areas, which had been filled with a gray insoluble material resembling polyester resin car body filler. This had remained stable, and had retained its adhesion to the lacquer surface very successfully. From the type of material used we assume that they were executed in the West in the twentieth century.

#### *Scheme 5*

The fifth scheme was extensive, involving the introduction of new hardware, fills combining sawdust and adhesive, the application of a toning layer and a Western resin coating to the entire chair surface. The materials and techniques in this series of repairs are characteristics of the work of a furniture restorer. The joints of the chair had obviously loosened over time and required strengthening. X-radiographs revealed that the joints between the arms and the back stiles and the side foot rails and the back stiles had been reinforced with the addition of countersunk modern three and a half inch screws.

(See fig. 6.32) The countersink appeared to be filled with sawdust and an adhesive which was water soluble and had the characteristic crystalline appearance of aged hide glue. This had also been applied to many edge losses and over the gray insoluble filler found around the base of the arms. Although, it also had remained stable, some of these fills were reduced during the cleaning process.

Cleaning tests revealed that these fills under UV light were coated with an orange fluorescent material and that in certain areas a toning layer had been applied before the coating. Cross sections later showed that this coating, which appeared to be shellac from the orange fluorescence, was widespread across the piece. The coating of lacquer objects, although rarely performed in Western museums today, was not uncommon when lacquer surfaces had been exposed to sufficient light to render them matte and powdery in appearance. In the same way as many pieces of furniture were given a new coat of polish, so lacquer objects often received the same treatment in an attempt to regain the char-

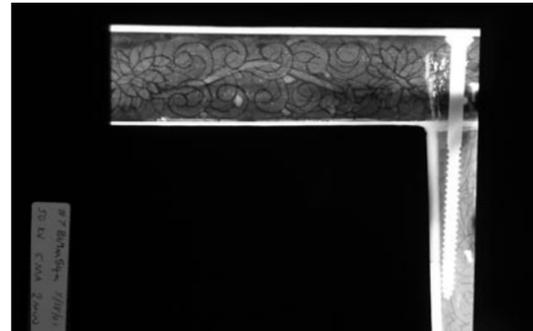


Fig. 6.32. X radiograph of arm on lacquer chair (B69M54a), showing attachment using a modern 3/16-inch screw. Technical data: Norelco X-ray unit (150 kV max.), Kodak Industrex AA film, 50 kV, 5 mA, 120 seconds, distance from tube, 36 inches.

acteristic luster of lacquerware. This coating had darkened and cross-linked with age giving the chair a dark brown appearance, rather than the orange brown color of the original lacquer. This effect was exacerbated by the toning layer that had been applied before the coating. Although not present everywhere, cross sections from the cresting rail (see fig. 6.26) clearly showed a dark toning layer close to the surface which was penetrating the craquelure. It was also found on the arms suggesting that an attempt had been made to integrate the slightly different lacquer colors on the chair.

#### Scheme 6

The most recent scheme consisted of a white powdery gapfill resembling plaster applied primarily to the front stretcher, although it was also found in some of the edge fills on the arms. From museum records we know that this was applied between 1969 and 1986. The plaster fills were failing to adhere to the lacquer ground, however this meant that it could easily be removed with

a scalpel. There were traces of a brown coating resembling acrylic paint that had been used to inpaint the plaster fills, and they were integrated by a coat of a green fluorescent material that, from its appearance and solubility, we assume to be a natural resin varnish. This coating clearly shows on the majority of the cross sections and covers the plaster fills. There is, however, no record of this in museum files.

#### Condition

When the chair was received, the construction was in a stable condition with no loose joints, although splits in the timber due to shrinkage were apparent on the corner brackets. X-radiographs showed that many of the joints had been repaired using modern hardware; for example, one of the corner spandrels had been reattached to the apron with 2-inch finishing nails.

A number of lacquer losses were noted on the surface, particularly down the edges of the legs and along the front stretcher. In some areas, as already described, failing fill materials were found. Initial observations showed the lacquer surface to be uniformly brown in color with an uncharacteristically shiny surface for lacquer. Splashes of black material along the insides of the stretchers suggested that toner had also been used. After the Western coatings had been removed, it became clear that the lacquer surface had been abraded extensively, removing much of the colored decoration and leaving the background lacquer patchy in places. In addition, the surface appeared dull and powdery, suggesting it had been damaged by light.

#### Treatment

The chair was initially cleaned using a small brush and vacuum attachment to dislodge surface dust. Unstable areas were avoided. After dry cleaning, we examined the surface and per-



Fig. 6.33. Lacquer chair (B69M54a), half-cleaned front view

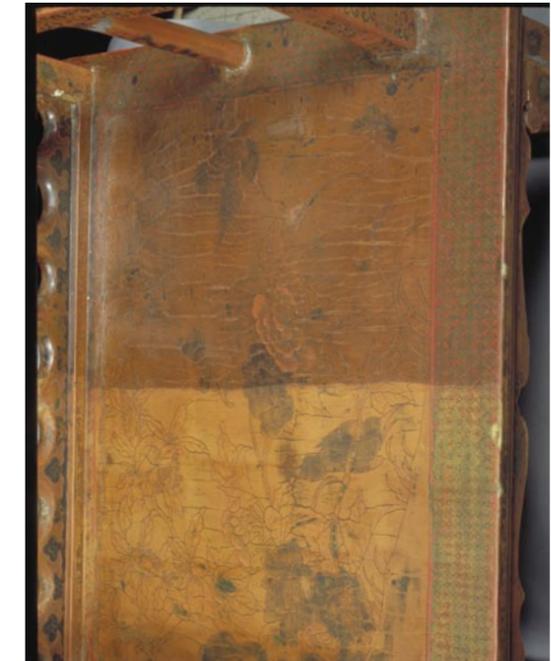


Fig. 6.34. Lacquer chair (B69M54a), half-cleaned seat

formed cleaning tests under ultraviolet light to assess the solubility of the Western coatings and toning layers. While removing the coatings would reveal the colors of the decoration and the original lacquer surface, we also needed to assess how soluble the varnishes were and possibly remove them before they became insoluble. The uppermost natural resin varnish was easily removed with a 3 : 1 mixture of acetone and ethanol solvent applied on small cotton swabs under extraction. The earlier orange fluorescent coating did not however readily respond to a range of commonly used solvents. It could be removed very slowly with ethanol, although each area required a long exposure to the solvent. We therefore tried to avoid the abrasive aspects of

swabbing by holding the solvent ethanol in a 2% Klucel GF gel. This was no more satisfactory. Due to the relative insolubility of this coating we decided its removal was necessary and chose N-methyl-2 pyrrolidinone because it quickly removed both coatings, thereby limiting exposure of the surface to solvent and not damaging the lacquer surface. Due to the slow evaporation of this solvent, once applied, it was quickly removed with Webril Handi-pads to prevent excessive exposure of the surface to the solvent. All solvent cleaning was performed with extraction. Removing the Western coatings revealed that the lacquer was in fact an orange brown color, much lighter in appearance than before (see figs. 6.33 and 6.34). In addition, the lacquer

appeared very powdery and matt, an appearance characteristic of light-damaged lacquer.

The cleaning process also revealed many of the older fills and so their condition could be assessed. Many of the original lacquer repairs had suffered mechanical damage and the plaster repairs had shrinkage failures. Unstable fills were removed with a microscalpel and acetone was used where necessary. The sawdust and adhesive paste had been partially dissolved by the solvent cleaning and the fills were too rough to be acceptable. They, too, were easily removed using the same technique. Although Ms Jaeschke noted that unstable fills could be consolidated, it was decided that, because many of the materials were failing, it would be better to remove them and introduce new material. Fills that had suffered no shrinkage, did not appear to be affecting the lacquer and their removal could cause damage to the surface were left in place. The insoluble gray fills, for instance, showed no signs of cracking or shrinking; they were, however, completely insoluble. Furthermore, the execution was poor in that it extended beyond the confines of the fill area, spreading over original undamaged surface. The fills were carefully pared down with a microscalpel and smoothed with abrasive paper to limit them to the area of damage. In general, no original decoration was found beneath the fills, and the filler had been applied over the gray ground. The original layers had, therefore, separated between the loosely bound protein-based ground and the denser black lacquer-bound ground. Samples of all these materials were kept for reference in the lab sample files.

Loosely bound protein grounds are often a point of weakness for Chinese lacquer objects. The original surface often delaminates at the conjunction of lacquer and ground, and replacement fills also cleave at this point. One

technique to overcome this is to strengthen the ground initially with a dilute consolidant and then secure lacquer flakes with a more concentrated adhesive. We had previously found that a 5% solution of B-72 introduced into the ground consolidates the area sufficiently for the later adhesion of flakes or new fills. In this case, the resin was dissolved in 1 : 1 acetone and ethanol, so as to balance the good penetrative qualities of acetone with the slower evaporation of ethanol. This mixture was slowly introduced by means of a pipette into the exposed ground. Covering the area with Mylar helps to slow the evaporation. Two applications were necessary to consolidate the ground sufficiently. Consolidation of this nature also provides a sealant layer to the original ground, both inhibiting the absorption of water from water-based fill materials into the ground and making the fill easier to remove in the future. Following consolidation of the ground, lifting flakes were reattached with 20% B-72 in acetone applied on a brush. After the adhesive had been introduced, the flake was covered with Mylar and small clamps applied to strengthen the join. A 20% B-72 solution was strong enough to secure the flakes on this piece. As Ms Jaeschke comments in her notes, care must be taken to ensure that the consolidant does not cause changes in the appearance of the lacquer. Acetone, in particular can cause a rapid and largely irreversible distortion to particularly thin lacquer, and may cause a color change if left on the surface. To reduce these risks, we tested the solvent carefully before use, and quickly cleared adhesive residues on the surface.

The chair had suffered a significant number of losses over its life, leaving many areas of exposed ground and vulnerable edges. To help integrate the piece visually, and to limit further losses as a result of mechanical damage of the surface, it was decided that filling was necessary.

In the museum, extensive testing of fill materials had taken place and a mixture of 6% low-molecular-weight polyvinyl alcohol (PVOH) and ground Champagne chalk had already been noted as a superior fill, in that it was smooth, did not crack, and offered a balance of hardness and strength.<sup>24</sup> We used the same combination of materials for the chair. After mixing the materials to a thick dough, pigments were added as a colorant to help identify the fills attributable to this conservation scheme in the future. In retrospect, because many of the fills were on edges susceptible to mechanical damage, it may have been more appropriate to match the color of the fill material more closely to the color of the lacquer surface. This would still have identified the conservation treatment but would also, to an extent, disguise further damage as the color of the fill material would blend in with that of the original.

The fills were applied with a stainless steel spatula and initially smoothed using a wetted rubber spatula (see fig. 6.35). Where a second layer was necessary, a coating of 6% PVOH was brushed on between applications to improve adhesion of the layers. The material was left to dry overnight, after which it could easily be leveled using a range of Micro-Mesh abrasive papers.

In considering the use of PVOH for filling lacquer losses, caution should be employed. Being water based, it may not be appropriate for lacquers highly sensitive to moisture, and initial testing is appropriate. The order of mixing the materials is also important. A more consistent fill is obtained by first mixing the dry pigment and the chalk and then gradually adding the PVOH solution to form a dough. The mixture should be stirred slowly and smoothly as it is easy to introduce air bubbles, which leave pits on the surface as the material dries.

One disadvantage of this material is that a



Fig. 6.8. Box (B60M292), back side.

significant amount of dust is produced when the fill is smoothed with abrasive paper. This can be minimized by not overfilling the loss and by using extraction; however the surface usually requires cleaning again after treatment. On the chair, dust became caught in the incising lines of the decoration and was not easily brushed off. The solution to this also solved the problem that the initial cleaning had exposed a surface that was variable in its luster as a result of the application of lacquer surfaces and repairs at different times.

The original lacquer surfaces, which were very matt and damaged by light, contrasted with the glossiness of the relatively recently lacquered arm surface. The cresting rail was different again, and many of the lacquer repairs also did not match. We decided that the powdery matt surface was visually unacceptable and required some intervention. It seemed clear that previous restorers or conservators had faced the same problem and their solution had been to ap-



Fig. 6.8. Box (B60M292), back side.

ply a resin varnish. Because our intention had been to reveal the original surface, this did not seem appropriate and, as resins age over time, the darkening obscures color and decoration. Having taken the decision that treatment was necessary, the only other option was to burnish the matt areas lightly or to compact the powdery surface so that it reflected more light. Obviously, this was a difficult ethical decision, because some techniques may be removing original material and because it is a decision based on aesthetics rather than issues of stabilization. We decided to investigate several techniques to see whether any would overcome our concerns, and if any had a secondary effect of removing the chalk dust residues.

From the lacquer conservation literature six techniques were chosen and were assessed visually. At the time we had no access to more comprehensive analysis techniques such as SEM to assess changes in the surface structure or wheth-

er residues were being deposited on the surface as a consequence of the treatment. Two of the six involved the use of solvents: swabbing the surface with Stoddard solvent and removing the solvent with Webril Handi-pads, and the Japanese lacquer-cleaning technique of using a cotton cloth that had been barely moistened in water. The solvents worked well to remove the dust, but a lot of rubbing was required to change the luster of the surface; in other words, the surface needed to be abraded to achieve the desired effect. The four dry techniques involved the use of silk, Cerex (spun-bonded nylon), 12000 Micro-Mesh, and a Staedtler Mars Plastic vinyl eraser. Cerex had no effect on the dust or luster, 12000 Micro-Mesh abraded quite quickly but did not remove dust from the incising. Fine-weave silk also burnished but did not remove the dust. The Staedtler Mars Plastic vinyl eraser was possibly the most successful of the six and it saved the surface from being exposed to more solvent. Lightly rubbing the surface appeared to compact the powdery lacquer, making it more reflective. In addition, this compaction gave the colored decoration more saturation, thereby highlighting these traces. Dust was pulled from the incised lines and bound with the eraser waste, whereupon it was easily brushed off. The gold appeared considerably brighter after treatment, probably because dirt residues were also picked up by the eraser. No colored material was removed during this process and the effort appeared to compact the lacquer particles rather than remove degraded matter. We felt comfortable enough with this technique to employ it on the matte areas of the chair and considered the results very successful in that the different sections were more integrated and the colored lacquer and gold decorations were visually stronger.

Once the surface luster was attained, the fills

could be inpainted. Acrylic inks proved a good match for the chair's low level of gloss. In places we needed to add fumed silica to the ink to matte down the gloss. The colors were easily mixed from the bottles and gave good coverage when applied by brush to the fills. As Ms Jaeschke noted, the surface was considerably worn and there was color variation across the piece in addition to degrees of gloss. Using one base color for inpainting would therefore leave the fills too obtrusive. We made up stock solutions of base colors from which the gloss and color were manipulated for different areas. Although the tones across the fills were varied to aid in their integration, no attempt was made to recreate decoration.

To protect the chair from light and dust in storage, a Tyvek cover (see fig. 6.36) was sewn to fit it.

#### NOTES

- 1 C. V. Horie, *Materials for Conservation* (London: Butterworths, 1987), 106–109.
- 2 H. F. Jaeschke, "Oriental Lacquer Analysis: Thin-Section and Electron Microprobe," in *Application of Science in the Examination of Works of Art* (Boston: Museum of Fine Arts, 1985), 217–20.
- 3 A sample was taken from the surface of one of the pieces of inlay on the lid rather than from the lacquer surface, to avoid contamination from the lacquer, and was analyzed using FTIR spectroscopy and positively identified as shellac.
- 4 Arnold Mallis, *Handbook of Pest Control*, 7th ed. (Cleveland, Ohio: Franzak and Foster, 1990), 283–85.
- 5 Marianne Webb (*Lacquer: Technology and Conservation* [Oxford: Butterworth-Heinemann, 2000], 33), describes how excessive humidity can cause the top surface to dry too quickly.
- 6 This object is nearly identical in appearance and size to a nineteenth-century Korean inkstone cabi-

net illustrated in S. Kawada and T. Takahashi, *Korai Richo no raden* (Tokyo: Mainichi Shinbunsha, Showa 61, 1986), 124, plate 73.

- 7 R. L. Jaeschke and H. F. Jaeschke, "The Cleaning and Consolidation of Egyptian Encaustic Mummy Portraits," in *Cleaning, Retouching and Coatings* (London: International Institute for Conservation, 1990), 16–18.
- 8 A portion of the red layer was examined by FTIR spectroscopy and the resultant spectrum was identified as a protein. The red sample was then extracted with warm water to separate the protein from any additional material. Calcium carbonate was the only additional material identified. A portion of the sample was analyzed for elemental content by SEM-EDS. The main element identified was calcium, with smaller quantities of aluminum, silicon, phosphorus, sulfur, chlorine, potassium, and iron. The elements suggest a clay and calcium base.
- 9 A portion of the gray layer was examined by FTIR spectroscopy and the resultant spectrum was identified as a protein.
- 10 This layer is clearly visible in cross-section samples using fluorescence microscopy. By means of FTIR spectroscopy of a scraping from the top of a cross-section sample, the layer was identified as shellac.
- 11 The decoration is very similar in design and execution to a chest in the Museum für Lackkunst (accession number AS-K-a-1) illustrated in Monika Koppin, *Museum für Lackkunst. Band I. Ostasiatische Lackkunst Ausgewählte Arbeiten* (Münster: BASF Lacke + Farben AG, 1990), 130–31, and a cabinet sold by Christie's in 2002 (see no. 65 in Christie's London, *Japanese Art and Design*, 19 June 2002, sale 6589, p. 63).



## 6. Case Studies: Sculpture and Helmet

This carved wood sculpture depicts the Bodhisattva Sho Kannon. The figure's right arm is raised at elbow height; it once held a lotus spray in that hand. The left arm is extended downward and slightly forward. The figure is shown wearing a skirt that falls in soft, symmetrical folds, a shawl over the upper back and shoulder, and a scarf draped over the left shoulder and tied across the chest. The hair is gathered in a high topknot and is covered with a simple crown. A circular jewel inlaid on the forehead represents the urna, the so-called third eye of Buddha. The figure stands on a small lotus base. The surface of the figure and base were originally covered with lacquer and gilded.

### *Conservation Record*

The sculpture was accessioned in 1960 as part of the Avery Brundage gift. Brief records in the museum's files indicate that the lacquer was consolidated twice and the proper left foot front was readhered, all with PVA emulsion, in the early 1970s. The statue and pedestal were fumigated with carboxide at that time. In 1989 the smallest finger on the right hand came off and was readhered with animal glue.

FRANK MINNEY WRITES:

### *Condition*

This object (see fig. 7.1) is made of wood decorated with black lacquer and gilding on a doro-

shitaji. It is generally structurally sound but shows signs of a past, slight, wood-borer infestation and the main joint between the halves of the lotus base has opened (see fig. 7.2). Most of the black urushi coating has been lost and the remainder is unstable and flaking in places, especially on the base (see fig. 7.3). The object is dusty and dirty overall. Traces of adhesive on the surface indicate that the statue has been treated previously and differences in the color of these indicate that this was done on more than one occasion.

### *Suggested Treatment*

Before the remaining lacquer coating can be stabilized the statue should be cleaned. The urushi coatings are slightly degraded but would not be adversely affected by cleaning with distilled water. However, the color and hardness of the shitaji or foundation layers indicates that they are not urushi-based but are similar to a conventional gesso and were probably made using a water-soluble glue binder. They are degraded, friable, and absorbent and in this condition could be damaged by water, as could the wooden structure. Water marking is a distinct possibility. Organic solvents could be used, but the possibility of staining the wood remains and the risk of detaching loose material must be considered.

A dry cleaning material that has proved very effective on friable painted surfaces is a filled,

Fig. 7.01. Sho Kannon (B60S420), Japan, Heian period, late 12th century, figure: H. 168 cm; W. 48 cm; D. 40 cm, base: H. 37 cm; diameter: 50 cm.



Fig. 7.2. Lotus base, Sho Kannon (B6oS420), showing the gap that has opened between the halves of the base.

vulcanized latex sponge marketed under the trade name Wishab and available in three grades of hardness. The softest grade would be most suitable for this object. In use a small block with a working surface of about 1 square inch (3 sq. cm) is “walked” across the surface of the object using a rocking motion and moderate pressure. One pass is usually sufficient to remove all loose dirt while leaving even detached flakes in situ.

With the surfaces cleaned the consolidation and stabilization of the shitaji and urushi coatings can be considered. Despite the fact that water can have undesirable effects on degraded gesso-type foundation layers, water-based adhesives, because of their softening action, are the most suitable for treatments. The effects of water can be minimized by consolidating the

shitaji before trying to secure lifted areas. This can be done using an organic solvent-based consolidant, which would not have a softening effect. A suitable material to use for preconsolidation is Paraloid B-72 (ethyl methacrylate copolymer). This is soluble in acetone, toluene, or xylene. When used at a concentration of between 3% and 5%, a single application is usually sufficient. The use of xylene or toluene solutions poses certain health risks and some conservators prefer to use an acetone solution. In either case, health risks should be minimized by the use of fume extraction and, if necessary, respirators.

If the acetone solution is used, it is usually mixed 50 : 50 with IMS (industrial methylated spirit [denatured ethanol]) to retard its drying

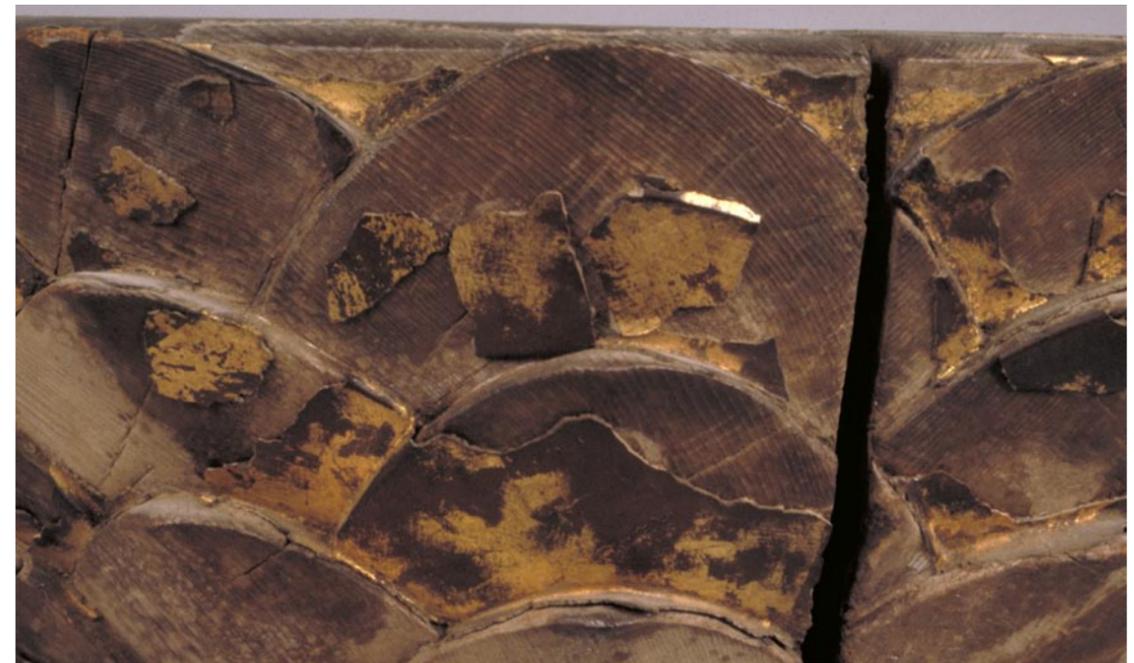


Fig. 7.3. Detail showing lifting and mispositioned lacquer on lotus base, Sho Kannon (B6oS420)

time. Because they believe that the acetone and IMS solution dries unevenly and may cause problems in the future, some conservators prefer to use the xylene or toluene solution, with suitable health and safety precautions. The solution is applied to the shitaji using hypodermic syringes, pipettes, or by capillary action from a small brush. Contamination of the urushi coatings must be avoided and wherever possible the consolidant should be applied under the shitaji layer or to an exposed edge, where it will be absorbed. Any surface contamination should be removed immediately. Conservators usually avoid contaminating the exposed wood with consolidant, but some will make one or two applications of consolidant to the wood surface to seal it against staining by dirt and

dust. This process can have the added advantage of enabling the consolidant to penetrate areas of shitaji that are not detached from the wood. Two applications of 3% B-72 in xylene will not significantly alter the color or luster of the wood surface but such visual changes can be more pronounced with the acetone and IMS solution. The consolidant should be allowed to dry for at least twelve hours with fume extraction maintained until drying is complete. It is not necessary to consolidate the exposed wood on the Sho Kannon.

Once the consolidant has dried, the flaking areas can be stabilized. The choice of adhesive depends on several factors, the most important being the possible effects on the surface coatings and efficiency in securing loose material.

Reversibility is a consideration but it is not realistic to expect that an adhesive or consolidant used to consolidate ground layers or secure decorative coatings will be entirely removable. A degree of reversibility is desirable in that it can be useful to be able to reactivate adhesives should further treatment be required. Also important are the stability of the chosen material over time and its compatibility with the original materials.

Water-based adhesives have proved to be most effective in stabilizing gesso-type foundation layers and their associated decorative coatings. This is partly because the softening effects of water on these layers allow distorted or sprung coatings to be pressed back against the support. Isinglass, glue size, water-based PVA emulsions or dispersions, and fish glue have all been used successfully. The PVAs and fish glue are particularly effective, but the compatibility of the PVAs with the original materials over time is yet to be proved. Water-based adhesives have one major disadvantage when used to treat urushi-coated objects: in certain circumstances—commonly, prolonged exposure to water—they can cause a color change in the urushi layers. The risk is minimized by preconsolidating the foundation layers, as described above. Another precaution is to delay the reattachment of the flaking coatings until most of the water has evaporated but the adhesive still has sufficient tack to re-fix the coating to the support. The length of time required for this varies with the type and condition of the foundation layers and top coating, the size of the area being stabilized, and the water content of the adhesive, but a period of between five and twenty minutes is usually sufficient.

An application of mineral spirits to the surface and area surrounding the flaking surface has been shown to aid the penetration of the ad-

hesive into the interface of the support and the coating interface and reduce the risk of staining exposed surfaces. The flaking areas are pressed back against the support and held in place until the adhesive has set. With doro-shitaji layers, light finger pressure sustained for a few seconds is often sufficient, otherwise the methods described for the Seated Amida (B60S10+) can be applied.

The open joint on the lotus base (see fig. 7.2) seems to be stable but should be sealed to prevent the ingress of dirt and atmospheric contaminants and the effects of environmental fluctuations. Various fillers could be used, but a particularly suitable and easily applied material is a fast-setting microballoon filler made by mixing polycarbonate or glass microballoons with a suitable medium such as an acetone solution of Paraloid B-72 or Mowilith 30 or 50. The precise formulation of the mixture is varied according to the hardness, degree of adhesion, and rate of flow required. For this object, a 15% solution of Mowilith 30 or Paraloid B-72 should be mixed with microballoons in proportions by volume of, approximately, one part medium to three parts microballoons. Powder pigments can be added to the mixture to integrate it visually with the original material. The resultant filler paste can be applied using a spatula but is best done using a hypodermic syringe fitted with a reducing nozzle to suit the dimensions of the area under treatment. When a crack in a hollow structure such as this lotus base is to be treated, the filler is applied at a rate that allows it to set in the crack without flowing through into the void. Because this can be difficult with wide cracks, small areas are treated successively until the entire gap is filled and, when the filler is set, a single thin application is made over the entire infill to present a uniform surface.

JANE WILLIAMS WRITES:

#### *Materials and Methods of Manufacture*

The sculpture was constructed in the yozegi-zukuri technique, from numerous pieces of carved wood. The wood was not analyzed, but the variety most commonly used for sculpture in the late Heian period was hinoki (Japanese cypress). With this technique, several blocks of wood are joined temporarily and the sculpture is roughly shaped. The pieces of wood are then separated and hollowed out, before being reassembled with mugi-urushi as an adhesive. The final carving comes next, followed by the application of surface coatings. This technique made sculptures considerably lighter and helped to reduce the shrinkage cracking that occurs in wood sculpture. There are joins in the following locations: the center of the head, the base of the neck, the center (vertically) of the torso, the shoulders, the wrists, the middle joints of the fingers on the right hand, and the fronts of the feet. There are also added pieces of wood on the sides of the figure, at the hips and lower edges of the garment, and thin sections of wood covering the back of the garment (see fig. 7.4). X-radiographs show the hollowed area of the interior (see figs. 7.5 and 7.6). Two wood pegs, approximately 1 cm in diameter, secure the vertical join in the head. The major joins in the body are currently secured with larger wood pegs, approximately 2.5 cm in diameter. However, these joins also show the broken remains of hand-forged nails or holes surrounded by corrosion. So, unless the current wood pegs replaced original ones at the same locations, the nails were the original hardware used at the joins. Small (2–3 mm) bamboo pegs are visible throughout the surface. These secure, for instance, the thin wood covering the upper back of the torso. A glass or rock crystal jewel is set into a recess in the forehead.

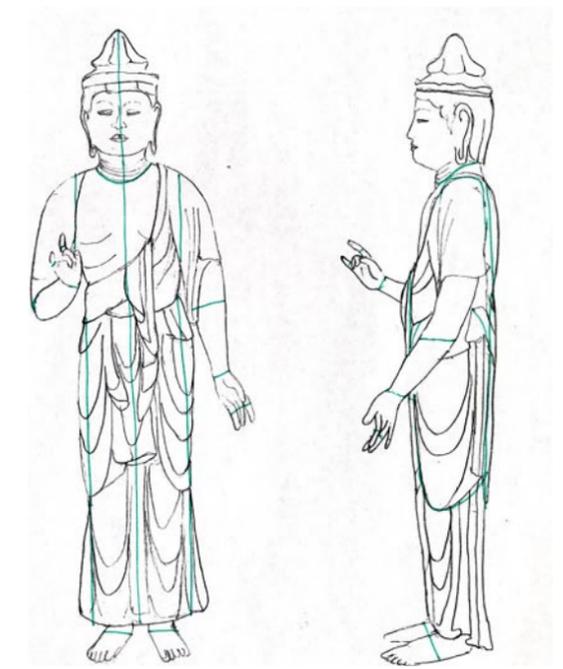


Fig. 7.4. Diagram showing joins in Sho Kannon (B60S420).

There are two circular holes on each side of the crown and numerous smaller nail holes on the top of the head and crown. These holes probably served to secure a metal crown.

There are multiple layers of preparatory grounds, lacquer, and gilding on the sculpture (see fig. 7.7). The lowest (oldest) visible surface layers consist of a pinkish ground identified as mainly kaolin and quartz in a protein binder, covered with a thin dark lacquer and gilding (fig. 7.8). In one area traces of a second thin application of gilded lacquer are visible. Most of what remains on the figure, however, is a later, thick, gray preparatory ground layer, covered with a reddish brown lacquer, and then gilding.

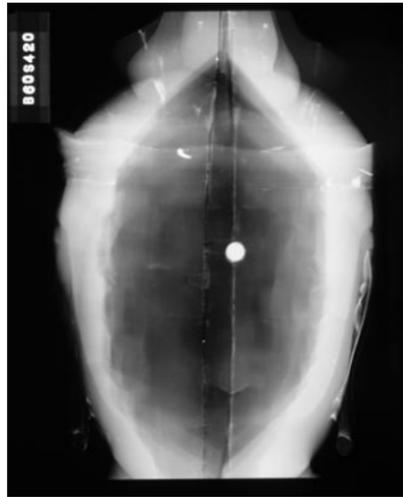


Fig. 7.5. X-radiograph of head, Sho Kannon (B60S420). Technical data (from 1970): Norelco X-ray unit (150 kV max.), Kodak Industrex AA film, 75 kV, 12 mA, 15 seconds, distance from tube, 25 inches.

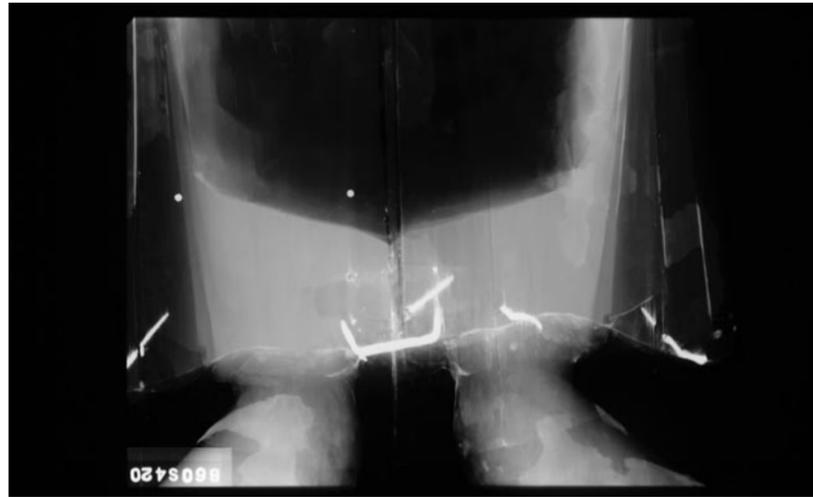


Fig. 7.6. X-radiograph of lower portion of sculpture, Sho Kannon (B60S420). Technical data (from 1970): Norelco X-ray unit (150 kV max.), Kodak Industrex AA film, 75 kV, 12 mA, 15 seconds, distance from tube, 25 inches.

#### Treatment History

The sculpture has had a number of undocumented structural repairs and has been completely disassembled and reassembled for repair at least once, as evidenced by the now-broken forged nails, described above, at joints. It remains a common restoration practice in Japan to take this type of sculpture apart entirely for structural repairs. In the X-radiographs, numerous machined nails of possibly two sizes are also visible. In addition to the recorded repairs, there are repairs to all of the fingers on the proper right hand. What appears to be an emulsion glue and mugi-urushi are visible in different joints on the hand. In addition to the recorded lacquer consolidation with PVA emulsion, there is residue on the surface from consolidation with another shiny, dark adhesive

that is more readily soluble in acetone. Many areas of lacquer on the base became completely detached at some point and were glued to the surface with little concern for their original placement.

At some point, probably in preparation for the art market, areas of the surface were painted black with a leanly bound, charcoal-rich ink or paint covered with a thick coating of shellac. That this was black paint rather than black lacquer was not immediately apparent, but only became clear with a detailed examination. The black coating closely follows the contours of the remaining “islands” of older lacquer, suggesting that it was applied after most of the lacquer had been lost from the surface. In some places it was painted directly on the older pinkish ground layer.

Perhaps at the same time the black coating was applied, the pinkish ground now exposed at the joints was painted to look like wood. The right forearm is a replacement. It is also entirely covered with this faux wood-grain finish (see fig. 7.9) and has a much lower radiodensity than the adjacent wood. In many areas, there is evidence of attempts to remove the later layers (from the thick gray ground layer up) with a sharp tool (see fig. 7.7). It is likely that this proved to be too time-consuming and the uneven patches of remaining gilding and exposed ground layers were instead covered with black paint and wood graining.

#### Condition

The structure is in good condition overall. The join at the proper left wrist shows some movement and should be stabilized. There are old insect tunnels throughout the sculpture. Because none of the tunneling appears recent and because the statue and pedestal were fumigated after acquisition, I am not concerned about current infestation. However, in two places—on the upper back torso and lower back of the garment—the tunneling has undermined the structure so that only a thin skin of wood remains on the surface. There is other insect damage on the figure, but nowhere else has it undermined the surface to this extent. The tangs extending from the feet are very eroded from insect tunneling, rot, and wear, but the wood that remains is reasonably hard and stable.

At the bottom of the garment fold hanging from the proper left shoulder there is one structural loss that appears to have become detached long ago at an original join near the elbow. The sculpture has chipped losses and worn areas throughout the wood surface.

The sculpture currently requires treatment

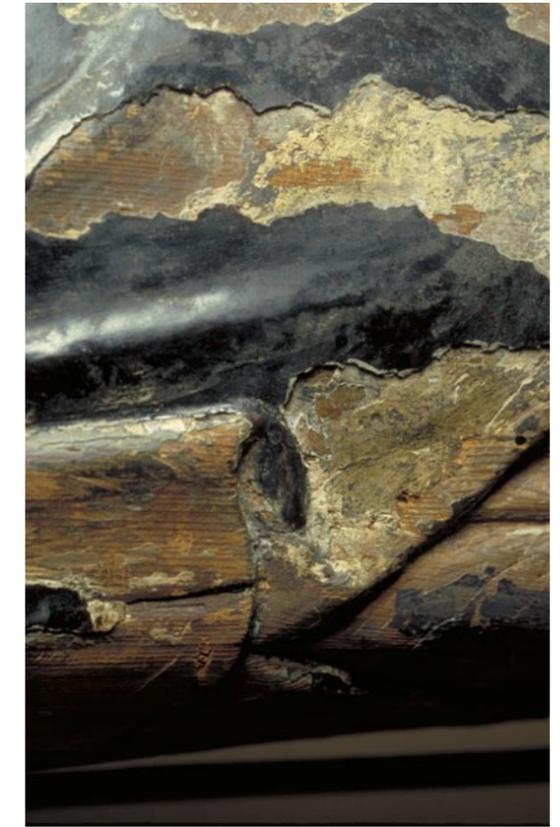


Fig. 7.7. Detail showing layers of lacquer and gilding on right side of Sho Kannon (B60S420); note sharp tool marks around edges of islands of later lacquer coated with black paint.

to stabilize the remaining lacquer surface, which is continuing to lift and flake in numerous places. The worst flaking is on the sides of the torso under the arms. Most of what is visible on the surface are the later layers, from the thick gray ground up to the heavy black paint, and most of even the later layers has been lost from the surface, with only isolated patches remaining. The surface of the sculpture is covered with a moderate layer of dust.

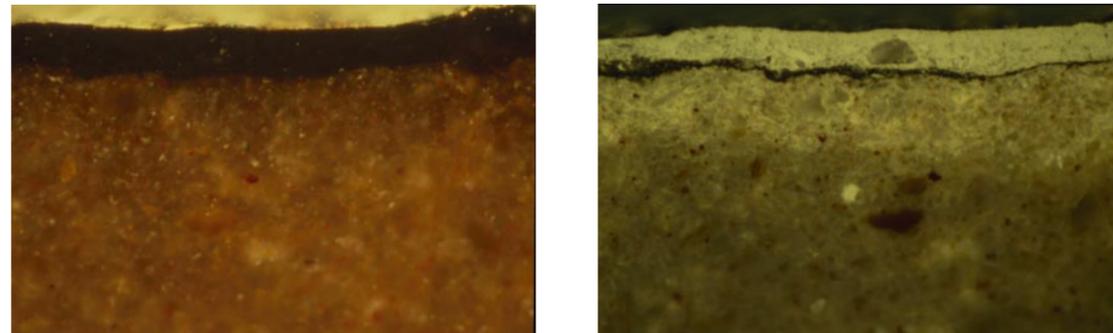


Fig. 7.8 Cross-section sample of surface layers on Sho Kannon (B6oS420) shown in reflected light (left) and ultraviolet light (right); photo taken at 400x magnification.

#### Treatment

The sculpture was first lightly cleaned with a soft brush and a dental vacuum to remove the most superficial dust. It was possible to do this without risk to the exposed gesso. Mr. Minney suggested that distilled water be used to clean the lacquer surfaces and Wishab be used to clean the wood. The discovery that the black coating was paint and not lacquer changed the cleaning requirements. For travel to an exhibition early in this project, the sculpture needed the immediate consolidation of the unstable surface and there was no time to fully analyze the surface layers or to remove the overpaint. Before consolidating the surface layers, I did, however, want to remove as much loose surface dirt as possible. I agree with Mr. Minney that, for exposed gesso and wood, contact with water is undesirable and that cleaning with a sponge is least likely to disrupt friable surfaces. I have tried the Wishab sponge and found that it does remove surface dirt very gently and effectively. I seldom use it though, because of the fine yellow crumbs it produces as it works. It would be very difficult and to remove all traces of this residue, particularly from a surface with as many crevices and cracks as this sculpture has. I cleaned the wood and painted surfaces with a

cross-linked polyvinyl acetate sponge that has a perfectly smooth, very fine-celled surface, much like cosmetic sponges, and that can be walked across damaged surfaces as Mr. Minney described for Wishab. This sponge is rock hard when dry and must be soaked in deionized water to make it soft and flexible. It can then, however, be squeezed and blotted out until it feels no more moist than skin.

The excess PVA emulsion used in a previous repair could be swelled with acetone and carefully picked off the surface with a scalpel where drips of it remained. The staining from thinner applications of this adhesive, where it had penetrated into the wood, proved impossible to remove completely. On some areas of the surface there is another shiny dark adhesive that was much more readily soluble in acetone. Its residue was removed from the surface as much as possible with acetone and swabs.

The solubility of the ground and lacquer layers was tested in water, ethanol, acetone, Stoddard solvent, and xylene. None of the layers was visibly affected by any of these solvents. Because there are multiple lacquer coatings and paint on the surface, I was reluctant to consolidate the lifting areas with anything that would make it

more difficult to separate or remove selected areas if desired at some point in the future. Mr. Minney advised preconsolidating the ground layers with a solvent-based adhesive. I did not believe, however, that I could get the distorted, lifted lacquer to relax and regain contact with the surface without introducing moisture into the ground layers. I wanted to minimize the heat used in applying the consolidant, because the combination of heat and water can lead to color changes in lacquer. For these reasons I chose isinglass, which gels at a much higher temperature, rather than rabbit-skin or hide glue. After the initial warming to dissolve the adhesive, isinglass can be used at nearly room temperature. This quality also makes it somewhat easier than hide glue to work with. As it does not have to be held over heat, isinglass does not evaporate down and change concentration as quickly as hide glue solutions do. Another possible choice for a consolidant would be a cold fish glue, such as Lee Valley High Tack Fish Glue, which has been successfully used by conservators for that purpose. I have not used it, but colleagues have reported favorably on its strength, relative flexibility, and working characteristics. I did not choose to use it here because I cast out sheets of it, as well as of isinglass, hide glue, and gelatin. After leaving the sheets to dry thoroughly on silicon-coated polyester film for a couple of weeks, I compared their brittleness and found the fish glue to be the most brittle of the group. Fish glue is sold in solution and contains preservatives and other additives to maintain it in liquid form without deteriorating. It could be that the fish glue I used had exceeded its shelf life (it had been purchased two years earlier, but there is no way to know exactly when it was manufactured).

I used 5% isinglass in deionized water to preconsolidate the ground. Following Mr. Minney's advice, I flowed a nonpolar solvent (Stoddard solvent) under the lifting lacquer first and also brushed it on the adjacent exposed wood, then introduced the consolidant with a small brush. This prewetting



Fig. 7.9. Replacement forearm on Sho Kannon (B6oS420).

process seemed to improve the flow of the consolidant under the flakes, perhaps by discouraging the absorption of the consolidant into the first porous wood or ground it encountered and encouraging the consolidant to travel farther into the gap by capillary action. Prewetting the surrounding wood was very effective also in preventing discoloration of the wood by the consolidant solution. Once the solvent had evaporated, no tide line was left on the exposed wood or ground layers. After twenty-four hours of drying time, a 12% solution of isinglass was flowed in with a brush to readhere the lifting lacquer. Again following Mr. Minney's

suggestion, I waited between five and ten minutes after applying the consolidant to clamp the area. Because the sculpture was treated while it was upright, weights or heavy clamps were impractical, so the pressure was exerted with wide latex bands and pads of polyethylene foam or with light carbon-rod clamps. In the tight spaces under the arms the lacquer was held in place by lining the area with Mylar and then polyethylene wedges and strips of cotton blotter were inserted gently to put pressure on the lacquer.

The shitaji layers on the base were thicker and did not respond as well to consolidation with isinglass. Even with repeated consolidation, the first areas to be consolidated lifted again a day or two later. For this reason hide glue was used as the consolidant there. Being stronger, it secured the lacquer successfully in the first application. The lacquer on the base that was clearly positioned incorrectly was not consolidated, so that it can more easily be removed and repositioned if there is time at a later date.

In a few locations on the base the wood had shrunk or moved too much for the lacquer to lie flat again. In these places a very lightweight fill of 15% Acryloid B-48N in acetone, with glass microballoons and dry pigments was inserted between the lacquer and wood to protect the lifted edge of the lacquer and to provide that layer with support. I chose Acryloid B-48N as the binder for this mixture because, in my experience, it is more flexible and stronger than B-72 or the PVA resins are. The same mixture was injected into the hollow areas of insect damage on the back of the figure, where the thin skin of wood left in those areas seemed particularly vulnerable to being crushed.

The join at the left wrist was stabilized by injecting 35-40% B-72 in acetone, to which a small amount of fumed silica was added to reduce shrinkage. Hide glue was not used, because it is less effective in joins like this one that are

not tight. Also, because the area is difficult to clamp (I used rubber straps) I wanted an adhesive in a quickly evaporating solvent, so that it would set up quickly. I did not fill the gap in the base as Mr. Minney had recommended. The lacquer surrounding it is stable and supported. As the gap has opened at a join, and so is not a true crack, it is still supported by joining hardware and is not causing any new splitting in the wood. It seemed likely that there would be movement along this join during the sculpture's travel and move, so I decided to leave it for the time being. Were I to fill it, I would probably use something flexible and easily removed, such as pieces of soft polyethylene foam. The foam could be covered with a thin fill of a bulked acrylic resin to blend it visually with the surrounding surface.

Nearly four years after this object was treated, it remains in stable condition despite having been part of a traveling exhibition and being moved to a new museum. After the move, I conducted tests of removing the black paint with solvents. While the paint is not harming the sculpture, it continues to confuse the interpretation of the original surface appearance. In the tests removing the thick shellac coating over the paint was difficult, even with n-methyl 2-pyrrolidinone or 1:1 ethanol : acetone. Also the tests exposed very little gilding remaining on the islands of restoration lacquer, so one would exchange black patches for dark red-brown (lacquer) patches – not a significant visual improvement. What appeared to be more promising would be to mechanically remove the restoration lacquer and its thick gray ground (taking the black paint with them) to reveal the thin, earlier gilded lacquer layer. The gilding is better adhered to the lacquer on the earlier layer and this layer appears to survive under most of the islands of restoration lacquer. Also, as described above, the unstable surface layers on the sculpture have generally been the restoration lacquer and ground, so it might be better to remove the later

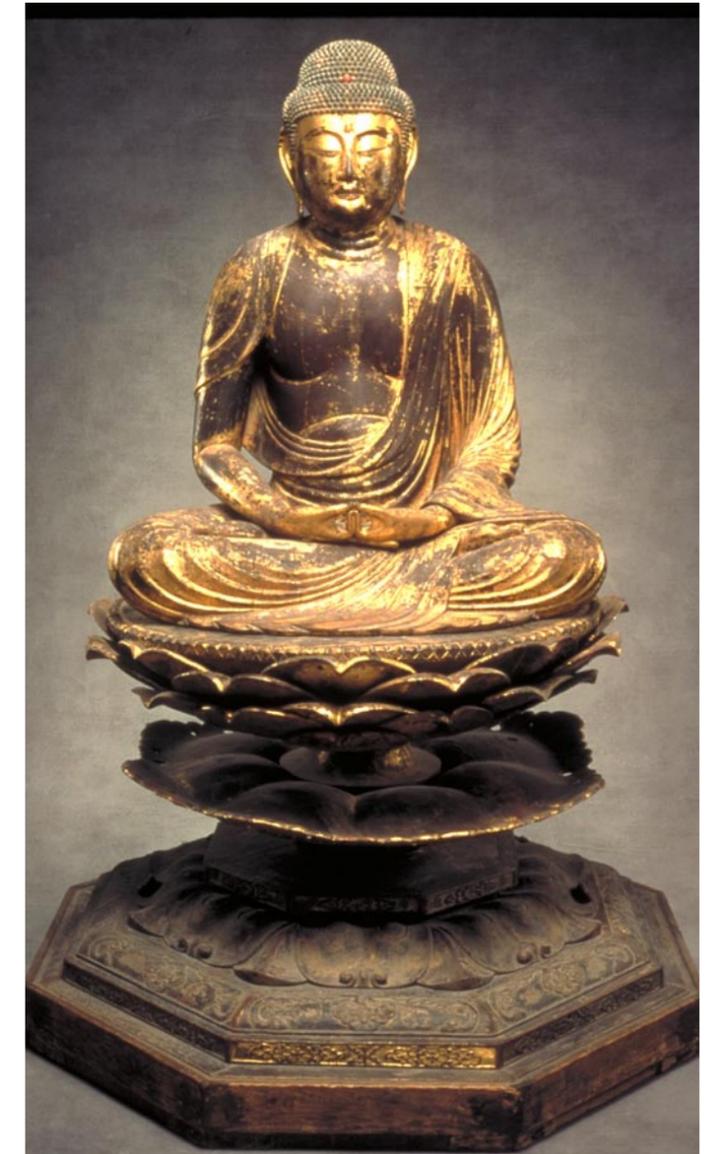
layers rather than to continue to spend the time consolidating them. The relatively soft, thick, restoration ground provides a good interface for removing the restoration lacquer mechanically without damaging the thin earlier gilding. The removal process would be time-consuming (as noted, whoever started to do it in the past gave up) and there was not enough time in this project to undertake it.

While the light levels on the figure are maintained at 50 lux or lower, this sculpture will remain on permanent display without cover. An effort is being made to keep its surface dusted regularly.

**S**eated Amida (B60S10+), Japan, late Heian period, 12th century, figure: H: 91 cm; W: 76 cm; D: 55 cm, base: H: 66 cm; W: 105 cm; D: 105 cm. This wood sculpture depicts Amida, the Lord of the Western Paradise, seated in deep concentration with half-closed eyes and hands held in the gesture of meditation (fig. 7.10). A robe covers the shoulders and back of the figure, draping over the left arm to cover the lower body and legs. The hair is represented with small, carved cone shapes and is painted blue. The inset urna and lips are painted red. He is seated on a traditional seven-tiered lotus pedestal. The tiers, starting from the top, include the lotus (renge), column (soku), floral plate (keban), flattened eggplant shape (shikinasu), support board (ukeza), everted petals (kaeribana), and platform (kamachi). The lowest three tiers are more ornately carved and are thought to date from a later period. The surface of the sculpture and base are covered with lacquer and gilded.

#### *Conservation Record*

The sculpture was accessioned in 1960 as part of the Avery Brundage gift. Records of treatment begin in 1969. At that time, flaking areas on the surface were readhered and losses were injected



*Fig. 7.10. Amida sculpture (B60S10+), after treatment.*

with polyvinyl acetate emulsion. The report did not specify where repairs were undertaken. The file for this object is thick with repeated concern about flaking surfaces since that time and there



Fig. 7.11. *Amida sculpture (B6oS10+)*, detail showing cracked and lifting surface layers on right side.

have been numerous, briefly documented consolidation treatments of flaking lacquer with animal glue and with gelatin. In the early 1980s the conservation department established that the sculpture had been displayed in the museum for extended periods under conditions of excessive light. More recently the light levels have been lowered to 50 lux, with the ultraviolet portion of the light filtered out, and are monitored carefully. The sculpture has remained on display, however, without the protection of a vitrine.

The report for a 1997 treatment by Tracy Pow-

er documents in detail the repairs done and the decisions made at that time. Constrained by time, this treatment was directed at stabilization of the sculpture for a travelling exhibition. A detached petal on the renga was readhered with concentrated hide glue. Losses along the join were filled with a pigmented animal glue and whiting gesso. Lifting lacquer was consolidated with animal glue diluted in water. When needed, a tacking iron was used to reactivate old PVA emulsion adhesives and also to relax the lacquer so that it would conform to the surface again. An animal glue and whiting gesso was used for the fills so that the repair materials would be compatible with one another and all materials and techniques would be reversible. To save time, some surfacing of the fills was done with a softer vinyl spackle bulked with microballoons and tinted with acrylic emulsion paints. Exposed areas of ground that were stable and not significantly below the level of the surrounding lacquer were not covered with fill, but were toned instead with watercolors.

#### FRANK MINNEY WRITES:

The sculpture was constructed from carved wood coated with urushi-shitaji and decorated with urushi coatings and gilding. This Buddha image was constructed using the yozegi-zukuri technique and the plinth is made up of seven separate main elements, each constructed from three or more parts.

#### *Condition*

This object is structurally sound but dirty overall and the urushi and shitaji layers are flaking in several areas (see figs. 7.11 and 7.12).

#### *Suggested Treatment*

Cleaning and flake laying could be executed using similar materials and techniques as for the

statue of Sho Kannon (B6oS420) but, since the shitaji layers on this object are urushi based, they should be consolidated by kijigatame (hardening the ground). In this process urushi resin, sometimes diluted with ligroin (petroleum ether), is applied to areas of damaged shitaji to harden and consolidate them much in the same way as Western conservators would use a material such as Paraloid B-72. Contamination of the surface coatings should be avoided and any that occurs should be removed immediately, using cotton wool swabs moistened with ligroin. Following the application of urushi to the damaged areas, detached or loose layers are pressed back against the support and held in place using suitable clamping devices to hold pressure pads against the damaged area. The pads are made by covering the treated area with a thin layer of Melinex (polyester film, to prevent the pad from adhering to the surface), followed by a piece of thin Plastazote (polyethylene foam, to spread the pressure and conform to minor irregularities), and placing a piece of Perspex (clear acrylic sheet) on top. If the area under treatment is flat, the Perspex sheet should be thick enough to stay straight when clamped; if the surface is curved, the sheet should be able to bend and conform more or less to the curvature of the object. The pads are pressed into place using suitable clamping devices, a process that will cause excess urushi to be squeezed out onto the surface. This excess must be cleaned off immediately, so the clamps should be released, excess urushi removed on cotton wool swabs moistened with ligroin, the Melinex sheet replaced, and the area clamped again. The object should then be placed in a furo (a wooden humidity chamber) or other enclosure, where the humidity can be maintained at about 70% for about seven days.

Kijigatame will sometimes secure flaking areas, but it will usually be necessary to use an ad-



Fig. 7.12. *Amida sculpture (B6oS10+)*, detail showing splits in wood and cracked and lifting surface layers on a lotus petal on the base, before treatment.

hesive to complete this process. Japanese conservators use a mixture of rice or wheat flour paste and ki-urushi (raw urushi) known as nori-urushi or mugi-urushi, for this process but water-based PVA or fish glue are equally effective. Whichever system is used, the adhesive is applied under the flakes using a small brush, a hypodermic syringe, or a pipette, the clamping procedure described above is used to press the flakes back into contact with the support, and the adhesive is allowed to dry. For PVA or fish glue, a drying period of between twelve and twenty-four hours should suffice. If mugi-urushi or nori-urushi are used, this period extends to between seven and fourteen days. Once the flaking areas have been secured, the object could, if necessary, be further cleaned with distilled water on cotton wool swabs. Special care should be exercised over the gilt areas as the gilding on this type of figure can be very fragile. It may be perfectly hard and secure in some places and very susceptible to easy removal in others. Where pressure cannot be applied using clamps or wedges, the Japanese shinbari is both versatile and effective. Pressure

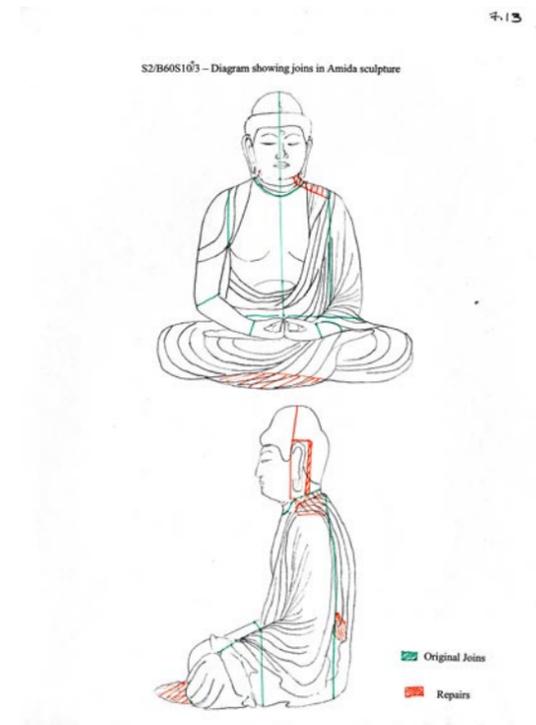


Fig. 7.13. Diagram showing joints in Amida sculpture (B60S10+).

is applied using wooden rods and pressure pads. Rods with different degrees of flexibility, diameter, and length provide a range of pressures to suit the requirements of the object.

JANE WILLIAMS WRITES:

*Materials and Methods of Manufacture*

The figure was produced using the yosegi-zukuri technique as described for the Sho Kannon sculpture (B60S420). The wood was identified as Japanese larch (*Larix kaempferi*). The figure

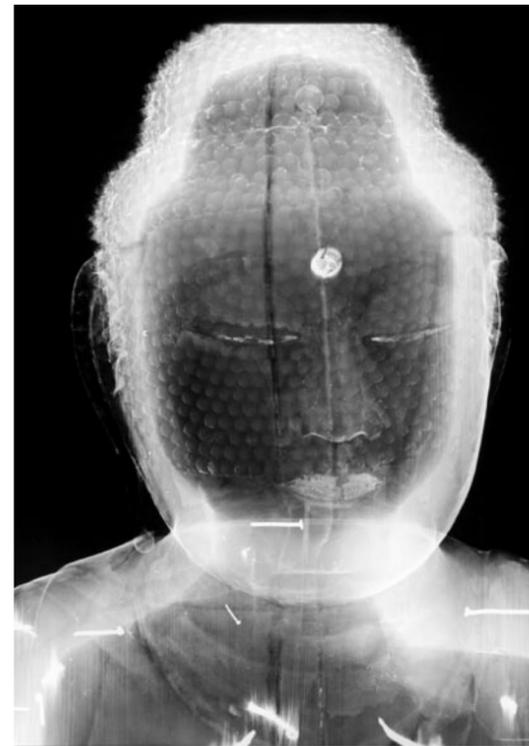


Fig. 7.14. Amida sculpture (B60S10+), X-radiograph of head. Technical data: Gulmay X-ray unit (320 kV max.), Kodak Industrex AA film, 35 kV, 5 mA, 60 seconds, distance from tube, 36 inches.

originally had joints down the center of the head and body, through the neck, shoulders, elbows, hips and wrists (see fig. 7.13)

In X-radiographs, it is possible to see that both bamboo or wood dowels and hand-forged, now heavily corroded, nails were used to secure most of the joints in the body (see figs. 7.14 and 7.15). It is not known which hardware was used in the original construction and which dates to a previous restoration. Coarse plain-weave textile strips at one time reinforced all of the joints on the interior of the sculpture, except the joint through the



Fig. 7.15. Amida sculpture (B60S10+), X-radiograph of front of torso. Technical data: Gulmay X-ray unit (320 kV max.), Kodak Industrex AA film, 25 kV, 5 mA, 60 seconds, distance from tube, 36 inches.

center of the head. The textile was applied with a natural adhesive, perhaps starch based, that was particularly appealing to insects. Where the textile was applied to the interior, the wood surface is very specifically and very extensively damaged by insects (see fig. 7.16). The exterior was covered entirely with a layer of loose (10 threads per cm), plain-weave textile. Cross-section samples of the layers covering the textile from various locations on the figure were compared. Unlike the Sho Kannon (B60S420), on this sculpture only one scheme of surface decoration was found



Fig. 7.16. Amida sculpture (B60S10+), interior of upper torso.

(fig. 7.17 shows a representative cross-section). A beige ground was applied in two applications and was covered with multiple coats of unpigmented lacquer (2–4 lacquer layers could be identified in the samples from different areas). The uppermost lacquer layer served as the adhesive layer for the gilding. These layers are not found on the carved hair curls, which were instead coated with azurite.

The base was not X-radiographed. The individual tiers are threaded onto a central wooden pole. The petals on the lotus (renge) are carved

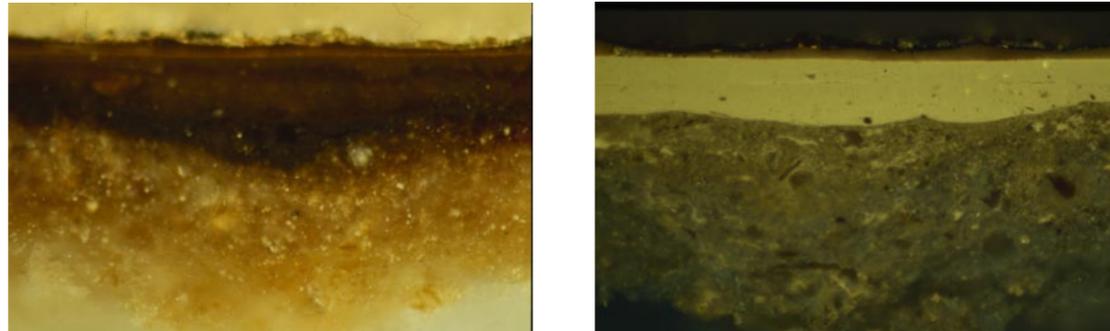


Fig. 7.17. Amida sculpture (B60S10+), cross-section sample of surface layers shown in reflected light (left) and ultraviolet light (right); photo taken at 400x magnification.

from separate pieces of wood and are nailed in place. There is no textile layer between the wood and the ground layers on the base.

#### *Treatment History*

In addition to the treatments documented in the museum's records, examination of the sculpture shows that it was completely disassembled at least once for restoration. The textile strips and the older, corroded, hand-forged iron nails have been split along all of the joins. Some dowels are now missing; the extant ones may have been added or replaced in the most recent reconstruction of the sculpture.

Probably in the twentieth century and most likely in Japan the sculpture was taken apart and reassembled, with wire nails (almost all visible in only X-radiographs) and a coarse paste that looks like kokuso used as an adhesive and filler (see fig. 7.16).

On the interior the kokuso on the joins also covers a relatively recent repair to the left shoulder. There are some small holes from wood-boring insects on same left cheek and left side of the neck, which suggest that insect damage may have necessitated the repairs to the shoul-

der. The shoulder was reconstructed from a clumsy assemblage of blocks (see fig. 7.16), two of which are held together by a wire nail. The blocks are glued together with what appears to be an emulsion-based wood glue: in visible light it is a semiopaque tan color and in UV light it fluoresces a hazy whitish color. In order to fit the replacement wood into the shoulder, the restorers apparently made many adjustments to the head and neck. Thin wedges of the same replacement wood were fitted in between original blocks on the other side of the neck. The two original halves of the head were split in half vertically along the axis of the ears, then the ears were sawn out on roughly rectangular sections and fitted back in with clumsy wedges (see figs. 7.18 and 7.19). The current joins in the head were secured with a dark resin, rather than the kokuso found elsewhere. It is only clear that all the pieces of the head are original to the head because the wood grain continues across the side joins and the ears. The head appears to be original to the body because the join between the two is reinforced with the same insect-damaged textile found on the rest of the original joins.

When the sculpture was taken apart and reas-

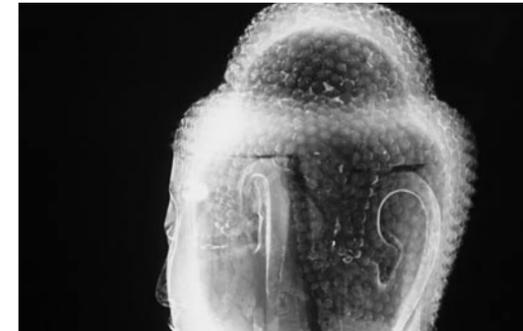


Fig. 7.18. Amida sculpture (B60S10+), X-radiograph of head, side view. Technical data: Gulmay X-ray unit (320 kV max.), Kodak Industrex AA film, 35 kV, 5 mA, 60 seconds, distance from tube, 36 inches.

sembled, it was not relacquered overall. Instead, losses to the lacquer and gilding along the joins were covered with smooth fill and surfaced with what appears to be lacquer and gold powder, rather than gold leaf. Replacement parts that have this same finish are the tip of the cloth hanging down the back and the flat extension of drapery at the front. Restoration hair curls were inserted to camouflage the repairs to the head. The gold leaf on some areas of the surface, such as the inner arms and the forehead (see fig. 7.20) appears more recently and haphazardly applied. It is bubbled and not firmly attached to the surface. In some places the gilding has been scraped off to reveal the dark lacquer below (see fig. 7.11). The lacquer may have been quickly and selectively gilded or regilded and then distressed to make it look like an aged gilded surface. No gilding remains on the figure's cheeks; they were painted with bronze powder paint at some point to integrate them better with the surrounded gilding.

#### *Condition*

The sculpture currently requires treatment to stabilize the lacquer surface, which is continu-



Fig. 7.19. Amida sculpture (B60S10+), X-radiograph of right ear. Technical data: Gulmay X-ray unit (320 kV max.), Kodak Industrex AA film, 25 kV, 5 mA, 60 seconds, distance from tube, 36 inches.

ing to lift and flake in numerous places. In 1997 treatment focused on the sculpture itself. Currently the most actively flaking gilded lacquer is found on the older, upper four tiers of the base. On these tiers, the gilding and lacquer generally remain well adhered to the shitaji, which is thick and appears to be well bound. These layers are separating from the wood in large sections at the interface of the shitaji and the wood. The worst flaking is on the petals of the lotus (rengé), where large areas of lacquer are curling and pulling away from the wood. Some damage has occurred to the floral plate (keban), where lacquer covers a convex surface and shrinkage of the wood has left a shell of unsupported lacquer that has been cracked and crushed at some point. There is another area of damaged lacquer on the floral plate, where the underlying wood shrank and split open, causing the lacquer to split and become unsupported over the wide crack (see fig. 7.12).

The flaking on the figure is less severe. The areas consolidated in 1997 remain stable. However, the figure is covered overall with a dense network of fine cracks that make it vulnerable to continued flaking and loss. Throughout the



Fig. 7.20 *Amida sculpture (B6oS10+)*, detail of forehead showing bubbled gold leaf.

figure there are isolated areas or flakes that are lifting along the edges. In most of these areas, unlike the base, the lacquer is separating from the ground, which remains adhered to the wood. On the back of the right shoulder is an area where the lacquer is stable, but the underlying ground feels spongy under light pressure.

The figure's structure remains in the condition described in the 1997 reports and is currently stable. While there are old holes from wood-boring insects in various locations, there is no evidence of recent insect damage. Most of the insect holes on the figure predate the last major restoration of the sculpture (see Treatment History above). The surface of the sculpture currently has a moderate layer of loose dust and grime.

#### *Treatment*

The surface was first cleaned with a soft brush and a vacuum and then cleaned with a cross-

Fig. 7.21. *Amida sculpture (B6oS10+)*, detail showing splits in wood and cracked and lifting surface layers on a lotus petal on the base, after treatment.

linked polyvinyl acetate sponge as described for B6oS420. Further cleaning, including removing or reducing the wax on the surface, could not be done prior to surface consolidation. The only structural repairs on the sculpture required gap filling rather than joining. The open split in a petal of the lotus base (this split is visible before and after treatment in the left side of figs. 7.12 and 7.21) was filled with a mixture of 25% Acryloid B-48N in acetone mixed with 1 : 1 glass microballoons : Whatman CF-11 cellulose powder. Because this split is misaligned, I wanted a fill with enough adhesive strength to hold the wood in better alignment. But, because realigning the wood places the fill and wood under some stress, I wanted a fill that would be weak enough to give way itself before causing a new split in the wood. Among some of the more commonly used synthetic resins that are thought to remain stable and soluble for the long term, B-48N was chosen, rather than B-72 or a PVA resin, for its

relatively greater strength and flexibility. The mixture of glass microballoons and cellulose powder was used because the microballoons give the mixture lightness and dimensional stability, while the fibrous cellulose powder adds toughness and decreases brittleness. The hollow space between the lacquer shell and convex wood surface on the top of the floral plate was filled with the same mixture.

The two wide-open splits bridged by unsupported lacquer, one in the same lotus petal just described (see figs. 7.12 and 7.21) and the other in the underside of the floral, bridged by unsupported lacquer were filled with a weak mixture of cellulose powder with just enough methyl cellulose to hold it together. The splits are not posing a risk of greater structural damage, but cannot be closed and will probably continue to move, so I was looking for a weak, compressible material to fill the gaps and support the lacquer surface. If there were greater access to the gaps, I might use a piece of soft, polyethylene foam. However, since the lacquer largely covered the gaps, I needed a fill mixture I could insert through the open cracks in the lacquer. The lacquer and ground layers on the figure and base were found to be unaffected by water, ethanol, acetone, Stoddard solvent, and xylene. Lifting lacquer on the base and figure was consolidated with hide glue. The unstable lacquer was distorted and my preference was to use moisture rather than heat to relax the lacquer layers. Hide glue was chosen because it had been used before and the specific areas known to have been consolidated with it (those documented in 1997) have remained stable. PVA emulsion had been used as well, but some of the areas where it appears to have been used had released again before the 1997 treatment and were released now. Because the lacquer on the figure was likely to continue to be a problem, I also felt that hide glue provided more options for future



Fig. 7.22. *Lotus base of Amida sculpture (B6oS10+)* during treatment, showing clamps and wood dowels used to apply pressure during surface consolidation

retreatment. PVA emulsions, particularly when applied thickly as they have been on this sculpture, create a somewhat sealed surface, resistant to penetration or dissolution by a range of solvents. The ground in the area with lifting lacquer was preconsolidated with dilute hide glue with a few drops of alcohol. After about twenty-four hours the lacquer was set down with more concentrated hide glue. On the base I used a combination of small clamps and wood dowels set up on the same principle as shinbari (see fig. 7.22). At the time I did not have a better range of wood dowels or bamboo sticks of various thicknesses for applying pressure and nor did I have the space or time to construct a framework that could accommodate the sculpture or base and apply pressure in three dimensions. However, even with my rudimentary setup, the wood dowels were very useful for applying pressure to the surface. On the few spots of thin, lifting lacquer that I consolidated on the figure itself, I was able to use finger clamp-

ing, as Mr. Minney suggested for the treatment of B6oS420, until the adhesive had gelled.

Like the previous attempts, the current treatment of the surface of this sculpture addressed only the most actively flaking lacquer, an approach that was necessitated by a lack of time for more extensive consolidation or cleaning of the surface, but it was successful in preventing surface loss when the sculpture traveled and when it was moved to the new museum. Also, I treated the most active flaking locally because I wanted to analyze the existing surface layers before beginning a more extensive treatment. However, this Bando approach is not a satisfactory long-term solution. Without further treatment and a different approach, the flaking and deterioration of the surface, particularly on the figure with its fine network of cracks on a macroscopic and microscopic scale, will continue.

I agree with Mr. Minney that the surface layers need more extensive consolidation, as he described for the kijigatame process. A very dilute adhesive should be flowed into cracks and losses. The chosen solvent needs to allow optimal penetration of the adhesive into the ground layers to consolidate them well and evenly. The choice of adhesive is still problematic. Dilute urushi, as recommended by Mr. Minney may well be the best material. It is known to be effective, durable, and compatible with urushi and urushi-based grounds. Its water content helps to relax distortions in the aged lacquer and ground. It can be diluted in hydrocarbon solvents that facilitate good penetration of the resin. It is insoluble once it has hardened but, if it is carefully and thoroughly removed from the lacquer surface, this may not be important. No dilute consolidant applied to a porous substrate under a lacquer coating will be removable, even if it does remain soluble.

Even so, urushi would not be my first choice for a variety of reasons, beginning with my lack

of experience with it. Working with urushi in this sort of application may not, in practice, differ greatly from working with any dilute consolidant. However, I am so used to working with resins that remain soluble when dry that I hesitate to use an insoluble material that is not in my usual repertoire. A large humidity chamber would need to be set up in the lab (there is currently no furo of any size) or tests would need to be carried out to ensure that the urushi would dry properly in the ambient conditions of the lab. If a furo were used I would have concerns about the effect of the elevated humidity on the complex structure of the sculpture. Other practical challenges would include setting up a dust-free working space, and obtaining the appropriate grade of urushi from Japan.

If I were to decide that it is not to practical or possible to use urushi here, my first choice would likely be B-72 or B-48N in xylene or B-67 in Stoddard solvent. If none of these were effective in tests I would consider an acrylic dispersion such as Rhoplex AC-234. However, an aqueous adhesive is less desirable for general consolidation than for localized consolidation because more water is introduced into the substrate and the water would have more direct contact with the exposed lacquer surface, both in application and cleanup. For this reason in part, although protein glue is appropriate for relaxing and resetting lacquer flakes, I would probably not choose it for this application. Protein glue does remain soluble (albeit in water, which may not always make it a safe solvent for the aged lacquer surface), but it can be expected to become increasingly brittle and weak as it ages. In museum conditions protein glues should add strength to a weakened substrate for years to come, yet I think of them as providing a shorter term solution than would urushi-based adhesives or conservation-grade acrylic resins.

More extensive consolidation of the surface would allow a more thorough cleaning of the sur-

face. In the cleanup of the excess consolidant, a solvent could be used that will also reduce the wax residue on the surface. After further consolidation, the existing fills, which are stable, could be reshaped and toned to be integrated more closely with the surrounding gilded lacquer. Currently, in the new museum, the sculpture remains on permanent display with light levels below 50 lux. It is uncovered and will require regular cleaning to ensure that dust does not accumulate on the surface. □

**H**elmet and half-face mask (B87M22 a,b,c), Japan, Edo period, 18th–mid-19th century, helmet: H. 45 cm, W. 33 cm, D. 25 cm, mask: H. 15 cm; W. 17.8 cm; D. 14.5 cm. throat guard: H. 9 cm; W. 18 cm; D. 2 cm. This type of Japanese helmet (see figs. 7.23 and 7.24), made between the sixteenth and the mid-nineteenth centuries, is called a kawari kabuto, literally, a “different helmet” because its three-dimensional form differs from the bowl shape of the standard helmet. Fig. 7.25 is a diagram labeling the many components of the helmet and its associated face mask with their Japanese names. This lacquered helmet has a two-lobed, laminated-paper (hara-kake) superstructure rising from the top back of the helmet’s iron bowl (hachi) and raised brow ridges on the front. What this shape represents has not yet been identified. The front of the helmet and the outside of the six-tiered iron neck guard (shikoro) are covered with nashiji decoration. The back of the helmet is red and the inside of the neck guard is black. The helmet has a small rectangular iron spring clip in the center front for attaching a front crest (maedate). On the back it also has a V-shaped iron attachment with a spring clip on each prong for securing back crests (ushirodate). The helmet has holes all around its lower edge for the stitching that secures the textile cap lining (ukebari), and for additional attachments



Fig. 7.23. Helmet (B87M22), after treatment.

that are now missing - the four pins (hachi-tsuke-byo) that attached the neck guard and the three loops (shinobi-ne-o) for the tying cord (shinobi-no-o). The neck guard has sugake odoshi, a style of relatively widely spaced lacing. The patterned front-edge braids (mimi-ito) are dark blue, turquoise, green and white and the rest of the laces are turquoise. The cap lining and its leather edge are also turquoise.

This helmet is exhibited with a lacquered iron face armor (fig. 7.26) or men gu, a mask of a particular type, called ressei men, that covers the face below the eyes and has an aggressive expression, wrinkles, teeth, and whiskers. The donor did not purchase this helmet and face mask together, but he believes they date from the same time period. The exterior of the iron mask



Fig. 7.24. Helmet (B87M22a), after treatment; reverse.

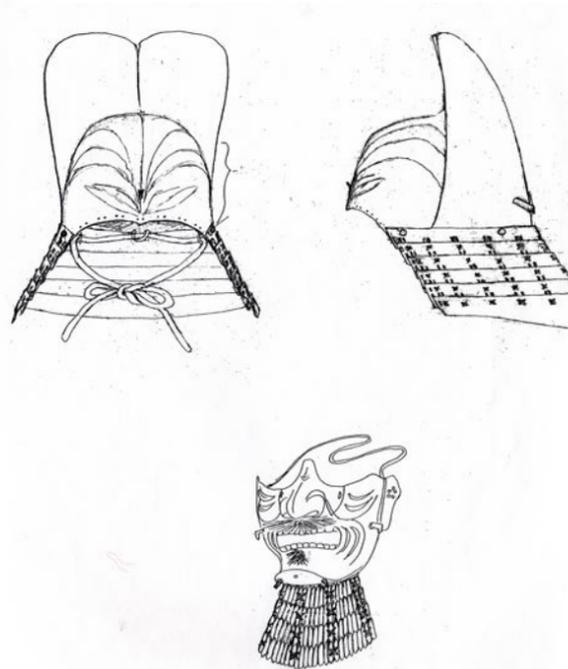


Fig. 7.25. Diagram of helmet showing Japanese terminology for parts.

is coated with red lacquer and the interior with brown black lacquer. The nose is a separate piece of iron secured with pins that allow its removal. The mask has a hair mustache and tuft of hair on the chin. The teeth are made from a lacquered and gilded oval band of copper alloy metal. The mask has two projecting studs riveted to sides of the chin for fastening to the helmet. It has a hole in the bottom of the chin for drainage and the ears are each pierced with five small holes. The mask has a pair of holes on either side of the top edge for tying it on and holes all along

the bottom edge for lacing on the throat guard (yodare kake). The throat guard consists of four iron lames (plates), cast with ridges on the front to look like scales and coated with brown black lacquer. It is not original to this face mask. The row of closely spaced holes along the bottom of the mask are for kebiki odoshi, a tightly spaced lacing that covers much of the surface, whereas this throat guard has widely-spaced lacing (sugake odoshi) with dark blue silk. The curve of the bottom edge of the mask also does not match that of the top lame of the throat guard.



Fig. 7.26. Face mask and throat guard (B87M22b,c), after treatment; note the discrepancy between the lacing holes of these two unrelated elements.

#### Conservation Record

The helmet was donated to the museum in 1987 by a private collector. No record exists of the helmet's treatment prior to or subsequent to being accessioned.

#### FRANK MINNEY WRITES:

#### Condition

The lacquer layers are detached overall, cracked, and lifting (see fig. 7.27). Significant areas have been lost. The urushi layers on the

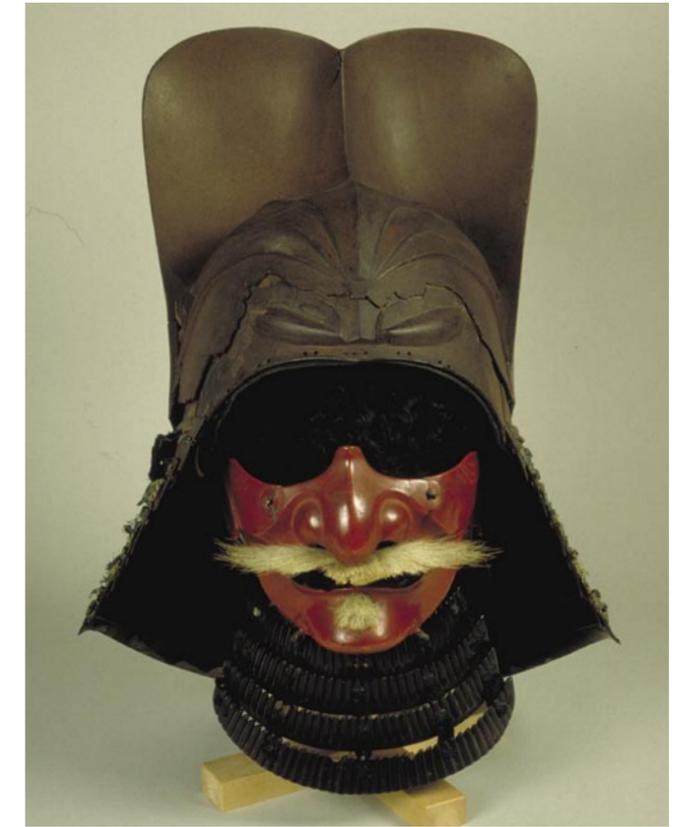


Fig. 7.27 Helmet and half-face mask (B87M22a,b), before treatment.

helmet have been coated or recoated with an alcohol-soluble varnish that has degraded to a dull and dusty aspect obscuring the original nashiji. A small area was tested and found to be fairly readily soluble in ethanol and demonstrated other characteristics of shellac. It is possible that at some time after the object was acquired by a Western collector, the original finish was considered to have lost its luster and an attempt was made to revive it with a coating of shellac or a similar spirit varnish. This coating has subsequently degraded to the surface



Fig. 7.28. *Helmet (B87M22a)*, detail of lower right side, showing lifting surface layers due to separation between laminated paper structure and the iron helmet bowl.

seen today. The exposed iron portions of the helmet are lightly rusted but this does not appear to be active.

The lobed superstructure appears to be constructed of laminated paper (*harikake*) covered with a thin *doro-shitaji* resembling gesso and decorated with a glossy *shu-urushi* on the verso and with coatings matching the helmet bowl (*hachi*) on the recto. This is dirty overall but some of the apparent dirt may be an applied coating

intended to simulate aging. The superstructure displays several more-or-less horizontal cracks on the verso that, though they penetrated the *shitaji* layer, appear stable. More serious instability and losses have occurred where the laminated paper of the superstructure joins the iron of the helmet bowl, especially on the back. Here the superstructure has become detached, particularly at the proper right side, where the structure has suffered some losses and sprung away from the iron surface (see fig. 7.28).

The six-lamellae neck guard (*shikoro*) is finished to match the helmet and presents a similar dull and dusty appearance. It is in somewhat better condition but is actively flaking in many places and has suffered some losses to the *urushi* coatings, especially along the uppermost and lowest lamella. The indigo silk braids supporting the neck guard are degraded, have snapped in several places (see fig. 7.29), and parts have been lost.

The throat guard (*yodare kake*) is formed of four lamellae modeled with obliquely pointed scales coated with a hard, thick *shitaji* and brownish *uwa-nuri*. The tips of some of the scales are chipped, exposing the *shitaji* and the iron substrate, which displays light but stable rusting. The indigo braids connecting the lamellae are slightly abraded but otherwise sound. There is some accumulation of dirt between the lamellae. The iron face mask with separate nose guard is coated with a thin, hard *shitaji* decorated with *shu-urushi* that displays the same aged appearance as that on the helmet. The coatings on the recto are essentially sound, with only slight chipping, loss, and instability around the fixing staples. The verso displays some cracking. Though these areas are slightly mobile, they seem to be fairly secure. The face mask's natural fiber (perhaps horsehair) mustache and goatee beard has been damaged by insects and the goatee has been slightly crushed.

#### *Suggested Treatment*

The flaking areas will need to be stabilized before the object is cleaned. In most places the coatings over the iron components retain sufficient flexibility to allow them to be reattached to the support. Water-based adhesives would have adverse effects on the iron so organic solvent-based adhesives should be used instead. A 20% solution of Mowilith 30 in acetone should be effective. The adhesive should be injected into the interface between the coating and the support using an hypodermic syringe and allowed to stand for one or two minutes, after which the flaking areas can be pressed into contact with the iron support and held in place with clamps until the adhesive is thoroughly set, which will take between eight and twelve hours. Because these coatings are comparatively stiff, it may be necessary to use two or three clamps for each lifting area. The first should apply pressure toward the back of the area, the others at each side of the front. If it proves necessary, the adhesive can be reactivated during the process by the application of a little acetone.

Because of the rigidity of superstructure, the losses in the worst affected areas, at the point where the superstructure joins the helmet bowl (*hachi*), cannot be stabilized by adhesives alone. This area, illustrated in fig. 7.28, can be stabilized and, if necessary, reconstructed by back-filling with a microballoon filler composed of a 30% acetone solution of Mowilith 50 mixed with three or four parts by volume of microballoons. Mowilith 50 is recommended because of its greater flexibility, which should allow some movement between the components in case of differential thermal expansion or contraction.

During the cleaning procedure it is important to be aware of what may have been the original intent of the maker. It is likely that the helmet (*kabuto*) was intended to present a dull



Fig. 7.29. *Neck guard of helmet (B87M22a)*, showing damaged braids.

and rusted appearance and that the *shu-urushi* finish is meant to be marked as if from use. This idea gains some credence from the fact that the *shu-urushi* finish on the reverse is still quite lustrous whereas the finish on the front of the helmet appears dull and degraded, as if from exposure to light. If the object had been exposed sufficiently for the coatings on the helmet to degrade, those on the reverse would be similarly affected and this is not the case. The varnish coating mentioned above should be removed using IMS. It is possible that the varnish was not applied to all of the *nashiji* coating and care should be taken to distinguish those areas that require this treatment. Accumulated dirt and grease can be safely removed using mineral spirits. Treating a small area at a time, a cotton wool swab moistened with mineral spirits is rubbed briskly and with small circular movements over the surface, the swab being turned frequently so that a clean surface is constantly offered to the

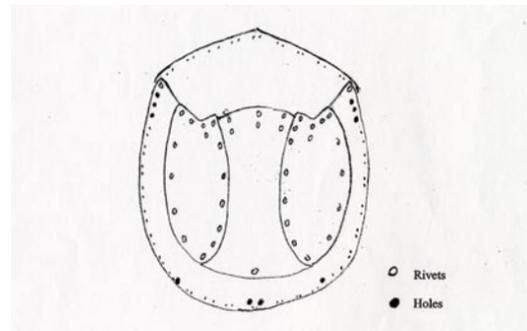


Fig. 7.30. *Helmet (B87M22a)*, diagram of iron helmet bowl construction.



Fig. 7.31. *Helmet (B87M22a)*, detail of neck guard showing difference between protected and exposed nashiji finish.

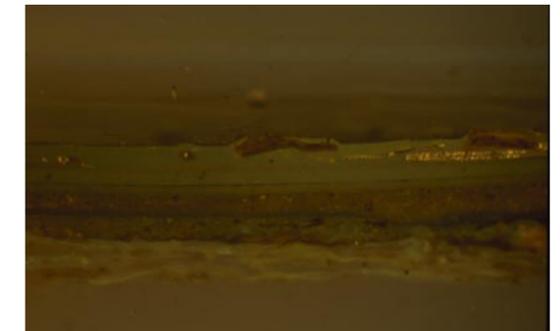
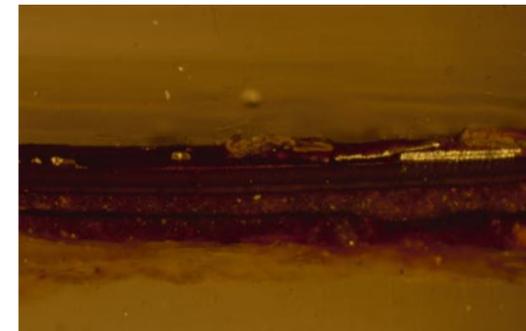


Fig. 7.32. *Helmet (B87M22a)*, cross-section sample of surface layers on front shown in reflected light (left) and ultraviolet light (right); photo taken at 200x magnification.

object. This process should be continued until no further dirt is seen on the swab and without allowing the surface to dry. When this point is reached, and before the remaining white spirit evaporates from the surface, a clean dry swab is worked over the area, lightly at first but with increasing downward pressure until the surface is dry. This method will successfully remove contaminants and restore a degree of the original appearance without adversely affecting the original coatings.

The silk braids supporting the neck guard (shikoro) are degraded and several have torn. In most Japanese and some Western collections, weak and degraded braids are replaced with specially made duplicates. Western practice usually demands that the braids are retained in situ and various methods are used to achieve this. They can be chemically consolidated, but this often alters their appearance and reduces flexibility. They can be individually reinforced with textile supports held in place with adhesives or fine stitches, but this rarely strengthens the areas of greatest wear. A more sympathetic method is to

relieve the pressure on the braids by taking the weight of the lamellae on a supplementary support. A frame arranged to support each lamella can be incorporated into a display or storage mount and would not materially alter the appearance of the object.

#### JANE WILLIAMS WRITES:

##### *Materials and Methods of Manufacture*

The iron structure of the helmet bowl, or hachi, is completely obscured by the surface coatings. It can, however, be seen and felt through a large rip in the cap lining. The bowl is constructed of five iron plates that are riveted together (see fig. 7.30). Forging was used to raised brow ridges in the front of the bowl. The composition of laminated paper (harikake) structure that was then attached to the iron bowl is partially visible where the lacquer has cracked. Laminated paper is also visible in cross-section samples taken from damaged areas (see figs. 7.31 and 7.32). The layers of fibrous paper would have been pasted together over a wooden form and dried. When

dry, the hardened structure was adhered to the helmet bowl, and then the entire surface of the completed helmet was coated with a hard, brown foundation, followed by layers of brown (unpigmented) lacquer. This brown lacquer was the original finish for the reverse side of the helmet (now red—see fig. 7.32) and neck guard. On the front of both a nashiji finish was applied over this coating (fig. 7.31). The nashiji in this case were identified as tin filings. This layer also contains black and translucent brown flecks that have not been identified. During treatment of the helmet, protected areas of the neck guard were exposed and showed that the original appearance of the nashiji here, and presumably also on the helmet, was a high-gloss, orange brown coating with golden and black flecks (see fig. 7.33). When submerged in the lacquer, the tin filings gave the effect of golden flecks.

The cap lining (ukebari) is made of two layers of plain-weave textile (a turquoise blue cotton covered with an indigo blue bast-fiber layer) quilted together with concentric rows of running stitches. The bottom edge is lined with a

folded strip of hide that is dyed turquoise blue. The braids used to lace the neck and throat guards are all silk, single-layer twill braids with eight ridges. At least three distinct turquoise braids were identified on the neck guard by the number of plies (2, 3, and 6) in the silk yarn, the evenness and intensity of the remaining color, and the condition of the silk. There is no pattern to their positions on the helmet. It is not yet clear whether they are all original or whether some or all have been replaced. The patterned edge braid (mimi-ito) is almost entirely gone. What remains was diagrammed to try to establish the pattern. The braiding progressed from the top lame downward. The braids were wedged into the holes of the neck guard with small plugs of rolled paper inserted under the braids from the front side as the lacing progressed. The ends of the braids were tacked in place with a now-darkened adhesive.

##### *Treatment History*

The red lacquer on the back of the helmet was suspected to be restoration coating because

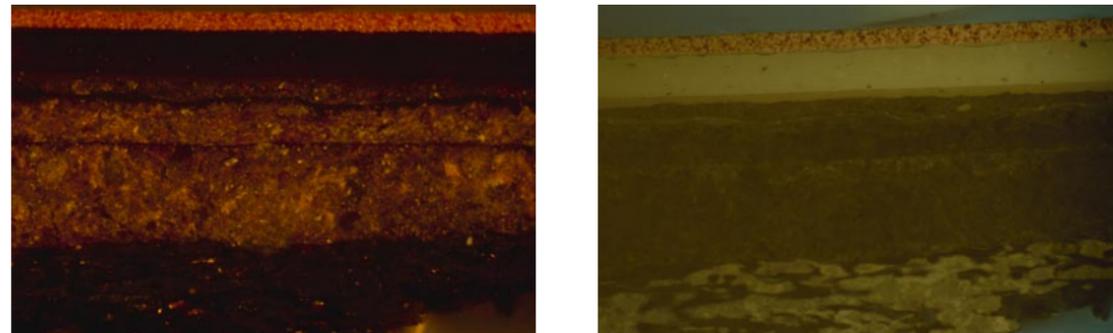


Fig. 7.33. Helmet (B87M22a), cross-section sample of surface layers on reverse shown in reflected light (left) and ultraviolet light (right); photo taken at 200x magnification.

glossy brown black lacquer was visible under the red lacquer on the back of the helmet in a circular loss and along the edge where it meets the nashiji finish. X-radiographs of the laminated-paper part of the helmet (fig. 7.34) confirmed this supposition, by revealing a fill and a loss underlying the intact red lacquer. The aged, brown lacquer finish on the reverse was recoated with red lacquer, which explains why, as Mr. Minney noted, the back does not appear to have had the light exposure and aging that the front has. The helmet and neck guard would have originally matched, with nashiji on the front and unpigmented lacquer on the back. In many of the cracks and gaps on the red-lacquered areas of the helmet there is a thin residue of a fine, white, powdery material, possibly the residue of a fill now covered by the red coating. The red front of the face mask may also have been relacquered. There are a few spots on the nose and chin where the top layer of lacquer has spalled off and exposed another red layer.

#### Condition

The surfaces of the iron components, where exposed by losses to the urushi layers, are covered

with thin brown or orange corrosion. The worst corrosion is found on the lower back edge of the helmet, where the laminated paper has separated from the metal, and on the reverse of the neck guard, where the lacquer is applied very thinly. Here large areas of lacquer are actively flaking and there are numerous detached or missing flakes (see fig. 7.35). There are also isolated warts of corrosion beginning to erupt through the lacquer. The laminated paper (harikake) and lacquer layers are cracked all around the helmet where they meet the helmet bowl, and are completely detached on the lower back. Across the lower front there is a wide horizontal crack through these layers and substantial losses to the lacquer, but the surface is still adhered to the metal in some places. There are large open vertical cracks on the sides of the superstructure and another through the top center that has sprung out of alignment. There are additional, closed cracks throughout the laminated paper superstructure.

The lacquer on the face mask is in better condition than that on the helmet. It is, however, cracked in a few places, particularly around the



Fig. 7.34. Helmet (B87M22a), X-radiograph of laminated paper superstructure. Technical data: Norelco X-ray unit (150 kV max.), Kodak Industrex AA film, 40 kV, 6 mA, 60 seconds, distance from tube, 36 inches.

ears and lower edges, and the lacquer along these cracks is lifting and has minor losses. The throat guard has a few losses to the tips of iron “scales” and minor losses to the lacquer.

As Mr. Minney noted, the silk braids on the neck guard are in very poor condition. Only three of the seventeen braids remain unbroken, and fibers on these are beginning to split. The broken braids have missing sections and frayed ends. The braiding on the throat guard appears to have been replaced. The pattern of the lacing and end knots does not follow other examples in the collection. It is simpler and many many ends are secured with a resinous adhesive.

The cap lining of the helmet was made smaller than the helmet so that it would keep the wearer’s head from pressing against the iron bowl. At some point, however, the lining tore from the stress on it while being worn or displayed. There are associated large losses and fraying to both textile layers at the center top. The stitching securing the lining to the helmet through holes in the lower edge of the helmet is broken, with losses to the thread at the front (just to the right of center) and on the right side.



Fig. 7.35. Reverse of neck guard before treatment, helmet (B87M22a).

The leather strip around the lower edge of the helmet is worn and has a tear where it is folded over the edge of the iron.

Leather thongs tied with square knots secure the throat guard to the face. Because these thongs are too tight, the tips of the scales are gouging the lacquer on lower edge of the face mask. On the face mask the mustache has two patches where the fibers were damaged by insects. Many fibers of the tuft of hair on the chin and fewer in the mustache have been crushed.

FTIR spectroscopy did confirm the presence of a discontinuous shellac coating the helmet and neck guard, as suspected by Mr. Minney. However, it is found on both the dull nashiji areas and the shiny red restored back, and so is not responsible for the current dull gray-brown appearance of the nashiji finish. The dull appearance appears to be due to deterioration of the lacquer; in a few protected areas on the neck guard the surface is better preserved. In cross-sections of the nashiji, fine cracks are visible throughout this layer (see fig. 7.36). The dull, grayed appearance of the surface comes from the cracking and also from islands of lacquer having spalled off where

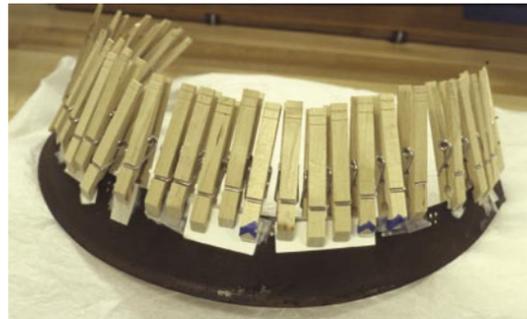


Fig. 7.36. Neck guard of helmet (B87M22a), showing clamping during consolidation of lacquer surface.



Fig. 7.37. Helmet and face mask (B87M22a,b), after treatment, showing storage support.



Fig. 7.38. Reverse of neck guard after treatment, helmet (B87M22a).



Fig. 7.39. Two lames of the neck guard of helmet (B87M22a); the top lame has been coated with 3% Paraloid B-72 in xylenes; the bottom lame is shown before coating.

they originally covered tin flakes. Now exposed, the flakes have a dull, gray, oxidized appearance. Dark spots and staining on the red restoration coating on the back of the helmet and on the face mask that appear to be migrating up from the iron. The surfaces of the helmet and face mask are very dusty overall, much of the dust coming from deteriorated silk fibers.

#### Treatment

The initial plan was to treat the helmet with the neck guard attached and intact. The order of treatment was to be the helmet first and, on the helmet, first the lacquer on the neck guard, then the braids, and then the lacquer on the helmet. This order was chosen because the helmet could not be moved or touched without losing lacquer from the underside of the neck guard, so I did not believe it possible to manipulate the braids without considerable loss to the lacquer. The harikake and lacquer on the helmet were becoming detached from the surface, but largely as an intact section; therefore, as long as the helmet was supported and handled carefully, losses could be avoided and consolidation

of the helmet could be left as the third step. To prepare for the consolidation of the lacquer on the neck guard, the helmet was placed on its back, supported with polyethylene foam padding and cotton-covered sandbags. If I were to do this again, I would have taken the time to make a specially designed, rigid support for the individual lames of the neck guard, as I think a more rigid support would have prevented some of the continued degradation of the silk braids.

The metal and lacquer were covered with dust and deteriorated silk fibers. Their surfaces were cleaned first with a soft brush. A vacuum could not be used safely because there are so many frayed fibers in the area. The dark lacquer was found to be insoluble in deionized water, ethanol, acetone, Stoddard solvent, and xylene. The surface was cleaned, to the extent that it could be done safely, with swabs and Stoddard solvent. As Mr. Minney points out, a solvent-based adhesive is preferable to an aqueous one on iron surfaces. Acryloid B-48N in acetone was selected as the consolidant for the lacquer because it was formulated as an adhesive for metal and

will bond well to the iron plates. Many conservators consider it to be stronger and more flexible than B-72. It also has good aging characteristics and should remain reversible over the long term. Although in some circumstances I still use PVA resins, their acidity makes them less suitable for metals. The lacquer on the neck guard retains enough flexibility where it is lifting to be flattened out without cracking and to regain good contact with the metal surface. Warts of corrosion under intact lacquer leave the surface uneven in many areas. The resin was introduced under the flaking areas with a small brush. A 5% solution in acetone was introduced first. When this had dried, a thicker, 15% to 20% solution in acetone (the highest concentration that would still flow under the lacquer) was introduced with a small brush. The lacquer was clamped in place (see fig. 7.36). The most effective clamps were small rare earth magnets, carbon-rod clamps, or wood clothespins used over stacked pieces of cotton blotter, to distribute the pressure evenly, and silicon-release Mylar. In some areas the consolidation had to be repeated.

The next elements to be treated were the silk

braids on the neck guard. Once the lacquer on the neck guard had been consolidated as much as possible with the helmet resting on its back, I examined the silk braids. Two of the ties holding the neck guard to the helmet were shoelaces and two were lengths of silk braid tied in square knots, a lacing technique not traditionally used in Japan. I could also see the impression in the lacquer around the holes of the metal pins (*hachi-tsuke-byo*) that would have originally attached the neck guard to the helmet. I decided the rest of the treatment would be facilitated by removing the neck guard. The ties were photodocumented and the knots diagrammed before they were removed and saved in polyethylene bags.

Once the helmet and neck guard had been separated, I was able to evaluate the condition of the silk braid more carefully and to consider the practicality of stabilizing it in situ. I planned to have the museum's mount maker construct a mount that would support each lame of the neck guard to take the weight off the deteriorated silk while not detracting from the appearance of a traditional Japanese helmet

mount. If the silk braids were left as they are, as Mr. Minney suggested, even with support from a mount, the fraying and disintegrating silk fibers would continue to coat the lacquer surface and the area around the helmet, so containment of the braids was necessary. Because satisfactory adhesive methods for consolidating silk have not yet been found, I planned to encase each braid in a folded strip of silk crepe lined in place. In order to insert the crepe, the paper plugs would need to be removed from the lacing holes. I tried a test with one area and found that the manipulation needed caused additional losses both to the braids and to the surrounding lacquer (which could not be thoroughly consolidated with the braids in place). Thus I decided, given their extremely poor condition, to document the braids carefully, remove them, retain them, and replace them with like braids. In future treatments, I would always try first to preserve original textile elements in place. (An article written by conservators working for the Royal Armouries Museum, Leeds, England, gives excellent arguments and practical suggestions for retaining and supporting deteriorated textile components of Japanese armor in situ). Custom-made braids were thought to be the best way to match the color and weight of the existing braid. Fortunately, Setsuko Kawazu, a Japanese paintings conservator who was working in the lab, had learned to use a takadai (see note 25) and was willing to take on the task of making new braid. She used custom-dyed silk yarn and made samples until she had a braid of comparable weight and width to the existing braid and that would fit through the existing holes. A padded folder was made to house the braid remnants (see fig. 7.37). A shelf was made for the braid folders in the storage box made

for the helmet, so that they will remain associated with the helmet. The braids were photographed and diagrammed before they were removed and as the knots were being unlaced. After undoing one knot, I confirmed my observation of the structure by discussing it with Ian Bottomley, the curator at the Royal Armouries Museum. The braids were removed slowly with padded tweezers and plastic spatulas, but some damage and loss to the braids was unavoidable. The braids were placed in the folder following their order on the helmet, along with the paper plugs used to wedge them in.

Once the braids had been removed, consolidation of the lacquer on the individual lames of the neck guard continued. The reattachment of the lacquer layers to the metal substrate of the helmet followed next. Acryloid B-48N was again used as the consolidant. First a 5% solution in acetone was injected into the gaps with a syringe to consolidate the ground and harikake layers. After the consolidant had dried, a thicker, 15% to 20% solution was flowed in. Originally I planned to use shinbari to press the lacquer down, pressing as much of the lacquer down at one time as possible. However I found that carbon-rod or metal clamps and rubber straps were easier for me to use as I could adjust them quickly as I moved through an area. Also, using clamps allowed me to change the position of the helmet while working so that I could inject the adhesive with the helmet upside down or on its side and clamp it immediately. Since the lacquer was still nearly attached at the center and top front and the center back, I reattached it by gradually working downward and toward the side from the better adhered areas. Despite the limited flexibility of the lifting harikake and lacquer layers, it was possible to readhere them surprisingly close to

their original positions. The main distortion that remains is in the blind, sprung crack at the front top center. It was easier to reposition the layers where they could be pressed against the metal bowl of the helmet. At the top, the structure forms a hard, hollow shell, and pressure to the sprung crack threatened to extend the length of the crack, so the final positioning in this area was a compromise. Along the vertical side cracks and along the bottom edge, there remained narrow gaps under the lacquer after the layers were secured. These gaps were filled with a bulked adhesive mixture of 20% B-48N in acetone mixed with 1 : 1 glass microballoons : CF-11 fibrous cellulose powder. The lifting lacquer on the face mask was consolidated with B-48N in acetone as described for the helmet. The losses to it were smaller and less vulnerable to further loss than those on the helmet, so they were left unfilled.

The next issue was filling losses to the lacquer surface on the helmet. Mr. Minney advocated leaving the losses unfilled. I felt, however, that the exposed metal and the edges of the lacquer needed some protection. Yoko Woodson, Curator of Japanese Art at the museum, agreed with me that the deeper losses to the thick layers on the front of the helmet also detracted from reading the three-dimensional form of the helmet. The losses to the thicker lacquer on the helmet and front of the neck guard were filled with a mixture of 20% B-72 in acetone bulked with Champagne chalk and dry pigments. Chalk makes a smoother fill than is possible with cellulose powder or glass microballoons. I felt that B-72 or B-48N would both be effective binders for the fill, but that B-72 might dissolve more readily if it were necessary to remove the fill in the future. The fill was smoothed as much as possible with a spatula dampened with acetone,

then sanded with fine sandpaper and Micromesh of increasing fineness, avoiding the edges of the lacquer. The fills were toned with Rowney FW acrylic inks.

For the extensive losses to the thinner lacquer on the reverse of the neck guard, I experimented—in the hope of saving time and avoiding the task of working and sanding fills completely—by casting out a film, cutting it to shape, and inserting it in the loss. B-48N mixed with dry pigments and cast out on Mylar was an excellent match for the color and gloss of the original lacquer. Orasol dyes, which are made by Ciba-Geigy, are light-fast, and can be dissolved in solvents, would also work well as colorants. I traced the outline of the losses on Mylar and then cut out the dried film with a scalpel to match the loss. Backing the film with spun-bonded polyester, by coating the polyester with dilute B-48N and pressing it against the cast resin, made the somewhat brittle film easier to cut out. Matching the shape exactly still proved somewhat difficult. The fill was secured in place by brushing the surface to which it would be attached with dilute B-48N in acetone and then pressing it in place. It would be easier to attach the fill with an adhesive with different solubility, such as B-67 in Stoddard solvent. The method worked well for small losses, but proved impractical for very long losses. It was too difficult to make a cast fill that conformed to all of the edges and curves and did not crack. In the end, I was also concerned that this fill was too easy to remove, and would not offer enough protection to the vulnerable edges of the remaining lacquer. This method was also time consuming, though no more than other fill methods that would replicate the appearance of the lacquer well. I did not use this technique, but do think it has potential

for other situations, where a very easily separable fill that is not worked in situ is needed.

Instead I decided to apply a protective fill just to the edges of the remaining lacquer (about 2 to 3 mm from the lacquer) to make a gradual slope between the lacquer and metal. The fill would also support areas where slightly more of the ground layer than the lacquer had been lost, leaving the lacquer unsupported at the edge. A mixture of 20% B-72 in acetone bulked with Champagne chalk and dry pigments was used for the fill. This mixture was applied with a tiny spatula and smoothed with a spatula dampened with acetone. The exposed metal was cleaned with acetone and cotton swabs and, under magnification, rough corrosion was reduced carefully with a scalpel. I then coated the metal with pigmented B-72 in acetone (see fig. 7.38).

Cleaning of the helmet, and the deteriorated nashiji finish in particular, was addressed after consolidation of the lifting surface layers. In cleaning tests any material (silk, cotton jersey, cotton swabs, sponges) that is rolled or wiped over the surface picks up tiny fragments of the lacquer, sometimes only detectable under magnification. Ultimately I did very minimal cleaning of the nashiji, only some blotting of the surface with cotton jersey dampened with Stoddard solvent. The areas with solid color lacquer finishes were cleaned by wiping them with cotton jersey dampened with Stoddard solvent. The fragility of the nashiji finish, on which the loss of lacquer fragments and the oxidation of the tin flakes was continuing, was concerning. While I avoided overall consolidation of deteriorated lacquer on the other objects in this project, the surface consolidation of the helmet could only be done while the helmet was unlaced. In this case, I decided that it was more responsible to applying a consolidative coating than to leave

the surface untreated. The surface was brushed with two applications of 3% B-72 in xylene, allowing time for drying between applications. B-72 was chosen as the consolidant for its stability and its good performance as a protective coating for metal. In this slow-evaporating solvent and at this concentration, the B-72 should penetrate the cracks in the lacquer well. It was not wiped with solvent afterward, but was left on the surface to coat the exposed metal flakes. B-72 does not do a good job of replicating the surface sheen of lacquer, but that was not the goal of this treatment. So little resin was deposited on the surface with the two brush applications that the treatment had little effect on the surface gloss, only slightly saturating the color (see fig. 7.39, which shows one lame before and another after consolidation).

The bent hairs on the mustache and imperial were straightened as much as possible by dampening individual hairs with a small sable brush dipped in deionized water and using tweezers to reposition them. The missing pins (hachi-tsukebyo) that connected the neck guard to the helmet were replaced with simple domed-head brass pins with split shanks. Padding was placed between the pins and the original surfaces. The missing tying cord (shinobi-no-o) and loops (shinobi-ne-o) to secure it to the kabuto were not replaced. Because the large tear in the cap lining allows access to interior of the helmet for examination and study, the decision was made not to repair it but simply to cover it with a layer of spun-bonded polyester. The padded display mount looks like a traditional wood helmet mount, but supports the helmet by its lower edge, so there will no longer be stress placed on the cap lining. When in storage, the helmet will rest on its lower edge on a padded support, with the neck guard extended flat behind it (see fig. 7.37). □

**H**ead of a Bodhisattva (B60S14+), China, style of Tang dynasty, height 34.5 cm, width 19.3 cm, diameter 18 cm. This head of a Bodhisattva has a serene expression with half-closed eyes. The hair, originally painted green, is represented with shallow ridges and is held in a high topknot secured by a gilded band. The details are molded in a coarse putty with a textile support. The entire surface is covered with a layer of black paint, but originally the skin was gilded.

#### *Conservation Record*

The head was accessioned in 1960 from an American collector. A sticker applied to the interior states that it was “Made in Occupied Japan” (see fig. 7.38), evidence that it was at least exported through Japan after 1945. There is no record of the sculpture’s treatment prior to or subsequent to being accessioned.

#### FRANK MINNEY WRITES:

The head appears to be a dry-lacquer construction consisting of two layers of urushi-bound organic matter sandwiching a layer of textile. Finished with a coating of ground and coated with black lacquer, the surface bears traces of gilding and greenish pigments. However, the color and consistency of the body indicate that this is not a dry-lacquer construction and that the binder is something other than urushi, probably a protein glue.

#### *Condition*

The body is brittle and friable, the surface coatings are loose, flaking in places, and have suffered some losses. Several deep cracks penetrate the coatings through to the intermediate textile layer especially in the area of the hair (see



Fig. 7.40. Head of a Bodhisattva (B60S14+).

*I think figures are misnumbered in text from here through end of chapter*



Fig. 7.41. Head of a Bodhisattva (B60S14+); detail of cracks in the hair.



Fig. 7.42. Head of a Bodhisattva (B60S14+); X-radiograph showing vertical seam remaining from fabrication in two-part mold. Technical data: Norelco X-ray unit (150 kV max.), Kodak Industrex M film, 35 kV, 4 mA, 90 seconds, distance from tube, 36 inches.

fig. 7.39). Some of these join to form isolated patches of loose material. Traces of an adhesive label were found on the back of the neck and the object is dusty overall.

#### *Suggested Treatment*

The object will respond well to cleaning with Wishab and the adhesive and paper traces from the old label can be removed using cotton swabs moistened with distilled water.

The decorative coatings can be stabilized by consolidating the shitaji in areas of discontinuity using a 5% Paraloid B-72 solution in xylene and securing the top coatings with a water-based adhesive using white spirit as a surfactant. Stabili-

zation of the structural layers will be more problematic. These are so friable, brittle, and absorbent that any attempt at adhesion is likely to fail. Preconsolidation may help but it is probable that so much consolidant would be required that the nature of the structure would be unacceptably altered. An alternative is to use a microballoon filler to lock the fragments in place rather than to adhere them to the layer below. A mixture of 15% Paraloid B-72 mixed with three or four parts by volume of microballoons should be effective. This mixture should be injected into the voids between the fragments, the intention being to bridge the gaps in isolated spots rather than to fill the voids completely. The reason for using this

method is that the body of the object is so friable and brittle that any adhesive or fill may tear away from the surface, and this method would minimize possible damage of that nature, but still offers some support to the structure without completely consolidating the body layers, which is unacceptable for the reasons given above.

JANE WILLIAMS WRITES:

#### *Methods and Materials of Manufacture*

During the lacquer symposium, questions arose concerning the attribution of the object. Michael Knight, Senior Curator of Chinese Art at the museum, was consulted and he felt further technical study and dating of the object was warranted. A sample of the putty from the head was sent to the NSF University of Arizona AMS laboratory for carbon-14 dating. The textile exposed at the edge was a candidate for sampling, but because an older piece of textile could have been used in the manufacture of the head, the decision was made to sample the putty. The putty lining the interior, apparently of the same composition as that on the exterior, was thought to be the least likely to have been contaminated. A site was chosen far from the lower edge and the surface was scraped away with a scalpel before the underlying lacquer mixture was sampled. The sample did not date to the Tang period, instead its age overlapped with the period between 1700 and 1950, when the concentrations of radiocarbon in the atmosphere fluctuated considerably, making it impossible to assign a more precise radiocarbon date.

A number of aspects of the manufacture that are inconsistent with the original attribution. Hollow dry-lacquer sculptures were traditionally formed by applying layers of textile saturated with lacquer to a clay model. The shape and details of the figure were built up in a paste made of lacquer mixed with such things as incense powder, clay, sawdust, or hemp.



Fig. 7.43. Interior of head of a Bodhisattva (B60S14+), showing seam at top.

When the textile and lacquer paste had dried and hardened, the clay mold was removed, leaving the hardened textile layers as the primary support. This head, however, appears to have been made in a two-part mold. X-radiographs (see fig. 7.40) helped to identify a seam bisecting the head vertically through the axis of the ears. It was then also detected on the interior surface (see fig. 7.41). The textile layer is not continuous, but consists of separate pieces that overlap at the seam. The textile protrudes to the interior at the top of the head. The textile is a coarse (10–11 threads per cm), bast-fiber plain-weave. The putty, which consists of a thick, orange brown mixture of clay, sawdust, and an unknown binder, was pressed into negative molds and reinforced with a single textile layer. The putty lining the interior is of the same consistency and approximate thickness as the putty on the exterior, and has the texture and appearance of having been pressed onto the textile. A traditional Chinese dry-lacquer sculpture might have traces of a clay model on

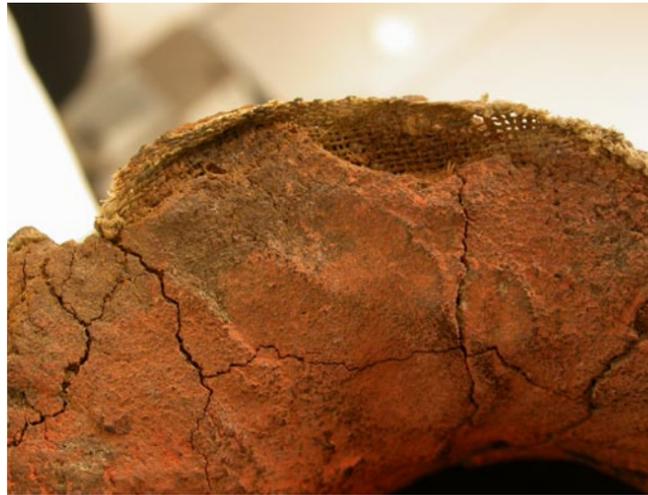


Fig. 7.44. Interior edge of head of a Bodhisattva (B6oS14+), with seldge edge of textile support exposed.

its interior, but it would not have a discreetly applied putty layer. Additionally, although the surface layers around the neck edge are broken and incomplete, the exposed textile support (see fig. 7.42) has a seldge edge, suggesting the head was made as a head and not as part of a full sculpture.

The first layer of pigment on the hair is light green. The green pigment was analyzed using FTIR spectroscopy and polarized light microscopy and was identified as emerald green, a synthetic copper acetoarsenate pigment first manufactured in 1814. Its presence has been documented on a few Asian art objects dated to the nineteenth century. The hair band and face originally had a white ground, covered by a reddish resin or lacquer, applied as a base gold leaf. The head, then, was made as a reproduction or fake. Given its complicated repair history, it may have been made as early as the late nineteenth century.

#### *Treatment History:*

A pink fill was applied to cover surface losses on large areas of the skin and a couple of locations on the hair. The fill was coated with a darker pink brown paint or wash. This material covers so much of the face that, until traces of earlier gilding were found near the hairline on the forehead and behind the ears, it was difficult to identify the original surface decoration of the face. Subsequently, smaller losses to the surface, around the left eye and forehead, the nose, and lips were filled with a white material that is highly radio-opaque. Most recently the head was coated uniformly with black paint that is readily soluble in water. Brush strokes are visible where it is applied to the hair band. This paint was analyzed using FTIR spectroscopy and is a mixture of charcoal and a small amount of an unknown binder. This sculpture probably received the same coating given to the Sho Kannon sculpture (B6oS420) in Japan. If this coating was not applied in the same place, it is likely that was applied for the same reason, that is, to give the surface a more uniform and subdued appearance. For unknown reasons, most of the interior surface was at some point coated with irregular patches of red lead pigment.

#### *Condition*

The pink surface layer on the face is cracked and lifting in many areas. Although there is some cracking to the gilded layer on the hair band and the green paint on the hair is somewhat powdery (although largely consolidated by the surface coating of black paint), the original layers on the head are not actively lifting or flaking. As Mr. Minney described, there are large cracks through the putty layer, particularly on the exterior of the hair and on both the interior and exterior of the neck, creating islands of putty with some movement between them. These is-

lands are not, however, currently lifting from the textile support. The surface is dusty overall. The adhesive label residue on the back of the neck is soluble in acetone.

#### *Treatment*

The decision was made to leave the head untreated as it has now been identified as a modern forgery, so its primary value is for study purposes. The reattribution also meant that it was not to go on view and was not a priority for treatment, so the most minimal intervention was appropriate. Even before a decision was reached about whether the head was modern, I was influenced by my discussions about this piece with Mr. Minney. He debated with himself over the course of his visit whether consolidation could be achieved very satisfactorily. We discussed the difficulty of readhering the thick lacquer to the textile support via access through existing cracks in the surface without also infiltrating the surrounding lacquer and surface layers. This process would consolidate restoration layers to earlier layers and would be difficult to do without saturating or darkening the surface. It would also make the localized, treated areas harder and less flexible than untreated areas. I liked the suggestion Mr. Minney offered in the end of locking the putty fragments together with fill to give it more structural integrity, and would have chosen to do that if more numerous fragments were becoming detached from the textile. The option I decided upon was one that Mr. Minney had suggested earlier: not to consolidate the head, but to provide passive support and readhere any flakes when they came off. The pink restoration layers currently are the most vulnerable to becoming detached. A couple of flakes of this material did become detached during examination of the head and were retained in a labeled polyethylene bag. If flakes that are not



Fig. 7.45. Head of a Bodhisattva (B6oS14+), showing support used for transporting and storing sculpture.

clearly restoration material become detached, I would probably use an acrylic resin, such as B-72, to readhere them. In addition to being a stable, conservation-grade resin, B-72, being soluble in a fast-evaporating solvent, would be suitable for readhering the lacquer putty to the three-dimensional textile support.

A passive support was constructed for the head to secure it during the move and to minimize contact with and handling of its fragile surface. The head had previously been stored resting on its back, which cracked the layers of putty at the neck and abraded the hair. The head now rests on supports made of polyethylene foam covered with cotton sheeting (see fig. 7.43). It is tied down to the support with Volara closed-cell polyethylene foam sheet laced through cotton twill tape. With this support the head traveled to the new museum facility undamaged. □

## NOTES

- 1 A Chinese ink coating has been found on objects sold from Go Hyaku Rakanji (500 Arhat) Temple in Japan after World War II; conversation with Michael Knight, AAM Senior Curator of Chinese Art. A cross section sample of the surface layers was examined with reflected and UV light microscopy. Individual layers were excavated from the sample and analyzed using FTIR spectroscopy.
- 2 For a detailed description of this technique, see Kocho Nishimura et al., "A traditional Japanese lacquer method for repairing wood Buddhist statues," Conservation of Wooden Objects, preprints of the IIC conference on the Conservation of Stone and Wooden Objects, 7–13 June 1970, 2nd ed. (London: International Institute for Conservation of Historic and Artistic Works, 1971), 2:87–96; and I. Nagasawa et al., "Polychrome wooden Buddhist sculptures in Japan: History, materials and techniques," preprints of the 12th triennial meeting, International Council of Museums—Committee for Conservation, Lyon, 29 August–3 September 1999 (London: James and James, 1999), 2:434–37.
- 3 *Ibid.*, 1:435.
- 4 The sculpture was X-radiographed in 1970 using a Norelco unit (max. kV 150) Kodak Industrex M film, 75kV, 12 ma, 25 inches, for fifteen seconds, with a distance of 25 inches between the target and film.
- 5 According to Yoshiko Kakudo, the type of simple crown on this sculpture usually served as a base for a more elaborate, detachable metal crown; see Y. Kakudo, *The Art of Japan: Masterworks of the Asian Art Museum of San Francisco* (San Francisco: Asian Art Museum and Chronicle Books, 1991), 67.
- 6 A portion of the ground layer was analyzed by FTIR. The resultant spectrum was identified as mainly inorganic (kaolin and quartz), with additional absorptions at 1649 cm<sup>-1</sup> strongly suggesting the presence of protein. Additional absorptions around 2900 cm<sup>-1</sup> suggest the presence of an additional organic material, as yet unidentified.
- 7 Representative cross-section samples of the different surface layers on the sculpture were taken before treatment, but were not studied or analyzed until later in the project.
- 8 Absorb 'N Dry PVA Block, made by Kanebo.
- 9 Marianne Webb has observed color changes in lacquer at temperatures as low as 50°C, in tests where heat and moisture are applied together; M. Webb, *Lacquer: Technology and Conservation*, 59.
- 10 Russian sturgeon bladders purchased from Conservation Support Systems, Santa Barbara, California, were used. The bladders were prepared according to the package directions: soaked in water to cover them for about twelve hours and then kneaded into a paste. Water was added to cover the mass by about 2 cm and then it was heated in a double boiler at about 160°F for about three hours. The clear liquid that resulted was strained through gauze and spread out on silicon-release polyester film until dry. The dried film was weighed out and dissolved in water to obtain the desired solution.
- 11 The hide glue used was 5A High Test Technical Gelatin sold as 100% solids by Conservation Support Systems, Santa Barbara, California, and described in the company's catalogue as a hide glue that is classified as a technical gelatin because of its high purity.
- 12 Museum accession records.
- 13 From incomplete records of the sculpture's exhibition the staff found that it had been displayed for at least six years in a part of the museum that receives at least 600 lux of light and 125 microwatts per lumen ultraviolet content.
- 14 See note 1, above.
- 15 A sample of the wood from the interior was identified by Professor Richard Dodd, Department of Environmental Science, Policy and Management, University of California, Berkeley.
- 16 See note 11, above.
- 17 In my limited experience with urushi, I have found that thin applications of dilute urushi will dry at between 50% and 55% relative humidity.
- 18 Alexandra Munroe, ed., *Spectacular Helmets of Japan, 16th–19th Century*, exh. cat. (New York: Japan House Gallery, 1985), 188.
- 19 The terminology for Japanese armor used in this report is taken from Kozan Sakakibara, *The Manufacture of Armour and Helmets in Sixteenth-Century Japan* [Chukokatchu Seisakuben], trans. T. Wakameda, rev. A. J. Koop and Hogitaro Inada (1912), rev. and ed. H. Russell Robinson (Rutland, Vermont, and Tokyo: Charles E. Tuttle, 1963); and Ian Bottomley, *Japanese Armor: The Galeno Collection* (Berkeley, Calif.: Stone Bridge Press, 1997).
- 20 Conversation with Dr. William Galeno, November 2000.
- 21 The fiber was identified tentatively as white deer hair by comparing a sample to known samples using polarized light microscopy.
- 22 The process of making harikake is described in Munroe, ed., *Spectacular Helmets*, 188.
- 23 The metal was identified by scanning electron microscopy with energy dispersive X-ray spectrometry.
- 24 All fibers were identified by comparison to known samples with polarized light microscopy.
- 25 The terminology used here follows Masako Kinoshita ("A Braiding Technique Documented in an Early Nineteenth-Century Japanese Treatise, Soshun Biko," *The Textile Museum Journal* [1986], 47–65), who follows Noémi Speiser (*The Manual of Braiding* [Basel: privately printed, 1983]). Since the Edo period most handmade lacing braids for Japanese armor have been made using a high stand called a takadai. Powered braiding machines introduced in Japan in the late nineteenth century nearly made hand-braiding obsolete. Kinoshita studied older braids and texts on braiding techniques and determined that a type of now-obsolete hand-held loop-manipulation technique predated the takadai. Braid made by the loop manipulation technique can be distinguished from braid made on a takadai by the number of strands.
- 26 The red coating was identified as urushi by FTIR spectroscopy.
- 27 According to Masako Kinoshita (e-mail correspondence, March 2002), Japanese scholars and restorers of armor come to collections in the United States and Europe to study the textile elements of Japanese armor, because the objects in these collections are more likely to have retained their original components. The replacement and renewal of textile components continued in Japan long after the armor became part of museum and private collections. More recently, however, an interest has developed in preserving and documenting these components.
- 28 Alison Guppy, Poppy Singer, and Annabel Wylie, "A Seventeenth-Century Suit of Japanese Armour with Original Textile Components: Its Description, Conservation, and Mounting," *The Conservator* 21 (1997): 59–70.
- 29 To match the color of samples of the existing braid, silk yarn was dyed with indigo by Cheryl Kolander, whose company, Aurora Silk, in Portland, Oregon, sells naturally dyed silk yarn.
- 30 After consulting with Margaret Geiss-Mooney, the textile conservator at the Asian Art Museum, and Joann Hackett, a textile conservator at the Fine Arts Museums of San Francisco, the folder was patterned on examples illustrated in Virginia Greene, "Adaptation of Standard Matting Folders," in Carolyn L. Rose and Amparo R. de Torres, eds., *Storage of Natural History Collections: Ideas and Practical Solutions* (Society for the Preservation of Natural History Collections, 1992), 149–152.
- 31 E-mail correspondence, October 2003.
- 32 The B-72 color chips, prepared mixtures of B-72, and well-ground pigments available from Conservation Support Systems, Santa Barbara, California, were used for the ease with which they yielded an intensely colored, smooth coating.
- 33 Correspondence with Dr. A. J. Timothy Jull, Senior Research Scientist, NMS University of Arizona AMS laboratory, Tucson, Arizona.
- 34 For a description of the techniques of dry-lacquer sculptures, see Kyotaro Nishikawa, "Dry Lacquer Statues of Japan," *Urushi: Proceedings of the 1985 Urushi Study Group*, ed. N. S. Brommelle and Perry Smith (Marina del Rey, Calif.: Getty Conservation Institute, 1988), 127; Paul Jett, "The Study and Treatment of Chinese Dry Lacquer Sculpture," in *Conservation of Urushi Objects: International Symposium on the Conservation and Restoration of Cultural Properties*, November 10–12, 1993, ed. Kyotaro Nishikawa (Tokyo: National Research Institute of Cultural Properties, 1995), 168; and Donna Strahan, "The Walters Chinese Wood-and-Lacquer Buddha: A Technical Study," *Journal of the Walters Art Gallery* 51 (1933): 105–20.
- 35 A sample of the fiber was examined using polarized light microscopy.

- 36 The distinctive spherulites (10–15 microns) of emerald green pigment were observed with a polarizing light microscope. For a discussion of this pigment, its composition, manufacture, and occurrence on art, see Inge Fiedler and Michael Bayard, “Emerald Green and Scheele’s Green,” in Richard L. Feller, ed., *Artists’ Pigments: A Handbook of Their History and Characteristics*, vol. 3, edited by Elisabeth West Fitzhugh (Washington, D.C.: National Gallery of Art, 1986–), 219–73.
- 37 *Ibid.*, 258.
- 38 This fill is partially soluble (a reddish pigment remains insoluble) with effervescence in dilute hydrochloric acid, indicating the presence of carbonates.
- 39 The pigment appeared light orange by transmitted light and showed an anomalous blue green color between crossed polars. The red pigment was dissolved in dilute nitric acid, heated to dryness, redissolved in water, and a small crystal of potassium iodide was added to the solution. A bright yellow precipitate formed, confirming the presence of lead. The painted areas appear highly radio-opaque.

## 6. Case Studies: Screens



### THE CONSERVATION OF COROMANDEL SCREENS *Marianne Webb*

The word *Coromandel* conjures up images of tall ships laden with spices and other exotic wares, among them, lacquered screens. These Chinese lacquered screens did not originate from the Coromandel Coast on the eastern shores of India, but at some point the name became associated with the screens. Today, we use the word Coromandel to describe a lacquered screen on which the decoration is first incised and then painted, usually in bright colors. Until the twentieth century, this type of lacquerware was referred to as Bantam work. Now Coromandel seems to be the universally accepted term for these incised screens.

Although the screens appeared to have first been made in the seventeenth century for the Chinese domestic market, they were very shortly manufactured for export. Early screens made for the Chinese were often inscribed and dated. Sometimes the Chinese domestic screens differed in style, each separate panel made with a frame holding several smaller panels. Occasionally these inset panels were lacquered on one side only. The reverse of the screen was a second panel, again lacquered only on the exposed surface. The backs of the two panels, unseen on the interior, were not finished in any way. For the European market screens tended to be made out of a single slab of wood or boards joined to form a flat panel. Evidence of wear and cracks reveals their structure.

To prepare the surface for carving, a ground coat of a light-colored clay was applied to the wooden panel. This was usually white to light gray in color and relatively soft in character, suggesting that the ground was bound with a protein-based glue. Although some screens of better quality probably have Asian lacquer used as a binder, the vast majority seem to have an animal protein-based binder. After the clay base had been ground to a smooth surface, several coats of Asian lacquer were applied. The quality of the screen was readily apparent in this stage of production. The inexpensive ones received only a couple of coats at best. One can often see trapped dust particles, fine wrinkles caused by applying the lacquer layer too thick, and other imperfections on inexpensive screens.

Once the panel was produced, the design was cut through the lacquer to reveal the ground. Here again the quality was demonstrated. Some screens were cut so finely that details such as hairs on the head of figures could be seen. Cuts varied in depth and shape to create many effects, from those barely piercing the surface, to broad strokes over an eighth of an inch in depth. The incised design was then painted in bright colors. Although some literature states that the painting was done in oil, it is doubtful that this was determined through chemical analysis. In all the screens this author has encountered, the paint has been bound with a water-based medium, most likely animal glue. Most of these remain water-soluble unless a later coating has been added.

Fig. 8.01. Traditional hinges on a Chinese screen.

*Deterioration of Coromandel Screens.*

Damage on Coromandel screens typically falls into three general categories: structural damage, damage to the lacquer surface, and damage to the painted recesses.

Structural damage can be divided into two areas: the deterioration caused by the environment and mechanical damage to the edges of the panels. When the panels are exposed to extremes in relative humidity, they tend to warp. Many of them are of inferior quality, produced rapidly while the trading ships waited for their order to be filled. Because the lacquer itself is carved, it does not offer any protection to the wood substrate during changes in relative humidity, so the panels will slowly warp, producing an undulating surface. Over time the joins between the panels become weak and the lacquer on the surface cracks. Panels lacquered only on one side are even more likely to warp due to the differing stresses on the two sides. The warped convex boards producing a wavy appearance on the surface of the panel.

Almost all screens are mechanically damaged in some way. Because they are heavy, it is difficult to handle the screens, which then suffer numerous dents and losses to the surface. The edges and feet are especially vulnerable. The feet are not only damaged by vacuum cleaners and brooms, but also they are often subject to damage from rising damp. Moisture from damp floors travels through the wood from the open grain at the end of the feet. As the ground becomes weak, this moisture accelerates the loss of lacquer on the surface during dimensional changes of the wood.

Most screens including those examined in the Asian Art Museum, show considerable damage to the edges caused by the original hinges. When first manufactured, Chinese screens are outfitted with pin and loop hinges as seen in fig. 8.1. These are set in a shallow groove. When the screen is set up, each panel is handled separately and are

joined together when the pins are slid through the loops of the hinges. The screens are thus easy to handle and quite portable. These hinges also allow the panels to bend in either direction, that is, 360 degrees of rotation is possible. Since the pins and loops protrude from the surface, they can chip the lacquer on the next screen if handled improperly. Most screens have had the original hinges replaced with modern hinges that attach all the panels together permanently. This results in an extremely heavy object that is difficult to move. Because the panel is usually less than one inch thick, the modern hinges are under a great deal of strain. The result is that, when the screens are handled, the accumulated weight of several panels pulling in the wrong direction can cause the hinges to be ripped out of the wood. Clearly, the hinge, of either type, is the weak point of the screen and site of extensive physical damage.

Damage to the lacquer surface usually takes the form of light degradation. The lacquer fades and becomes increasingly translucent over time. Many screens have been on continuous display for years and almost all will exhibit a certain degree of degradation. Often the lustrous black surface has faded to a translucent brown so thin that the ground beneath can be seen. Aggressive cleaning of the lacquer accelerates this fading, which often follows the pattern of the warped panel. Raised edges at the joins on a concave warp or the centre of a board on a convex warp receive more wear during cleaning. Also common is fading that is more pronounced on the front than on the back of the screen.

Deterioration of the carved and painted images takes the form of paint loss and accumulated dirt and coatings. The binder for these paintings is usually an animal glue of some type, which remains soluble in water. Previous attempts at water cleaning may have removed the color from the recesses. Drying and shrinkage of the binding media also causes lifting, cupping, and

subsequent loss of the paint, sometimes to the extent that only small dots of color remain in the deep crevices of the carving.

In an attempt to bring back the luster of degraded dull lacquer the screens were frequently varnished or waxed, which introduced another set of problems. These coatings were applied indiscriminately over the entire surface. The porous paint and grounds allowed these coatings to penetrate deeply, which now makes them very difficult to remove. A wax coating can attract and hold dirt, which accumulates in the grooves and eventually obscures the colors of the original painting.

*The Asian Art Museum Screens*

The three screens examined, two large and one small, exhibit damage typical of Coromandel screens. All three have cracks between the boards that make up the panels. This type of damage is typically caused by changes in relative humidity. The constant movement of the wood as it shrinks in response to low relative humidity and swells in response to high relative humidity eventually results in separation of the joins and flaking of associated lacquer. As unfortunate as this damage is, the cracking pattern is helpful in identifying the construction method used. The lacquer on all three screens has degraded with excessive exposure to light. Probably as a result of degradation and the mechanical damage, the screens have all been restored at some time.

Because they are similar in construction, age, and condition, my treatment proposals are much the same for each screen. Any recommended treatment proposal should be adjusted as the work continues. Visiting conservators can make recommendations, but only the conservator who actually performs the work can make the final decision about the appropriate course of action. Once chemical analysis is complete and further discoveries are made as the work begins, the choice of treatment will become clear. □

**S**creen (B69M52), China, Qing dynasty, Kangxi period, dated 1670, 12 panels: each H. 275 cm; W. 55 cm; D. 1.5 cm. This twelve-panel screen (figs. 8.2, 8.3), is dominated on one side by a palace scene across the ten central panels. The top and sides depict vessels and baskets of flowers and some of the “hundred antiques.” Groupings of cut branches of flowers are arrayed across the bottom of the screen. The reverse of the screen has a lengthy inscription over ten panels indicating that the screen was presented to an officer Li from his high-ranking friends and providing a date of the ninth year of the Kangxi emperor’s reign (1670). Cut flowers and more of the “hundred antiques” are depicted across the top on the reverse. The side and bottom panels depict birds among rocks and vegetation. The borders evoke longevity with circular medallions alternately containing cranes and shou (longevity) characters against a background of tortoiseshell patterns.

*Conservation Record*

The M. H. DeYoung Memorial Museum acquired the screen from C. T. Loo, Paris, before 1965, and transferred it to the Asian Art Museum in 1969. There are no surviving records of the screen’s history before that time. The only documented treatment of the screen prior to now, in 1971, indicates only that spots with missing polychrome were touched up, hinge screws tightened, and the entire screen lightly cleaned and waxed on both sides.

## MARIANNE WEBB WRITES:

*Condition*

Some of the panels have vertical cracks, which are especially noticeable at the feet. These cracks indicate that each panel was constructed of several vertical boards. One can see clearly how the narrow boards used on the edge of each panel



Fig. 8.02. Screen (B69M52), after treatment, front view.

extend beyond the bottom to become the feet on each panel.

There is considerable mechanical damage to the edges of the panels and some flaking of the lacquer. Overpainting of old losses indicates that this damage has been continuous through the centuries. The original hinges have been removed and the screen has been altered by cutting out sections to fit Western-style hinges. This loss of the original wood on the edges makes it difficult to find evidence of the type of original hinges, however it is likely that they were the typical pins and loops. Evidence of the holes for the pins probably remains and could be imaged by X-radiography.

The ground on this screen is hard, which may be an indication that Asian lacquer was used as the binder. Because this is a seventeenth-century screen it may be of better quality than those produced later for the mass market. Perhaps this quality has contributed to its surviving in such good condition.

The lacquer surface is mostly intact except for mechanical damage; it has, however, degraded from exposure to light, fading to a translucent brown on the front, although the back, which obviously received less light, has remained black. Records at the Asian Art Museum indicate that the surface has been waxed. This is evident in the sheen of the surface despite the high level of light degradation. Normally the surface would be dull as well as faded. Fingerprints, caused by handling without the use of gloves, are seen at all edges of the panels. Losses of the lacquer on both the edges of the panel and in the center have been overpainted with an opaque black paint (see fig. 8.4).

The incised and colored design has suffered from numerous small losses probably caused by insufficient binder in the original paint. The cleavage occurs in the middle of the paint layer so that only the surface of the paint is lost. Where the original paint remains intact, it is darker in color than is the newly exposed

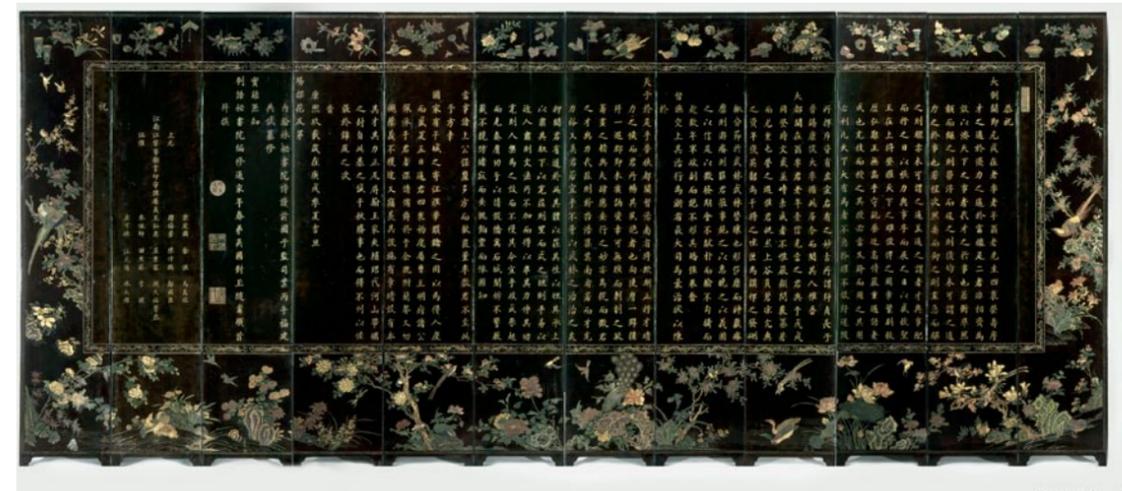


Fig. 8.3. Screen (B69M52), after treatment, reverse.

paint. This phenomenon is to be expected in red areas because cinnabar, the mostly likely pigment, darkens on exposure to light. In fig. 8.5 one can see several shades of red as the flaking and darkening has occurred over time. The darker original surface is also seen in yellow and green areas, leading to the speculation that additional factors such as a later coating, surface dirt, as well as aging of the pigments are causing the surface to darken.

#### *Suggestions for Treatment*

The sheer size of this screen makes treatment a challenge despite its being relatively straightforward in nature. Structural repairs should be made first. The vertical cracks should be adhered with cold fish glue and clamped in the conventional manner. A proprietary glue, available in Canada, produced by Lee Valley Ltd., is made from codfish skins and treated to remain liquid at room temperature. Stronger than rabbit-skin glue, it works well for structural re-

pairs. In addition it can be used as a consolidant for lifting and flaking lacquer thus avoiding the need to use two separate adhesives. Of several adhesives I have tested, this one works best for holding even severely distorted lacquer in place. Although it is liquid at room temperature, it can be thinned slightly by adding 10% water to make it suitable for injecting under the surface. Ethanol can be used as a wetting agent to aid penetration. Care should be taken that no adhesive remains on the surface. Because the surface has been so degraded by light, it will be susceptible to further discoloration by water and other polar solvents.

Consolidation of the lifting lacquer could also be done with Paraloid B-72 in either toluene or a combination of acetone and ethanol. The use of toluene as a solvent is ideal because it will not affect even degraded lacquer. However, I find that B-72 is not always strong enough at the percentage needed for penetration into the ground. Used at 15% it penetrates easily but



Fig. 8.4. Detail, screen (B69M52), before treatment, showing black overpaint and cracking.

does not hold the distorted lacquer for more than a few days; at 30% , it will hold the lacquer in place but does not penetrate well. Other conservators have had success in using this method, but I prefer the fish glue.

I would not recommend the use of urushi for the consolidation of these screens for several reasons. There are times when the use of urushi is acceptable, but in general it is not compatible with our North American conservation ethics due to its lack of reversibility. Because it takes a several years of training to be able to judge the correct strength of urushi to use for consolidation, few Western-trained conservators are familiar with its use. Mistakes cannot be corrected once the urushi has hardened. Thus, unless the conservator carrying out these treatments is trained in the use of urushi, it is not appropriate. In addition, these screens have already been treated with other materials, most notably wax. Some Japanese conservators have reported that on occasion

urushi will not harden properly in the presence of wax. Further studies need to be done on this subject before urushi-based treatment could be considered in these circumstances.

For these screens the removal of wax using mineral spirits would be the first step in cleaning. Mineral spirits will not dissolve Asian lacquer or its degradation products but it is not the most efficient cleaning agent. It will remove wax and oily dirt, such as recent fingerprints, but most dirt that accumulates on the surface is best cleaned with a polar solvent. Should fingerprints and grime remain, cleaning should be continued using ethanol swabs. Because ethanol evaporates more quickly than water does, there is less likelihood that staining will occur as degradation products are mobilized by the solvent. Overpaint too, can be removed during cleaning. Brief tests made during my examination of the screen show that the paint can probably be removed with ethanol without affecting the lacquer surface.



Fig. 8.5. Red paint on screen (B69M52), showing cupping of paint and flaking of surface; before treatment.

If the surface is sound, cleaning with water may also be an option. Water can be applied on a cloth that is barely damp. The goal is to remove the polar dirt without removing the lacquer degradation products. If one proceeds extremely slowly and cautiously, it is possible to remove the dirt and not the degraded lacquer. The color of the swab or cloth should be observed carefully during cleaning. As long as only gray dirt is removed and not the brown lacquer, cleaning can continue. Microporous latex cloths, available under proprietary names such as Mr. Clean in Australia and Sun Glo in Canada, are useful for cleaning. They can be wetted and wrung out leaving them only slightly damp. They leave so little water on the surface that it evaporates almost immediately, helping to eliminate the problem of streaks that can occur when cleaning with water.

It is recommended that chemical analysis of the pigment and binders be undertaken before treatment of the flaking paint. It is likely that

the pigments are bound with a water-based adhesive. A consolidant of either a 1% solution of gelatin in water or B-72 in ethanol could be applied in several coats without affecting the matte appearance of the pigment. This matte appearance should be preserved as part of the original aesthetic wherein the matte color contrasted with the highly polished black lacquer. The advantage of the gelatin is that a 1% solution could be applied by brush without distorting the pigment color or gloss. A concentration of a 1/2% of B-72 in ethanol could also be used, but would have to be applied with a nebulizer or ultrasonic mister to avoid darkening the pigment or leaving a gloss on the surface. Several applications would be necessary to achieve complete consolidation and areas that were not to be coated would have to be masked off. Other conservation literature should be consulted for the proper use of the method. An advantage of B-72 is that it is distinctly dissimilar from the original binder and easily identified as a later addition.

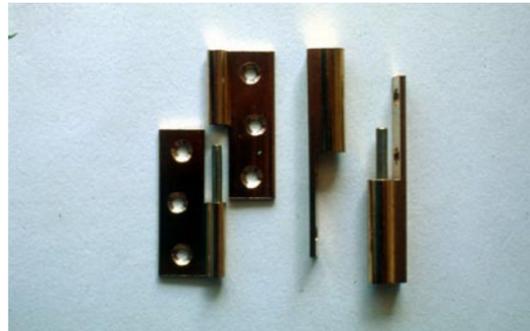


Fig. 8.6. Modern loose-pin hinges.

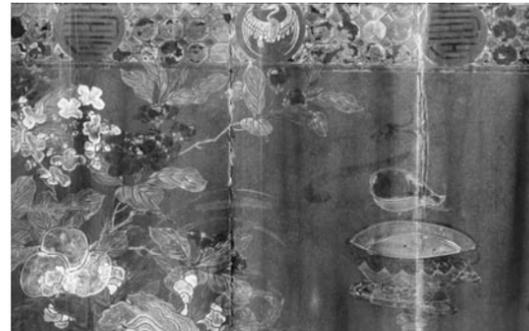


Fig. 8.7. X-radiograph of screen (B69M52), showing bamboo dowels and radio-opaque putty. Technical data: Norelco X-ray unit (150 kV max.); Kodak Industrex AA film; 40 kV, 5 mA, 30 seconds; distance from tube, 36 inches.



Fig. 8.8. X-radiograph of screen (B69M52), showing filled holes along edge for old hinges. Technical data: Norelco X-ray unit (150 kV max.); Kodak Industrex AA film; 40 kV, 5 mA, 30 seconds; distance from tube, 36 inches.



Fig. 8.9. Detail of damaged area on screen (B69M52), showing paper layer between the lower ground layer that included large, loose fibers in it and the subsequent, finer ground layer.

Once the screen has been cleaned and consolidated, its appearance may be improved. Losses should be infilled not only for aesthetic purposes but also to protect the exposed edges from further damage. Shallow losses can be filled with a paste made of 6% polyvinyl alcohol and calcium carbonate. Because this paste can be applied easily, dries quickly, and can be burnished to a very smooth finish, it seems a good candidate for use as a fill in this lacquer project. Furthermore, a polyvinyl alcohol and calcium carbonate fill is readily reversible using only slightly damp swabs. Tinting the fill is useful for areas where it is likely that more damage will occur and expose the undercoat, for example on the feet or surrounding the hinges. If, however, they are left white, the fills are more readily identifiable later. Once dry, the fills can be dry sanded or smoothed with a slightly damp swab.

To inpaint fills in the lacquer Primal WS-24 acrylic dispersion tinted with water-soluble aniline dye is most useful for imitating a variable and translucent faded lacquer surface. The Pri-

mal can be dyed to the natural color of the Asian lacquer and then applied in thin coats until the desired depth of color is reached. Once the color is matched a couple of thin clear coats can be applied. This acrylic is hard enough to be polished so that the degree of gloss can be matched to that of the surrounding surface. Micromesh polishing cloths are ideal for bringing the gloss up to the desired level. Starting at abrasive level 4000, one can move right through to 12000 if a mirrorlike finish is required. Watercolors or Liquitex acrylic emulsion paints may be used to inpaint losses to colorful painted areas if desired. Because the paint will already have been consolidated, this will act as the barrier coat for the inpainting.

The modern hinges should not be reused. The size and weight of the screen with all the panels joined together make handling very difficult. New hinges should be made so that each panel can be handled separately. It may be necessary to have this type custom-made but worthwhile in the long run. See fig. 8.6 for an example of the recommended hinges.

JANE WILLIAMS WRITES:

#### *Methods and Techniques of Manufacture*

The wood structure was identified as *Cryptomeria japonica* (Japanese cypress). As Ms. Webb has noted, vertical cracks reflect the panels' construction from multiple boards. X-radiographs (see fig. 8.7) showed that the panels are constructed of vertical planks edge-joined with horizontal bamboo dowels. Glue is not discernible on exposed join edges, but it is likely that the planks were glued together. The widely spaced dowels (more than 15 cm apart) would not have been strong enough on their own. The width of the central planks varies along their length by up to 5 cm, but they are sawn to fit together tightly. A horizontal crosspiece is secured across the top edge with vertical wood dowels and across the bottom between the extended side panels that form the feet. They must impart some structural stability to the nearly three-meter-long planks, but these crossbraces have also contributed to the vertical cracking in the panels. All of the cracks through the lacquer

occur at the joins between panels and originate at the top and bottom, where the vertical planks meet the crossbraces (see fig. 8.4).

The individual panels were connected originally with simple loop-and-pin hinges, which allow the panels to be moved and handled separately. Paired holes, now covered over with wood and fills, for the attachment of two hinges per edge, are discernible in X-radiographs (fig. 8.8).

Once each panel had been constructed, surface defects such as gaps between joined planks and knots were filled with putty. This putty can be detected in X-radiographs, where its relative radio-opacity suggests that it may contain lead compounds, such as lead white. The surface was then coated with a dark gray ground layer mixed with long, loose fibers, visible in areas of damage. In one of the largest areas of damage over a complex corner join, a paper layer was detected on top of this lower ground layer (see fig. 8.9). This layer was not apparent in the other, predominantly edge losses, so it may have been applied only over joins in the wood.



Fig. 8.10. Detail of figure with finely painted detail on his red robe.

Each panel was then coated with a thick gray ground layer, no finer than the first layer, but not containing loose fibers. Ming- and Qing-dynasty Chinese texts list kaolin, ceramic powder, ash or charcoal, and powdered horn or bone as among the bulking agents added to lacquer ground layers. In addition to urushi, the binders for ground layers could include animal glue, pig's blood, starch or lotus juice. Consistent with the literature, protein, clay, quartz, and cellulose were detected in the ground layer. Urushi was not detected in the ground layer by FTIR spectroscopy. The panels were then coated with lacquer. The Chinese term for the type of lacquer decoration used to make this screen is *kuancai* (polychrome carving). The images, designs, and inscriptions on the surface were carved through the cured lacquer layer. The recesses were coated (not filled completely) with a thick layer of paint or with gold leaf. Most of the polychromy does not appear to have been restored. The palette of repeating colors is relatively limited. Also, most areas are embellished with very finely painted details applied to the base color (see fig. 8.10). This delicate painting is presumed to be original. This approach to identifying different colors used in the paintings is not terribly scientific. If the museum had access to some type of nondestructive testing, the best approach would be to do a systematic survey of the surface to identify the range of different colors before sampling. To identify the colorants used and to study their layering, two or more samples were taken of each distinct color identified by visual examination, with an effort made to avoid areas that appeared to have been restored. The chart in fig. 8.11 shows the representative colors used in the polychromy—the areas sampled, photomicrographs of the cross sections, and results of analyses. Lead white was the pigment used most extensively. It was

used on its own and as the underlayer for most other colors, including the orange, blue, green, pale yellow, lavender, and black. Certain areas of the paint, particularly the white areas, have bubbles in the surface. The localized use of metallic pigments is clearly visible in the X-radiographs. Two of the more intense colors do not always have a lead white underlayer—the bright yellow, made with orpiment, and the deep red. The latter is a layered color having an orange-colored red lead underlayer glazed with a deeper red mixture of red lead and mercuric sulfide. The pigments were identified by a combination of SEM/EDS and polarized light microscopy of dispersed samples. The presence of lead in both layers was confirmed by X-ray dot mapping (see fig. 8.12). The other pigments used include common mineral pigments, such as green malachite and blue azurite. The black used to make the figures' hats is carbon black. Two of the colorants, used for a pale yellow color on some robes, and a lavender or rose color found on many flowers and on the base of the pavilion, could not be identified by the analytical techniques used for this study, and may have been organic colorants. Perhaps due to fading, this rose color can be detected only where it is pooled more thickly around the edges of the flowers (see fig. 8.11), which otherwise appear white. Gold leaf was used for architectural details, some of the antiquities, certain clothing, and for the inscription on the reverse. In the inscription, the gold leaf was applied over a layer of orpiment, which is not found under the gold leaf anywhere else.

#### *Treatment History*

There is evidence of at least two major campaigns of repair to the screens, but almost no documentation. The screen has no readily identifiable repairs made with urushi. For the first substantial campaign, what appear to be Euro-

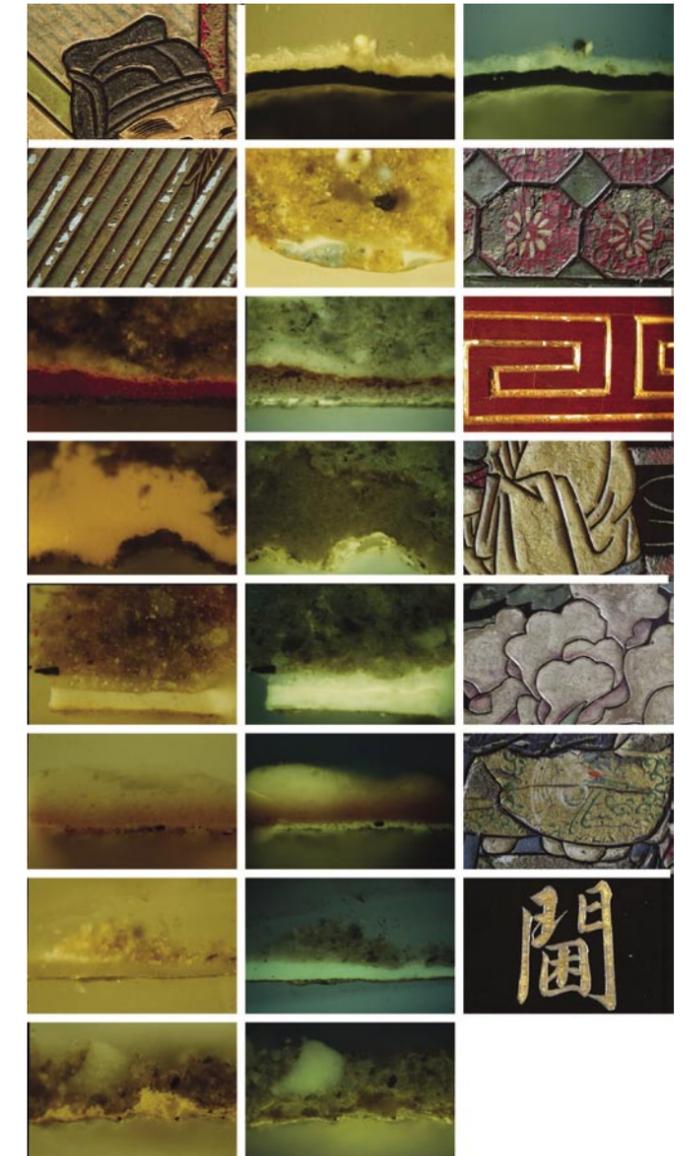


Fig. 8.11. Chart of representative paint samples.

pean materials were used: what appears to be a beige gesso coated with paint and a varnish. The largest damages and fills are found on the two end panels. On panel A, an area of the surface comprising approximately one-eighth of the front of the screen and a smaller portion of the reverse were carved out and replaced with fills. These fills match the style of the original surface decoration so well that the restorer may have had the damaged original surface to use as a model. Because the damaged areas were cut out and the remaining lacquer around them is in good condition, it is impossible to determine whether the localized damage was mechanical or caused by moisture. In this campaign the losses were not overfilled. In the process of finishing these fills, the surrounding lacquer was scratched and abraded until quite thin in some areas. The fills are generally stable and intact, except on the large restoration on panel A, where large areas of fill are cracked and separating from the wood.

The second major restoration was done more hastily. Again, a Western gesso appears to have been used to fill losses. This buff-colored fill, softer than the early restoration gesso, is readily soluble in water and contains carbonates. The gesso was applied over the length of most edges, rather than only to damaged areas. It was applied in and over long, vertical cracks and localized surface losses. Again, the lacquer around the fills was badly scratched in the process of smoothing the fills. The gesso fills were coated with a black paint that is readily soluble in acetone and somewhat soluble in ethanol. Like the fills, the paint was applied well beyond what it needed to cover, in many places covering several centimeters of the original surface. The replication of original carved and painted designs was clumsier in this campaign than in the earlier one. Most of these fills are still intact, but the

gesso has cracked and become detached in many places, predominantly where it was applied to fill cracks or large losses or over intact lacquer.

The second round of restoration seems too extensive to have been the treatment documented in 1971, when “spots of missing polychromy were touched up,” and the precise locations of the touch ups were not definitely identified on the surface. Some losses to the red polychromy have been thinly inpainted with orange red paint directly on the exposed ground, and could date to the 1971 treatment.

#### Condition

The panels are in good, structurally sound condition overall. Their primary structural problems are the open cracks through the lacquer and ground layers at the top and bottom of each panel along joins in the wood. These are primarily vertical, along joins between the lengthwise planks, but there is also cracking along the edges of the crossbraces. In the wider cracks, gaps of more than 2 mm are visible between planks. As mentioned above, the lacquer probably cracked because the wood planks have shrunk and their movement has been restricted by the crossbraces. Temperature and humidity fluctuations and stresses related to handling probably also contributed to the problem. Lacquer and paint have lifted and flaked off along most of these cracks. The two end panels have large areas of surface loss that are centered around the join where the lower crossbrace abuts the end plank that extends to form the foot.

The edges of the panels all show a great deal of wear. There are numerous losses to the lacquer and ground along the edges, and previous restorations are concentrated here. The wood is chipped and worn in some areas, particularly on the feet. Thin wedges of wood have split off along many of the lower side edges. Handling

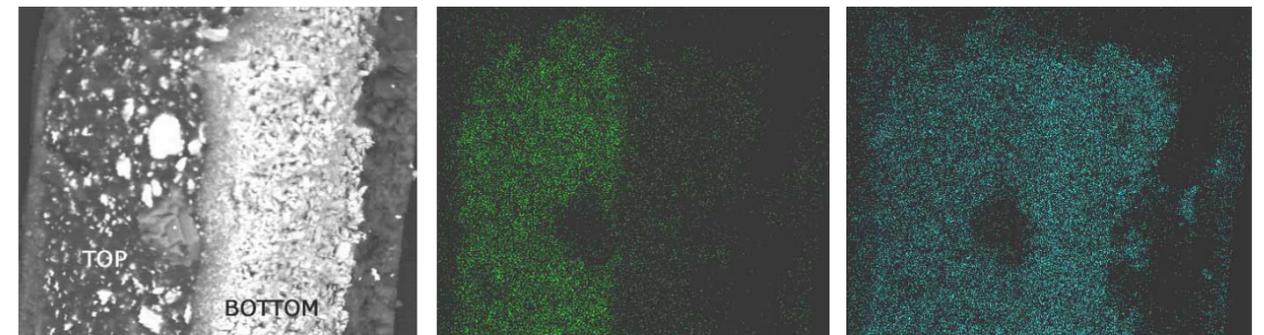


Fig. 8.12. X-radiograph dot maps of red pigment for lead and for mercury; dot maps for iron and cadmium were unremarkable.

such large and unwieldy panels is difficult and has caused much of the edge damage. The process of linking and unlinking the panels with metal loops and pins protruding from the edges probably caused a certain amount of damage. At some point the old hinges were replaced with European-style, brass screen hinges. Some flaking losses to the lacquer occurred when channels were cut in the edges for the new, recessed hinges.

Apart from cracking associated with mechanical damage and small lifting areas along cracks or losses, the lacquer, as Ms. Webb pointed out, is in very good condition overall despite evidence of light damage. As she observed, the side of the screen with the palace scene that has been displayed outward the most, has turned lighter brown and dull, while the side with the inscription remains darker and very glossy. Fine, horizontal cracks have formed in some areas of the lacquer on this side of the screen. The report of an examination in 1990 documented that the screen has been displayed for more than twenty years with light levels above 125 lux.

The condition of the paint is related to color. The red paint is in the worst condition by far. Little remains of the original, and what does re-

main is badly cupped and actively flaking (see fig. 8.5). The areas with gold leaf are also in poor condition, exhibiting severe cupping, flaking, and loss. Cross-section samples were analyzed to determine what makes the red and gold layers less stable than the other colors. The same protein binder was detected in the red and gold areas as elsewhere, but it was found that each has a layer of protein binder that contains little or no pigment: for the gold, this is the mordant and, for the red, it is the deeper red surface glaze (described above). The cupping in both these cases is likely due to the shrinkage of this layer. Apart from the areas adjacent to structural damage, most of the rest of the paint is in reasonably stable condition.

Ms. Webb described areas of unstable paint that are cleaving in the middle of the layer and exposing brighter, underbound paint below. Upon further examination, what appears to be flaking is a later coating that is sometimes taking the surface of the paint with it. Analyzed with FTIR spectrometry, this coating, like the original paint, was found to contain protein with a mixture of inorganic contaminants. This material was either dirty or sticky when it was applied. It is now brownish and contains substantial



Fig. 8.13. Red paint on screen (B69M52), after consolidation.

amounts of particulate and fibrous debris. In near ultraviolet light it fluoresces a mustard-yellow greenish color. This coating is clearly not original, because in UV light it can be seen to cover large areas of ground exposed by losses to the red paint. Another coating that absorbs UV light can be detected on top of this one. This second coating appears mainly on highpoints in the middle and very edges of the painted areas, as though it had been quickly wiped on the surface. The solubility where the second coating is present is no different from that of the areas that have only the first coating, perhaps because it is so thinly applied. A thick residue of wax, identified as a petroleum wax, can be detected in a few carved recesses. Where it is thick, the wax fluoresces a bright white in UV light, but this fluorescence is not visible overall. Like the second coating, its presence is not detected in solubility tests on the lacquer or paint surfaces. Many other lacquer objects in the collection also have records of having been waxed with an unspecified wax. I found that most had a similar solubility in a combination of ethanol and Stoddard solvent. For this



Fig. 8.14. Detail, screen (B69M52), after treatment; this image shows the area of the screen to which test fills using Japanese tissue were applied to losses on the red and gold painted areas.

reason and because a discreet sample of the wax was easy to obtain from the recesses, a sample was sent for analysis. Infrared spectrometry identified it as a petroleum wax, a category which includes microcrystalline wax, possibly also containing a small amount of beeswax.

Cross-section samples of the yellow pigment were taken to determine whether its distinct brown color, remarked upon by Ms. Webb, was the result of chemical alteration of orpiment pigment. In fact, its brown surface comes from the dirty protein-rich coating (see fig. 8.11, where it may be seen that, in UV light, the top layer, which appears brown in reflected light, contains no yellow pigment and has a fluorescence distinct from the rest of the sample). Small tests entailing the removal of the dirty coatings revealed the underlying paint to be much brighter than it currently appears. The response of the paint to cleaning is color-specific. In many areas the paint surface is very resilient to cleaning with saliva or small amounts of water. Not surprisingly, this is particularly true in light-colored areas, where the surface color is based on lead white. How-

ever, in other areas, particularly the blue and green areas, the paint under the coatings is very friable and water-soluble. It appears that the friable areas of paint had lost their original surface at some point, exposing underbound paint below, and that the coating was applied directly to this underlayer. The application of the water-soluble coating to the underbound paint makes it unlikely that the coating could be removed without damaging the remaining paint. Unfortunately, if the coating cannot be removed from certain areas or colors, it should probably not be removed at all, lest that leave the surface looking very uneven.

The surface has a moderate layer of surface dust. Along the edges it is covered with large, oily finger and handprints.

#### *Treatment*

This screen underwent a thorough conservation treatment because it was slated for exhibition in the new museum. The sheer size of the screen meant that any conservation treatment would be very time-intensive. While the twenty-two-month project allotted an average of one month to treat each object, I estimate that the treatment of each panel took between 100 and 150 hours of conservator time. For this reason, it could not have been treated without the help of numerous conservators and interns who worked in the lab during the project: Tonja Morris, Blanche Kim, Rowan Geiger, Nicole Grabow, Christopher White, Jennifer Kim and Jennifer DiJoseph.

The first step was to remove the restoration paint. This paint is very readily soluble in acetone and somewhat soluble in ethanol. Because acetone is a better solvent for the paint and evaporates quickly, it removes the paint thoroughly while exposing the lacquer to less contact with solvent. The solvents do not cause any visible change to the lacquer surface. The painted areas

were wiped with cotton lintens dampened with acetone and then immediately with dry lintens. The old gesso fills were removed or reduced by being dampened slightly and then carved down with a scalpel. The lacquer surface under the overpaint and overfill has a deeper color and gloss than the surrounding lacquer. The paint may have stained the thin lacquer, but the darker color and gloss of the underlying lacquer appear primarily to be a result of its being protected from light.

The next step in treatment was an overall cleaning of the panels. The surfaces were first cleaned, avoiding areas of flaking paint, with a soft brush to lift the dust and a vacuum attachment held away from the solvent to capture the dust. Brush or wiping marks remain across the surface, probably evidence of the wax application. As described in footnote 17, the wax is insoluble in petroleum distillates and ethanol alone. However, a mixture of 1:1 Stoddard solvent : ethanol applied with a soft cloth cleaned the surface reasonably evenly and without affecting the lacquer adversely. Some gloss was restored to the lacquer with the cleaning process, although some areas remain persistently duller. This cleaning process is probably thinning and buffing the wax layer, rather than removing it completely.

The next step was to stabilize the areas of lifting lacquer along losses. The exposed ground is porous and friable, so the first step was to consolidate the ground. Around some of the large gesso fills the original ground layers and lacquer appear swollen and distorted from exposure to moisture from the restoration gesso. The swelling of the ground layer is not surprising as it has a protein binder and contains organic fibers and clay. For this reason I decided to test solvent-based adhesives rather than use the aqueous cold fish glue suggested by Ms. Webb. A 5% solution of B-72 in 4:1 acetone : ethanol was flowed into the exposed

ground with a small brush. The consolidated areas were covered tightly and immediately with polyethylene sheeting and left for several hours to slow the evaporation of the solvents, so that the even penetration and distribution of the adhesive would be maximized. Xylene was also considered as a solvent for the consolidant but was rejected because it is toxic and because the museum lacks adequate ventilation for such a large object. Also the very slow evaporation of xylene can inhibit adhesion even weeks later. A thicker (roughly 15%–20%) solution of B-72 in acetone was used to adhere the lifting lacquer. A consistency of adhesive was chosen that was just thin enough to flow under the paint, but slowly. Where the lacquer showed movement, but was not lifting, the area was covered with silicon-coated Mylar, a piece of Plexiglas, and weights. Some areas of lifting lacquer needed more pressure and there clamps were used rather than weights. This procedure usually stabilized the lacquer, but occasionally a second application of consolidant was needed. The preconsolidation of the ground appears to be essential in effectively consolidating the lacquer with acrylic resin.

For the reasons just described, the same consolidant and two-part application was used to consolidate the lifting paint and gilding. Aqueous adhesives would pose the additional problem in the polychrome areas of partially removing the water-soluble darkened coating on their surfaces during cleanup. An aqueous adhesive might have helped to relax the cupped paint, but instead I flowed the B-72 solution under the cupped paint with a small brush, and then used a heated spatula over silicon-coated Mylar to relax the cupping and tack down the flakes by speeding the evaporation of the solvent. Figs. 8.5 and 8.13 show an area of the cupped red paint before and after consolidation.

The next repairs were to stabilize the vertical cracks in the lacquer. The cross-bracing of the

panels makes it impossible to close the gaps between the vertical planks. Once the restoration paint and overfill was removed, the narrower cracks were left untreated. The larger cracks are visually distracting and leave the lacquer at the edges of the cracks exposed and vulnerable to further loss. For these reasons they were filled. For the gaps between the wood a fill was chosen that would support the surface fill and have adhesive strength to inhibit individual movement of planks but still allow some shrinkage. The gaps were filled with wadded Abaca tissue (which has long fibers and wet strength) mixed with dilute B-72 in 4:1 acetone : ethanol.

Losses to the lacquer surface were filled to integrate them visually, but also to protect the lacquer surrounding the losses from further damage. Before the losses were filled their surfaces were sealed with dilute B-72 in acetone. The sealant layer was applied to inhibit the absorption of water from the new fill into the original ground or wood surface, and to make it easier to remove the fill if necessary in the future. The surface fills needed to be smooth to replicate the lacquer surface. The choice of fill entails several considerations. In general, I prefer to use a fill that I have mixed myself, rather than a proprietary brand, because I then have more control over the characteristics of the material. I have found acrylic resin-based fill mixtures difficult to apply quickly and have had trouble achieving perfectly smooth fills with them. For health reasons, I also preferred to not use solvent-based fills when they would be thickly applied and over a large area. Ms. Webb suggested a polyvinyl alcohol (PVOH) and calcium carbonate fill for the screen. PVOH has benefits over other aqueous binders, such as rabbit-skin glue: it shrinks much less and does not have to be heated. Ms. Webb's experience and that of others suggests that the most stable PVOH resins are those with low molecular weight (LMW) and low percentage hydrolysis. I

tested a LMW PVOH from Air Products at 4%, 6%, and 8% in mixtures with calcium carbonate on a sample board. The mixture at 6% was found to have the best working properties without being stronger than the original ground layers. The first test samples of this fill mixture were made with precipitated calcium carbonate. When applied to a thickness of more than 1/8 inch, this mixture developed shrinkage cracks in drying. To determine whether the fineness of the bulking material was affecting the formation of cracks, different mixtures were made up. Six percent LMW PVOH was mixed with, variously, precipitated calcium carbonate, ground Champagne chalk, and ground marble dust. The marble dust mixture did not crack at all, the Champagne chalk mixture showed minimal cracking, and the precipitated calcium carbonate again cracked extensively. The most satisfactory fill material in terms of its smoothness, lack of cracking, and hardness or strength was 6% LMW PVOH mixed with ground Champagne chalk. This fill mixture showed good adhesion to the sealed substrate, even when applied to very shallow losses. The best results were obtained when the fill was mixed to a thick consistency, somewhere between that of cream cheese and that of dough, and when it was applied in a layer 1/4-inch thick or less. The fill was easiest to use when applied in a single pass, as carefully and smoothly as possible, overfilling the loss very slightly, and then sanding minimally to the finished level and smoothness. The fill material can be smoothed quite well in application, which will save time in finishing and minimize the mess and risks associated with sanding. Stainless steel spatulas work much better for smoothing than do aluminum ones, which stick to the thixotropic mixture. Rubber spatulas sold for working with clay also work well. The reason to overfill is that it is difficult to apply small amounts of additional fill to fix imperfections: wet fill does not adhere well to the dried fill un-

less the surface of the existing fill has been dampened slightly. The fills were sanded with 400 and 600 grit sandpaper, with great care being taken to avoid the surrounding lacquer surface, and then with Micromesh cushioned abrasive cloths ranging from 1500 to 12000 grit.

For deeper or very large losses, I felt that a stronger fill than the PVOH and calcium carbonate fills would be more appropriate. I used a mixture of 20% B-72 in acetone bulked 1:1 with 3M glass microspheres and CF-11 fibrous cellulose powder. The dry ingredients were mixed with the resin until a fairly dry, almost crumbly mixture formed. When dry this mixture had good adhesion to the substrate and slightly softer than the wood. The mixture of dry ingredients was used because glass microspheres provide bulk (reducing shrinkage) and hardness to fills and the cellulose powder, because it is fibrous, makes the fills slightly softer and tougher. The bulked acrylic resin fills were brought to just below the level of the lacquer and were surfaced with the polyvinyl alcohol and whiting mixture.

To imitate the brown-black lacquer on the fills, three different inpainting materials were tested on a sample board: aniline dyes, Golden's acrylic emulsion paint, and Rowney FW aqueous acrylic inks. The acrylic inks were chosen because they gave an even, translucent color in a few coats. The aniline dyes, suggested by Ms. Webb, took many more coats to provide the same coverage with similar translucency. The acrylic inks also have better color stability than the aniline dyes. The acrylic paint did not go on as evenly or provide translucency. The acrylic ink alone had enough gloss to match the some of the duller areas of the original surface. When more gloss was needed, I used Primal WS-24, as Ms. Webb had proposed. Primal WS-24 is an acrylic colloidal dispersion in water, provided at 36% solids. It was thinned until it brushed out well and had the desired gloss level. It mixed



Fig. 8.15a. Screen (B67M8+), before treatment—first section.



Fig. 8.15b. Screen (B67M8+), before treatment—second section.

well with the acrylic inks, so generally I applied the initial coats of acrylic ink and then mixed diluted Primal WS-24 with the final coats of ink. Figs. 8.4 and 8.14 show a detail of one panel of the screen before and after treatment.

The losses to the paint were not filled. Being recessed, they are less vulnerable to further loss than the lacquer is. Michael Knight, Senior Curator of Chinese Art at the museum, concluded that the losses to the painted areas were visually acceptable given the age and size of the screen, and the limited time for its treatment. While we were discussing this, I did tests to determine what might be an appropriate way to fill these losses. The paint is so cracked and rough that the PVOH/calcium carbonate fill seemed inappropriate. I wanted a fill that would

be easier to separate from the original paint. Tests with thick wet-strength tissue toned with acrylic paint were quite successful at matching the opaque paint and visually filling the loss (see fig. 14). The tissue was cut or torn to bridge the loss and tacked to the exposed ground in the loss with dilute B-72 in acetone.

The modern hinges had been removed from the screen in 1990 in order to facilitate storage. As Ms. Webb suggested, loose-pin hinges that allow the panels to be separated easily have now been fabricated for the screen. The new hinges were made to fit the recesses and screw holes of the modern hinges. The hinges were not attached to the screen until after the move to the museum so that the panels would be easier to pack if we did not have to be concerned about the hinges bump-

ing and damaging adjacent edges. In the end the curator decided to display the screen flat against a wall and the hinges were not attached at all.

The screen is currently on view with light levels held under 50 lux. Cotton muslin covers were stitched for the individual panels for use in moving and in storage. Tyvek was used for many furniture covers but muslin was used for this object as the panels are in quite close contact with one other and might be damaged because Tyvek has a slight texture and is impermeable to moisture. The covers were designed as pockets stitched on three sides, with one long side left open to make them as easy as possible to slide off and on with minimal contact with the lacquer and paint. To keep dust and light out, the open edge rolls up and has hook-and-loop closures.

**S**creen (B67M8+). China, Kangxi period, end of the 17th century. H. 235.3 cm; W. 51.75 cm (single panel); D. 1.5 cm. This ten-panel screen with kuancai decoration has, on each of the eight central panels depictions of various views of landscapes in the area around Hangzhou. Near the top of each scene is a descriptive title. The reverse of each panel is inscribed with a poem about the scene and the signature of the dedicatory inscriber. On the two end panels and along the bottom of the eight panels, mythical beasts are shown in landscapes. Some of the “hundred antiquities” are shown across the top of the front side and the top and end panels of the reverse. Floral motifs decorate the bottom of the eight central panels on the reverse.

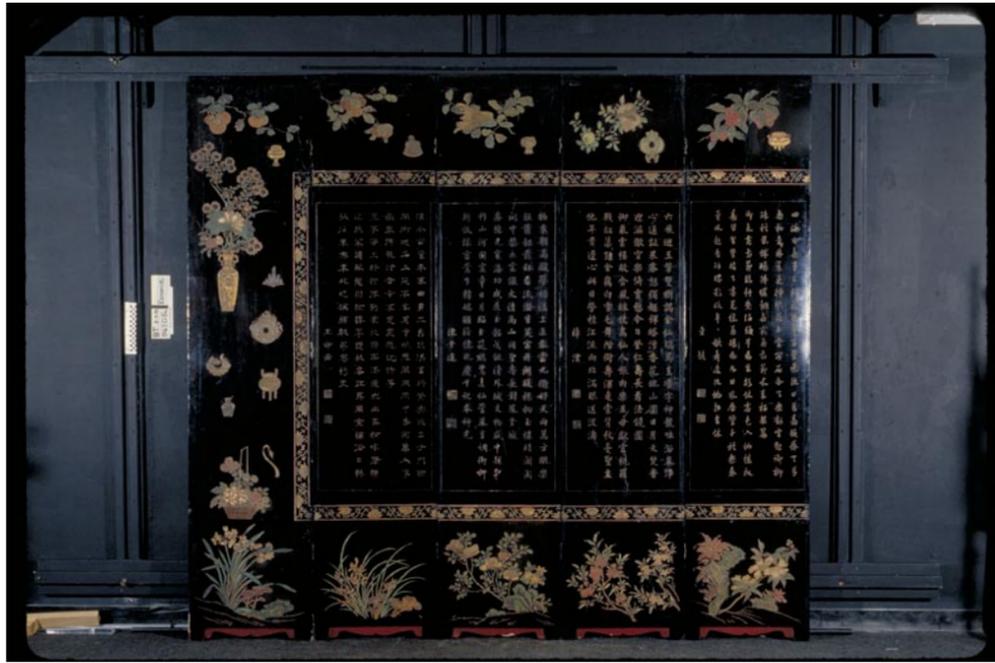


Fig. 8.16a. Screen (B67M8+), after treatment—first section, reverse.

#### Conservation Record

The screen was acquired from the Compagnie de la Chine et des Indes, Paris, in 1967. There is no record of its prior treatment.

MARIANNE WEBB WRITES:

#### Condition

The screen has suffered the same fate as the twelve-panel screen (B69M52), with cracking caused by changes in relative humidity, light damage, and previous restorations. The cracking pattern between the boards reveals the underlying structure and shows that the panels have a rectangular frame holding several vertical boards. There are cracks between the horizontal top pieces and the vertical boards; see figs. 8.15 and 8.16.

On the backs of the panels is a series of cracks perpendicular to the grain of the underlying wood, see fig. 8.17. These have not, as one might assume, been caused by changing relative humidity, but by stress within the lacquer layers that developed during the original manufacture. As lacquer dries there is a small degree of shrinkage, which produces tension in the lacquer layers. This tension is equal in all directions, both across the grain and with the grain of the underlying wood. If the wood core dries out, as often happens with lacquer exported to the West, the tension across the grain is relieved as the wood shrinks. But, because wood shrinks very little along the length of the grain, the stress remains in this direction. Eventually the stress overcomes the strength of the lacquer surface, resulting in a



Fig. 8.16a. Screen (B67M8+), after treatment—second section, reverse.

series of cracks across the grain. In lacquerware, these parallel cracks are usually quite uniform in their spacing, appearing approximately one centimeter apart.

Other structural changes include the application of Western hinges. On the edges the grooves that once held the pins or loops have been filled and overpainted, see fig. 8.18.

#### Suggestions for Treatment

The treatment of this screen should follow the same pattern as that for B69M52, with a few changes. Although the fish glue may work just as well, another option for the consolidation of the horizontal cracks in this screen is the use of Rhoplex AC 234. These cracks often occur quite early in the history of the piece and have a

strong memory of their distorted shape. In most cases Rhoplex AC 234 is strong enough to hold the curled lacquer down even at the edges of the cracks. This method also allows the curling lacquer to be put down without the use of clamps thus saving precious time when dealing with large surfaces. Other adhesives such as Paraloid B-72 and Beva 371 have been used by the author in similar situations but they did not have the strength to hold the flakes down for more than a few days.

Rhoplex at full strength is brushed on the open cracks, where it penetrates into the ground, and is allowed to dry until the adhesive turns clear. The lifting lacquer can then be adhered flat with a warm tacking iron. The use of silicone-coated Mylar is recommended both



Fig. 8.17 Detail, screen (B67M8+), showing one long crack along joint in wood and finer cracks perpendicular to the wood grain.



Fig. 8.18. Detail, screen (B67M8+), showing wood filling old hinge holes and groove.

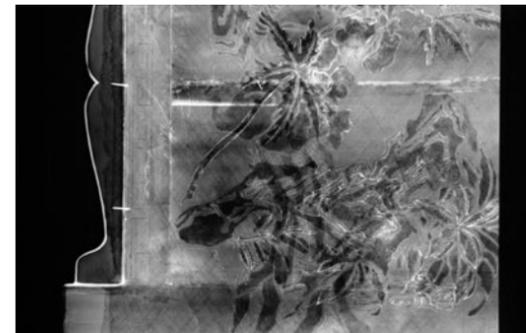


Fig. 8.19. X-radiograph, screen (B67M8+). Technical data: Norelco X-ray unit (150 kV max.); Kodak Industrex AA film; 45 kV, 5 mA, 60 seconds; distance from tube, 36 inches.



Fig. 8.20. Detail, screen (B67M8+), showing fills and yellow spattered coating.

to protect the lacquer and to keep the Rhoplex from sticking to the tacking iron. Excess adhesive can be removed from the surface with ethanol. Like other water-based adhesives, Rhoplex AC 234 will mark the surface of some lacquer, so testing before use is very important. The use of heat must be monitored carefully to avoid a thermochromatic change in the lacquer.

The hinges should be removed. For a strong structural fill that will allow the attachment of new hinges, the holes should be filled with epoxy and microballoons. As recommended for B69M52, new hinges should be made that allow each panel to be handled separately.

JANE WILLIAMS WRITES:

#### *Materials and Methods of Manufacture*

One panel, panel F, was X-radiographed to study the construction of the screen. It was constructed from a number of vertical boards—on this panel there are five, varying in width from 1.5 cm to 17 cm) glued together. Unlike the previous screen (B69M52), there is no evidence

of pins or dowels securing the boards. Like B69M52, the end planks extend longer to make the feet, and the panel has crossbraces along the top and across the bottom between the feet (see fig. 8.19 <Sc/B67M8/5>). A separate piece of wood forms the shallow, decorative socle set into slots in the feet and lower crossbrace. The X-radiographs show small wire nails securing the socle, likely dating to a modern repair. The screen now has European brass screen hinges. In the X-radiographs the sites of traditional pin and loop hinges are visible. The insets for the old hinges have been plugged with nailed-on wood strips.

The wood was covered with a diagonally oriented plain-weave textile to even the surface and reinforce joints. The loosely woven textile has a coarse, tan plant fiber warp and a finer, white fiber weft. The panels were coated with one or more gray foundation layers, then with unpigmented lacquer. When the lacquer had dried and was polished, the decoration and inscription were carved into the hard surface. The recesses were painted in various colors. The

composition of the surface layers was not studied, because there was not enough time for a thorough assessment. As suggested for B69M52, a good approach might be to map the surface with a nondestructive technique, such as a portable XRF spectrometer or a laser, before taking samples.

#### *Condition*

Two pieces of wood, each roughly 8 cm high and 1 cm thick, have split off the lower left edges of panels I and J. The panels have numerous losses to the lacquer and ground, primarily along the edges and feet. Like B69M52, the panels have vertical cracks originating along joints. There is extensive fine cracking throughout the lacquer surface. While minor localized areas of the lacquer are lifting and cupped, most of the lacquer and ground remains well adhered to the wood. There are numerous scratches, gouges, and dents throughout the surface.

Examination of the surface of panel F in visible and near ultraviolet light suggests that it has been coated repeatedly. On both sides the lower

design field has an overall light-colored speckling and a clear coating, both of which have a strong yellow fluorescence in near ultraviolet light. The speckling appears in the same location on all of the panels appears to have been applied deliberately, like an imitation nashiji (see fig. 8.20). The clear coating was also applied along the top edge. The rest of the front surface has a clear coating that has a bright orange fluorescence, like shellac, in ultraviolet light, and slightly overlaps the yellow fluorescing coating. Localized inpainting was done with a material that fluoresces a bright white in ultraviolet light. Subsequent to the clear coatings, a dark paint was sprayed (in ultraviolet light the fine spattering is visible and appears brown) on the edges near the top and bottom. The reverse has an overall brushed-on coating with a dull grayish fluorescence. It is not possible, because of the interference of all its strongly fluorescent coating, to determine with visual examination whether this coating was also applied to the front. As a result of the number of coatings and small areas of restoration, the lacquer surface has



Fig. 8.21. View of screen (B67M8+) in storage in new museum building, showing muslin covers.

an uneven color and gloss. It has numerous finger and handprints on the surface, mostly around the edges from handling.

#### Treatment

Because of the extensive restorations and the poorer condition of the lacquer surface, a complete examination and treatment of this screen to remove restorations, stabilize the lacquer, and fill losses would probably be more complicated and time consuming than the treatment of the larger screen (B69M52). Due to time constraints and because there is no plan currently to exhibit it, this screen was treated only to enable it to be moved without sustaining further damage. As Ms. Webb suggested, the hinges were removed from the screen to facilitate the handling of the panels. If the screen needs hinges for display, loose-pin hinges, like those for B69M52, could be made for it. The two pieces of wood that had split off the lower sides were reattached using hide glue.

Because the edges of the panels are so vulnerable, the decision was made to quickly consolidate and fill the edge losses to prevent further losses to the adjacent lacquer. The surfaces of the losses were sealed with 10% Paraloid B-72 in

acetone. When this sealant had dried, the losses were filled using 6% PVOH bulked with calcium carbonate and dry pigments, as described above for B69M52. The fills were not shaped and sanded to match the surrounding surface perfectly, but were simply smoothed with a spatula or cotton swab dampened with ethanol and left untuned (fig. 8.20 shows one such edge fill as it was left).

Each panel was encased in a custom cotton muslin cover (see fig. 8.21) like those made for B69M52. In the new museum, the screen is stored vertically with an edge facing outward so that individual panels can be taken out easily. □

**S**creen (B64M8+), China, Kangxi period, late 17th–early 18th century, Each panel: H. 70 cm; W. 22.5 cm; D. 1.5 cm. This screen consists of eight panels with kuancai decoration on both sides. Figures in landscapes are depicted on both sides. On one side they are scholars shown painting and on the other they are engaged in various pursuits. In narrow borders around the edges are archaic dragons on one side and phoenixes on the other.

#### Conservation Record

The screen was acquired from the Compagnie de la Chine et des Indes, Paris, in 1964. There is no record of prior treatments to the screen.

MARIANNE WEBB WRITES:

#### Condition

The third screen, which is only two feet high (see figs. 8.22 and 8.23), differs somewhat from the others in its small size and previous restoration history. The structure of the panel is seen by the cracking and separation of individual boards. Again, the original hinges have been replaced, but the grooves for the hinges remain. The edges of the panel show extensive chipping and losses, al-



Fig. 8.22. Screen (B64M8+), front, before treatment.

though most are stable following an earlier consolidation.

During the previous restoration extensive work was carried out on the feet. The original surface of the feet has been lost and was repainted to match the lacquer. The gloss and texture seem to indicate that oil paint may have been used. The surface of the lacquer, and perhaps the original paint as well, appears to have been waxed. Later water damage on the wax finish has left wax tide lines and small water marks that may extend through to the lacquer itself. Only removal of the wax will make it possible to ascertain whether this is the case. Evidence of restoration is also visible in the decorative paint layers. The paint has cupped in the past and remained that way long enough for the edges of each cup to become worn. In the

previous restoration the flakes were pressed back into position and the surface consolidated. Now there is new separation of the paint through the ground layer in some areas.

#### Suggestions for Treatment

Although the methods used in the past restoration would not meet today's conservation standards, there is no reason to undo the repairs as they are stable for the most part. There would be no advantage in removing the suspected oil paint on the feet because the previous restorer has been careful not to overpaint the original surface.

Analysis of the consolidant used on the painted areas would be useful. If it is one that cross-links with time, one might consider re-



Fig. 8.23. Screen (B64M8+), reverse, before treatment.

moving it to prevent damage later, a decision that must be weighed against the likelihood of damage incurred in the removal.

The rusted modern hinges should be removed, cleaned, and coated to prevent further corrosion. Because the screens have already been cut to accommodate these hinges, they can be reattached. The small size of the screen allows it to be handled even with all the panels joined together. The rusty nails used to attach them should be disposed of and the hinges reattached with brass screws.

Cleaning the lacquer, consolidating the lifting areas, and filling new losses should all be carried out in the manner previously described for B69M52.

This screen and the two others should not need any coatings over the lacquer once they have been cleaned and consolidated. Being in a muse-

um, they should not have to be protected against fingerprints and other mishandling.

#### JANE WILLIAMS WRITES:

Because of time limitations, the condition of this screen was assessed only to determine whether it could be moved without sustaining further damage. It has no areas of lacquer or wood that were vulnerable to further damage or loss if it were packed carefully. A paulownia wood box was found in storage that was a near-perfect fit for the screen. Sheets of acid-free tissue were inserted between the panels, the entire screen was wrapped in muslin, and then placed in the box, which had been padded out with polyethylene foam. It will remain in this box for long-term storage. □

#### NOTES

- 1 John Stalker and George Parker, *A Treatise of Japanning and Varnishing* (1688; reprint, London: Alec Tiranti, 1971); Sir Harry Garner, *Chinese Lacquer* (London: Faber and Faber, 1979), 260.
- 2 Garner, *Chinese Lacquer*, 259.
- 3 The description of the screen's iconography was written by Terese Bartholomew, Curator of Chinese and Himalayan Decorative Art, Asian Art Museum of San Francisco.
- 4 There have been a few technical studies and treatments of Chinese lacquer screens published recently. These include Irmela Breidenstein, "Considerations Regarding the Restoration of a Chinese Lacquer Screen," in Michael Kühenthal, ed., *Japanische und europäische Lackarbeiten / Japanese and European Lacquerware* (Munich: Bayerisches Landesamt für Denkmalpflege, 2000), 561–85; Silvia Miklin-Kniefacz, "The conservation and restoration treatment of the Chinese lacquered panels of the 'Japanese Room' of the Palais Esterházy" (ICOM Committee for Conservation, 1999): 2: 847–51; idem, *Zur Restaurierung der Vieux-laqu-Tafeln in Schönbrunn: Grundlagen und Vorarbeiten, Wissenschaftliche Reihe Schönbrunn, Band I*; and B. Piert-Borgers, "Untersuchungen zum Fassungsaufrbau von Koromandellacken—Vorüberlegungen zu einem Projekt," in *Ostasiatische und europäische Lacktechniken, Arbeitshefte des Bayerischen Landesamtes für Denkmalpflege, Band 112* (Munich, Karl M. Lipp Verlag, 2000), 93–106.
- 5 A sample of the wood was identified by Professor Richard Dodd, Department of Environmental Science, Policy and Management, University of California, Berkeley.
- 6 The use of a radio-opaque putty to fill defects was observed by Irmela Breidenstein in X-radiographs of another Chinese screen; . Breidenstein, "Considerations Regarding the Restoration of a Chinese Lacquer Screen," 566.
- 7 Cross-section samples of the surface layers on the screen were taken and were studied using reflected light and fluorescence microscopy. Samples were analyzed by James Martin, of Orion Analytical LLC, and Shirin Fozi, of Williams College, using scanning electron microscopy with energy-dispersive spectroscopy (SEM/EDS), IR microspectroscopy, and polarizing light microscopy to identify pigments and to characterize binding media and coatings.
- 8 Hirokazu Arakawa, "On the Chinese *Kyushitsu* Method, Based on a Study of *Kyushoku-roku*," in N. S. Bromelle and Perry Smith, eds., *Urushi: Proceedings of the Urushi Study Group, June 10–27, 1985* (Marina del Rey, Calif.: The Getty Conservation Institute, 1988), 3–6; and Wang Shixiang, ed., *Xiushilu Jieshuo* (The annotated lacquer decoration)(Beijing: Wenwu Chubanshe, 1983), as quoted in Donna K. Strahan, "The Walters Chinese Wood-and-Lacquer Buddha: A Technical Study," *The Journal of the Walters Art Gallery* 51 (1993): 105.
- 9 Peter Lam, ed., *2000 Years of Chinese Lacquer*, exh. cat., Chinese University of Hong Kong, Art Gallery, 1993, 208.
- 10 Lukas Kraemer is currently using such an approach to study the materials and techniques used to make a Chinese screen of a date very similar to this one in the Museum for East Asian Art in Cologne, Germany.
- 11 There are numerous shades of green on the screen. Three from different areas were sampled and all were found by analysis to be malachite. In trying to select representative greens, many large green patches were avoided because they looked as though they might include some restoration.
- 12 The ultrafine black particles in a dispersed pigment sample examined by PLM resemble carbon black. Carbon black cannot be identified by IMS or SEM/EDS, but these methods did not detect other black colorants, including metallic pigments or bone black.
- 13 Infrared microspectroscopy and SEM/EDS did not identify any yellow or purple colorants in these samples. A dispersed pigment sample of the rose color by polarizing light microscopy shows a diffuse pale purple color amid a mass of white particles. A few yellow particles are visible in a dispersed sample of the pale yellow pigment, but the particles are not obviously crystalline.
- 14 These materials have not been identified by analysis. The varnish, probably a natural resin, has a greenish fluorescence in ultraviolet light and is most soluble in acetone. The paint is more slowly soluble in acetone and insoluble in a range of other polar and nonpolar solvents. The gesso is readily soluble in water.

- 15 The fill material tested positive for carbonates. A sample of it dissolved completely with effervescence in 6N hydrochloric acid.
- 16 The spectrum also showed features consistent with kaolin, gypsum, calcite, quartz, and possible lead carbonate. In addition methylene stretching at 2919 cm<sup>-1</sup> and 2850 cm<sup>-1</sup> and carbonyl stretching at 1739 cm<sup>-1</sup> suggest the presence of oil or other fatty or waxy material(s). This coating is slowly soluble in saliva and in warm water. It is insoluble in cold water, ethanol, acetone, toluene, and Stoddard solvent.
- 17 The spectrum was identified by comparison to reference spectra and showed peaks at 1738 cm<sup>-1</sup> and 1718 cm<sup>-1</sup>, indicating the presence of one or more esters, possibly due to the presence of a small amount of beeswax. The wax is soft and white and melts around 190°F. Like the wax coating found on other objects in this study, the wax was found to be partially soluble in 1:1 ethanol : Stoddard solvent. It was insoluble in ethanol, Stoddard solvent, petroleum benzine, mineral spirits, acetone, and water. The wax mixture could be more specifically identified by gas chromatography, a technique that was not readily available for this project.
- 18 Marianne Webb, *Lacquer: Technology and Conservation* (Oxford: Butterworth-Heinemann, 2000), 88. See also, Michel Hebrard and Sophie Small, "Experiments in the Use of Polyvinyl Alcohol as a Substitute for Animal Glues in the Conservation of Gilded Wood," in D. Bigelow, E. Cornu, G. J. Landrey, and C. van Horne, eds., *Gilded Wood: Conservation and History* (Madison, Conn.: Sound View Press, 1991), 277–90; and J. Thornton, "Minding the gap: Filling losses in gilded and decorated objects," in S. Budden, ed., *Gilding and Surface Decoration* (London: UKIC, 1991), 12–17.
- 19 The 4% solution yielded a fill with a slightly powdery surface. The 8% solution made a fill that was too hard (it could not be scratched with a fingernail) and was difficult to sand.
- 20 K. Toishi and H. Washizuka, *Characteristics of Japanese Art That Condition Its Care* (Tokyo: Japanese Association of Museums, 1987), 163.

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- 20 K. Toishi and H. Washizuka, *Characteristics of Japanese Art That Condition Its Care* (Tokyo: Japanese Association of Museums, 1987), 163.

## Materials List

### APPENDIX A

*The product information provided below comes primarily from CAMEO—a searchable online encyclopedia compiled by the Conservation and Collections Management Department of the Museum of Fine Arts, Boston, and from information supplied by the manufacturers of these products. The information is intended as a general guide to the materials mentioned in the book. The formulations of proprietary materials can change at any time. The author makes no guarantee for the accuracy of the information and recommends that readers do their own research into these formulations and products. The names of the manufacturers and/or distributors are supplied in parentheses.*

ABACA TISSUE (SOLD BY ARCHIVART): a long-fibered tissue made from abaca fibers.

ABSORB 'N DRY PVA BLOCK (KANEBO): a fine-celled cross-linked polyvinyl acetate sponge.

ACETONE: a highly volatile, colorless solvent having the chemical formula CH<sub>3</sub>OCH<sub>3</sub> and molecular weight of 58.08. Also known as 2-propanone.

ACRYLOID. See Paraloid.

ACRYSOL WS-24. See Primal WS-24.

AGEPON (AGFA): a wetting agent containing 5%–10% anionic surfactants and 1%–5% sodium benzoate in water.

Akapad. See Wishab.

ANILINE DYES: a group of dyes that were the first synthetic dyes and are derived from aniline, a coal-tar distillation product.

ATG ADHESIVE TRANSFER TAPE (SCOTCH®): a soft, acrylic

pressure-sensitive adhesive system. It is supplied without a carrier, rolled on a strip of release backing.

BARECO 145 (BAKER PETROLITE): a high-molecular weight hydrocarbon wax with a fine crystalline structure. Microcrystalline wax is the remaining fraction of paraffin wax after the lower molecular weight waxes are removed. It is chemically inert.

BENZOTRIAZOLE (BTA; C<sub>6</sub>H<sub>6</sub>NHN<sub>2</sub>): reacts with metals to form stable salts. Used to prevent corrosion on bronze works of art.

BEVA® 371 (*Conservator's Products, Chatham, New Jersey*): a compound of Elvax (ethylene vinyl acetate [EVA] copolymer), Ketone Resin N (polycyclohexanone), A-C copolymer (EVA), Cellolyn 21 (phthalate ester of hydroabietyl alcohol) and paraffin; it was developed by Gustav Berger in 1970.

cerex® (*CEREX Advanced Fabrics, Pensacola, Florida*): a spun-bonded nylon fabric that comes in several weights. It is made by heat bonding continuous filaments of nylon.

Champagne chalk (sold by Sinopia products, San Francisco, Calif.): a ground chalk (calcium carbonate) from Champagne, France.

Coroplast: corrugated board made of polypropylene.

CRP: CLEANING, REVIVING AND POLISHING COMPOUND (CROBERSON & CO., LTD., LONDON): a commercial blend of beeswax and carnauba wax with mineral spirits and distilled turpentine.

DENATURED ALCOHOL: ethyl alcohol to which poisonous materials, such as methyl alcohol, have been added so that it can be used only for industrial chemical purposes.

DIBOND® (ALCAN COMPOSITES): a thin, rigid aluminum composite board, consisting of two sheets of 0.012-inch aluminum bonded to a thermoplastic core. The board is prepainted with a polyester finish.

DURAGLIT® SILVER (RECKITT & COLMAN): a thick, cotton wadding pad embedded with microfine aluminum oxide abrasives and moistened with mineral spirits. It leaves a slightly oily residue and red powder in cracks.

ETHAFOAM: See Plastazote.

ETHANOL: ethyl alcohol (CH<sub>3</sub>CH<sub>2</sub>OH)

FW ACRYLIC ARTISTS' INK (DALER-ROWNEY): an aqueous acrylic-based pigmented ink.

GLASS MICROBALLOONS. See Scotchlite® Glass Bubbles.

Golden Acrylics: a brand of water-soluble, 100% acrylic polymer emulsion paint.

HIDE GLUE: an adhesive made from animal protein. It is water soluble and in its pure form must be heated to be liquefied.

HIGH TACK FISH GLUE (LEE VALLEY): a fish glue supplied as a liquid for use without heating.

INDUSTRIAL METHYLATED SPIRITS (IMS). See denatured alcohol.

ISINGLASS: a clear, water-soluble protein adhesive made from the swim bladder of sturgeon or other fish, including hake or cod.

KAOLIN: a white-firing clay consisting mostly of the mineral kaolinite (Al<sub>2</sub>O<sub>3</sub>·2SiO<sub>2</sub>·2H<sub>2</sub>O).

KLUCEL GF: a nonionic hydroxypropylcellulose adhesive that is soluble in water and ethanol.

LASCAUX HYDRO-GRUND. See Lascaux Hydro-sealer.

LASCAUX HYDRO-SEALER (LASCAUX): an extremely fine, aqueous acrylic resin dispersion; in Germany, sold as Lascaux Hydro-Grund.

LASCAUX MODELING PASTE A (LASCAUX): a pure, thickened, aqueous acrylic resin dispersion bulked with high-grade, finely ground calcite filler.

LASCAUX STRUCTURA (LASCAUX): an aqueous acrylic resin dispersion with modified quartz filler.

LIGROIN, ALSO KNOWN AS PAINTER'S NAPHTHA OR PETROLEUM ETHER: a refined petroleum solvent, predominantly C<sub>7</sub>-C<sub>11</sub>, with a molecular weight of approximately 87-114. It is typically 55% paraffins, 30% monocycloparaffins, 2% dicycloparaffins, and 12% alkylbenzenes.

LIQUITEX (PERMANENT PIGMENTS): the brand name for an acrylic water-emulsion paint.

MELINEX® (DUPONT TEIJIN FILMS): the registered trademark for a series of more than nine hundred types of polyester film. Formerly produced by ICI, England, the films are made from biaxially oriented polyethylene terephthalate that is chemically inert and dimensionally stable; also called Mylar®.

METHYL PYRROLIDONE. See N-methyl 2-pyrrolidone.

MICRO-MESH® ABRASIVE CLOTHS (MICRO-SURFACE FINISHING PRODUCTS, INC., IOWA): silicon carbide particles adhered to a latex film on a nylon cloth backing; available from 1,500-12,000 grit.

MICROSPHERES, HOLLOW GLASS. See Scotchlite® Glass Bubbles.

MILLIPUT® (MILLIPUT CO.): a two-part epoxy putty that is sold in a dual stick form.

MINIATURE SCALPEL (AVAILABLE FROM CONSERVATION SUPPORT SYSTEMS, SANTA BARBARA, CA): disposable stainless steel blades used in a holder. The blades are approximately one third the size of standard scalpel blades and are available in the same range of shapes.

MODOSTUC (PLASVEROI INTERNATIONAL, ITALY): a proprietary polyvinyl acetate putty reported to contain, in addition, chalk, kaolin, and acrylic ester.

MOWILITH 30 (CLARIANT GMBH, GERMANY): a low-molecular weight thermoplastic polyvinyl acetate resin; Tg=30-40 C.

MOWILITH 50 (CLARIANT GMBH, GERMANY): a low-molecular weight thermoplastic polyvinyl acetate with an average molecular weight of about 113,000; Tg = 35-45 C. It does not contain any additives. This is the approximate European equivalent of the American resin PVA AYAF.

MYLAR®. See Melinex.

N-METHYL 2-PYRROLIDONE, ALSO KNOWN AS METHYL PYRROLIDONE OR PYRROLIDINONE: a colorless solvent with the chemical formula C<sub>5</sub>H<sub>9</sub>NO and a molecular weight of 99.1.

ORASOL® DYES (CIBA-GEIGY): a series of light-stable, synthetic dyes that are soluble in a range of polar and nonpolar solvents.

PAINTER'S NAPHTHA. See ligroin.

PARALOID® B-48N, FORMERLY ACRYLOID B-48N IN THE UNITED STATES (ROHM AND HAAS): a methyl methacrylate and butyl acrylate copolymer, containing an adhesion promoter for bonding to bare and primed metals. Analysis indicates that it also contains a dibutyl phthalate plasticizer.

PARALOID® B-72, FORMERLY CALLED ACRYLOID® B-72 IN THE UNITED STATES (ROHM AND HAAS): an ethyl methacrylate (70%) and methyl acrylate (30%) copolymer.

PERSPEX (ICI, ENGLAND): a transparent acrylic sheeting made from polymethyl methacrylate. In the United States the equivalent material is sold as Plexiglas.

PETROLEUM ETHER. See ligroin.

PLASTAZOTE (ZOTEFOAMS LIMITED): the brand name for a cross-linked polyethylene foam that is expanded with nitrogen gas. Plastazote, which is chemically and biologically inert, is supplied as sheets or slab

stock. The product will deteriorate, shrink, or warp in direct sunlight. In the United States, the equivalent material is Ethafoam.

PLEXIGLAS (ATOGLAS). See Perspex.

POLYFILLA®, FINE SURFACE (POLYCELL PRODUCTS OF ICI, ENGLAND): fine, soft paste that contains calcium carbonate in an aqueous styrene-acrylate based polymer. It dries in 30-60 minutes with minimal shrinkage and, after drying, the hard fill can be sanded or painted.

POLYVINYL ALCOHOL, PVOH: a water-soluble polymer resin. For this project Airvol 203S (Air Products, Allentown, PA)—a low molecular weight, low hydrolysis polyvinyl alcohol resin—was used.

PRIMAL WS-24 (ROHM & HAAS): a milky white aqueous dispersion of polyacrylic acid mixed with acrylic copolymers or sodium polyacrylate.

PVA AYAF (UNION CARBIDE): a low-molecular weight thermoplastic poly(vinyl acetate) resin with an average molecular weight of about 113,000. Tg = 24 C.

PYRROLIDINONE. See N-methyl 2-pyrrolidone.

RHOPLEX® AC-234 (ROHM & HAAS): an aqueous acrylic emulsion that has 46%-47% solids and dries to form a slightly tacky film. It has been used as a weak pressure-sensitive adhesive. In Europe Rhoplex is distributed as Primal.

SARAN® WRAP: thin plastic (polyvinylidene chloride) film.

SCOTCHLITE® GLASS BUBBLES (3M): hollow, soda lime-borosilicate glass bubbles formulated for the highest strength-to-weight ratio as an inert filler; article size: 30-120 microns.

SHELLAC: an alcohol-soluble natural resin secreted by the lac insect. It is cultivated primarily in India and Thailand. Once it is gathered the crude resin is crushed and heated to refine it.

SOLVOL AUTOSOL® (DURSOL-FABRIK GMBH & CO.): an abrasive paste developed to remove rust and oxides

from metal, it contains a fine abrasive powder (hydrated silica) dispersed in aqueous soap solution with small amounts of solvent and oil. It leaves an oily film on the polished surface and white powder in cracks.

STAEDTLER MARS PLASTIC ERASER (STAEDTLER): a soft, plastic (polyvinyl chloride) eraser

STODDARD SOLVENT: an aliphatic hydrocarbon solvent distilled and refined from mineral spirits. Collected in the boiling range of 177–190 C., it a boiling-point range of 149–204 C.

TYVEK® (DUPONT CHEMICAL): a spun-bonded, high density polyethylene fabric. The filaments are bonded by heat and pressure without fillers or binders.

2-PROPANONE. *See* acetone.

VOLARA® (VOLTEK ): a flexible, closed-cell, polyethylene foam with a smooth surface that is crosslinked by means of an electron irradiation process.

WEBRIL HANDI-PADS® (WEBRIL): 100% cotton, lint-free application pads.

WET-STRENGTH TISSUE: a paper tissue that retains its strength when wet.

WISHAB (AKACHEMIE ALBERT KAUDERER GMBH): a filled, vulcanized latex sponge; also called Akapad.

XYLENE: dimethyl benzene (C<sub>6</sub>H<sub>4</sub>(CH<sub>3</sub>)<sub>2</sub>).

## *Analytical Techniques*

### APPENDIX B

Fourier transform infrared spectroscopy (FTIR) was accomplished by crushing the sample to transparency and analyzing on a diamond cell. The spectra were collected on a Nicolet Magna-IR spectrometer with a Spectra Tech IR plan infrared microscope accessory. Infrared spectra were collected for 120 scans at a resolution of 8.

Elemental identification of samples was accomplished by scanning electron microscopy with elemental capabilities (SEM-EDS). Samples were carbon coated; elemental information was collected at 25kv, 00 tilt. The microscope used was an FEI Quanta 400, with a PGT liquid nitrogen-cooled elemental dispersive detector.

Cross section and dispersed pigment samples were examined using a Nikon E600 polarizing light microscope. The samples were examined in reflected light using external fiberoptic illumination and an internal epi-fluorescence illuminator with a 100W mercury lamp. UV examination was accomplished with the Chroma 11011 (UV-violet) filter set.

## Glossary of Lacquer Terms

*bengara*: red iron oxide. When mixed with *urushi*, it has a browner tone than *shu urushi*.

*dakanshitsu*: a dry lacquer mixture of *urushi* with a powdered organic material such as sawdust or chopped hemp fiber. The mixture is usually tempered by the addition of a little *nori urushi* or *mugi urushi*. An inorganic component such as powder clay may sometimes be added.

*doro shitaji*: foundation layers that are made using non-*urushi* binders such as protein glue. See also *shitaji*.

*gofun*: white pigment.

*hegigai*: a very thin shell made by cooking turban shell (*Lunatica marmorata*) in water for a long time and then splitting its nacreous layer. Color quality differs from that of thin shells made by grinding.

*hidori urushi*: base lacquer.

*kijigatame* (literally, “hardening the ground”): the application of *urushi* to the support or foundation layers to seal and harden them.

*ki urushi*: raw *urushi*

*kokuso*: forming and fill material made by mixing sawdust and hemp fibers with *mugi urushi*.

*kuancai* (Chinese): polychrome carving; a technique in which designs are carved into a lacquer base and the recesses are painted, typically with pigments in a protein binder.

*kuro urushi*: *urushi* colored black by the addition of black pigments.

*makie*: traditional manner of decorating lacquer objects. Designs are drawn on the surface with lacquer and sprinkled with metallic powder before the lacquer has dried.

*mitsuda-e*: oil- or glue-based surface decoration.

*mugi urushi*: raw lacquer thickened with water and rice or wheat paste, thus having a strong viscosity and adhesive nature.

*namari kanagai*: a flattened sheet of lead with stonelike appearance applied to the surface of a lacquer object; often used in Rimpa School pieces.

*nashiji*: a *makie* technique by which *nashiji fun* is sprinkled on thinly coated *urushi*, with a coating of clear lacquer applied over that. It gets its name from the resemblance of the surface to pear (*nashi*) skin.

*nashiji fun*: irregularly shaped, flattened metal filings.

*nori urushi*: an adhesive mixture of *urushi* and rice flour used in the manufacture, repair, and conservation of *urushi* objects. Depending on the particular school of conservation, the flour may be added to the *urushi* as a dry powder or as a cooked water paste.

*nurimono*: lacquerware.

*nuritate shiage*: a technique in which the last coat of black lacquer is simply painted. It is different from the *roiro shiage* technique, in which the surface is polished until shiny after the application of the final coat of lacquer.

*qiangjin* (Chinese): a technique involving inlaying thin gold leaf into an incised design on a cured lacquer base.

*roiro shiage*: the technique of polishing the lacquer

*Many of the definitions in this glossary are derived from the glossary in Tokyo National Research Institute of Cultural Properties, Project for Conservation of Works of Japanese Art in Foreign Collections II, (Tokyo: Tokyo National Research Institute of Cultural Properties, 2000,) 215–228. Shosai Kitamura, Hiroshi Kato, Yoshihiro Yamashita and Shayne Rivers also provided or reviewed definitions.*

surface to give it a high gloss. After the top coating of lacquer is applied, the surface is abraded to produce a smooth, even surface, and is then polished with *tonoko*; the process of *suri urushi* is then repeated until a high gloss is achieved.

*sabi*: fine mixture of *urushi* and *tonoko* (which has been premixed with water into a paste) used for final foundation layers.

*shinbari*: a Japanese six-sided wooden frame, with a solid top and bottom and open sides, in which bamboo or wood sticks are used to apply pressure in readhering lacquer flakes. The term may also be used to refer to the process of clamping an object using a *shinbari*.

*shitaji*: the foundation layers found between the support and the top coatings of an *urushi*-coated object. Usually made from a mixture of powdered stone or clay, with *urushi*.

*shu urushi*: *urushi* colored red by the addition of powdered vermilion and polished to develop a shine or luster.

*suki urushi*: translucent *urushi* made by further refining *ki urushi* to remove more water through a process of heating and stirring. Also called *kijiro urusho*.

*suri urushi*: the technique of rubbing in *ki urushi*. This technique is used in making and restoring lacquer objects to give luster to polished *urushi* or to fix the powders used in *makie*.

*takamakie*: one of the *makie* techniques by which the design is built up with charcoal powder or undercoating lacquer and finished with *makie* powder.

*tamenuri*: a lacquer technique in which *suki urushi* is coated over a *shu urushi* surface or a surface on which metal leaf has been fixed.

*tonoko*: a fine powder (traditionally, ground whetstone) used in *urushi* foundation materials. It is also used with oil to polish *urushi* surfaces.

*tsukegaki*: a lacquering technique in which fine lines

such as leaf veins are painted with viscous lacquer and sprinkled with fine *makie* powder.

*urushi*: the viscous sap of various species of rhus tree, particularly *Toxicodendron verniciflua* (formerly *Rhus verniciflua*) and *Rhus succedanea*.

*urushi gatame*: a term used only in the restoration or conservation of lacquer. It describes the consolidative process of rubbing small quantities of *urushi* (the type may vary) diluted with nonpolar solvent into a degraded lacquer surface. After the *urushi* has been applied, the surface is wiped repeatedly with cloths dampened with solvent to remove *urushi* remaining on the surface. Unlike *suri urushi*, the process does not change the gloss of the degraded lacquer.

*uwa nuri*: the top coating and the process of applying the top coats to an *urushi*-coated object.

*yakogai*: shell

*yosegi zukuri*: a Japanese technique for making wooden statues from several joined hollowed blocks rather than a single piece. The technique improves the structural stability of the object and makes it lighter.

*yushoku*: linseed oil.

## Bibliography

- Arakawa, Hirokazu. "On the Chinese *Kyushitsu* Method, Based on a Study of *Kyushoku-roku*." In Bromelle and Smith, eds., *Urushi*, 3–6.
- Bottomley, Ian. *Japanese Armor: The Galeno Collection*. Berkeley, Calif.: Stone Bridge Press, 1997.
- Breidenstein, Irmela. "Considerations Regarding the Restoration of a Chinese Lacquer Screen." In Kühenthal, ed., *Japanische und europäische Lackarbeiten*, 561–85.
- Carter, Rowan. "Contact and Collaboration: Developments in East Asian Lacquer Conservation since 1978." Research project report, Conservation Masters of Art Programme, Royal College of Art / Victoria and Albert Museum London, May 2000.
- Chase, W. T. "Lacquer Examination and Treatments at the Freer Gallery of Art. Some Case Histories." In Bromelle and Smith, eds., *Urushi*, 95–112.
- Christie's London. *Japanese Art and Design*, 19 June 2002, sale 6589.
- Diesinger, Rudolf Gunter. *Ostasiatische Lackarbeiten sowie Arbeiten aus Europa, Thailand und Indien*. Braunschweig: Herzog Anton Ulrich-Museum, 1990.
- Down, Jane L., Maureen A. MacDonald, Jean Tétreault, and R. Scott Williams. "Adhesive Testing at the Canadian Conservation Institute—An Evaluation of Selected Poly(vinyl acetate) and Acrylic Adhesives." *Studies in Conservation* 41(1996): 19–44.
- Eipper, Paul Bernhard. *Die Reinigung von Gemäldeoberflächen mit Tensiden*. Bern: Haupt, 1993.
- Fiedler, Inge, and Michael Bayard. "Emerald Green and Scheele's Green." In Elisabeth West Fitzhugh, ed., *Artists' Pigments: A Handbook of Their History and Characteristics*, 3:219–71. Washington, D.C.: National Gallery of Art, 1986.
- Foskett, Sarah. "An Investigation into the Properties of Isinglass." *Journal of the Scottish Society for Conservation and Restoration* 5, no. 4 (November 1994): 11–14.
- Gabbert, Gunhild. *Buddhistische Plastik aus China und Japan*. Wiesbaden: Franz Steiner Verlag, 1972.
- Garner, H. M. (Sir Harry Garner). *Ryukyū Lacquer*. Percival David Foundation of Chinese Art, monograph series, no. 1. London: University of London, 1972.
- . *Chinese Lacquer*. London, England: Faber and Faber, 1979.
- Green, Lorna. "A Re-evaluation of Lead Conservation Techniques at the British Museum." In *Proceedings of the International Restorer Seminar, Veszprem, Hungary, 1989*, 121–30.
- Greene, Virginia. "Adaptation of Standard Matting Folders." In Carolyn L. Rose and Amparo R. de Torres, eds., *Storage of Natural History Collections: Ideas and Practical Solutions*. . . Society for the Preservation of Natural History Collections, 1992.

- Guppy, Alison, Poppy Singer, and Annabel Wylie. "A Seventeenth-Century Suit of Japanese Armour with Original Textile Components: Its Description, Conservation, and Mounting." *The Conservator* 21 (1997): 59–70.
- Handler, Sarah. "The Korean and Chinese Furniture Traditions." *Journal of the Classical Chinese Furniture Society* 4, no. 4 (autumn 1994): 52.
- Heath, Diana, and Graham Martin. "The Corrosion of Lead and Lead / Tin Alloys Occurring on Japanese Lacquer Objects." In John S. Mills, Perry Smith, and Kazuo Yamasaki, eds., *The Conservation of Far Eastern Art*, 137–41. Preprints of the IIC Kyoto Congress, 19–23 September 1988. London: International Institute for Conservation of Historic and Artistic Works, 1988.
- Hebrard, Michel, and Small, Sophie. "Experiments in the Use of Polyvinyl Alcohol as a Substitute for Animal Glues in the Conservation of Gilded Wood." In Deborah Bigelow, Elisabeth Cornu, Gregory J. Landrey, and Cornelis van Horne, eds., *Gilded Wood: Conservation and History*, 277–90. Madison, Conn.: Sound View Press, 1991.
- Heckmann, Gunther. "Die Lackkabinette der Staatlichen Münzsammlung München: Untersuchungen und Konservierungskonzepte / The Lacquer Cabinets in the State Numismatic Collection in Munich: Investigations and Concepts for Conservation." In Kühnlenthal, ed., *Japanische und europäische Lackarbeiten*, 467–77.
- Horie, C. V. *Materials for Conservation*. London: Butterworths, 1987.
- Incarville, Père d'. "Abhandlung von dem chinesischen Lacke." *Allgemeines Magzin der Natur, Kunst und Wissenschaften, zwölfter und letzter Theil*. Leipzig, 1767.
- Jaeschke, H. F. "Oriental Lacquer Analysis: Thin-Section and Electron Microprobe." In *Application of Science in the Examination of Works of Art*, 217–20. Boston: Museum of Fine Arts, 1985.
- Jaeschke, R. L. "When Does History End?" In *Archaeological Conservation and its Consequences*, 86–88. Preprints of the IIC Conference in Copenhagen, August 26–30, 1996. London: International Institute for Conservation, 1996.
- , H. F. Jaeschke. "The Cleaning and Consolidation of Egyptian Encaustic Mummy Portraits." In *Cleaning, Retouching and Coatings*, 16–18. Preprints of the IIC Conference in Brussels, September 3–7, 1990.
- Jett, Paul. "The Study and Treatment of Chinese Dry Lacquer Sculpture." In Nishikawa, ed., *Conservation of Urushi Objects*, 167–85.
- Kakudo, Yoshiko. *The Art of Japan: Masterworks of the Asian Art Museum*. San Francisco: Asian Art Museum and Chronicle Books, 1991.
- Kamiya, Yukio, and Tetsuo Miyakoshi. "The Analysis of Urushi by Pyrolysis Gas Chromatography and Mass Spectrometry." In Kühnlenthal, ed., *Ostasiatische und europäische Lacktechniken*, 107–20.
- Kato, Hiroshi, chief ed. *Project for Conservation of Works of Japanese Art in Foreign Collections*, 1. Tokyo: Tokyo National Research Institute for Cultural Properties, 1998.
- . "Die Restaurierung von Exportarbeiten mit Tierleim und Urushi / The Restoration of Urushiware for Export with Animal Glue and Urushi." In Kühnlenthal, ed., *Japanische und europäische Lackarbeiten*, 81–84.
- Kinoshita, Masako. "A Braiding Technique Documented in an Early Nineteenth-Century Japanese Treatise—*Soshun Biko*." *Textile Museum Journal* (1986): 47–65.
- Kitamura, Shôsei. "Die Restaurierung alter japanischer Lacke / The Restoration of Ancient Japanese Urushi Art Objects." In Kühnlenthal, ed., *Japanische und europäische Lackarbeiten*, 61–72.
- Koller, Johann, Katharina Walch, and Ursula Baumer. "Französischen Lackmöbel des 18. Jahrhunderts: Criard, Deforge und Dubois. Eine technische und naturwissenschaftliche Untersuchung der Imitationslacke / French Lacquered Furniture of the 18th Century: Criard, Deforge, and Dubois. A Technical and Scientific Investigation on Imitation Lacquers." In Kühnlenthal, ed., *Japanische und europäische Lackarbeiten*, 537–59.
- Kopplin, Monika. *Museum für Lackkunst*. Vol. 1, *Ostasiatische Lackkunst Ausgewählte Arbeiten*. Münster: BASF Lacke + Farben AG, 1990.
- Kühnlenthal, Michael, ed. *Japanische und europäische Lackarbeiten / Japanese and European Lacquerware*. Munich: Bayerisches Landesamt für Denkmalpflege, 2000.
- . *Ostasiatische und europäische Lacktechniken*. Bayerisches Landesamt für Denkmalpflege, vol. 1. Munich: Karl M. Lipp Verlag, 2000.
- Kumanotani, Ju. "The Chemistry of Oriental Lacquer (*Rhus verniciflua*)." In Bromelle and Smith, eds., *Urushi*, 243–51.
- . "Traditional Japanese Urushi Techniques—*Kurome* and *Roiroshiage*: A Preface of Urushi Cultural Properties Conservation." In Nishikawa, ed., *Conservation of Urushi Objects*, 187–209.
- Lam, Peter, ed. *2000 Years of Chinese Lacquer*. Hong Kong: Chinese University of Hong Kong, Art Gallery, 1993.
- Lee, Yu-kuan. *Oriental Lacquer Art*. New York: Weatherhill, 1972.
- Ma Qinlin, Hu Zhidie, and Zhang Lan. "Conservation Techniques for Lacquerware and Carving Wooden Art Objects Excavated from Northern China and Research on the Softening of Lacquer Layers." *Proceedings of the Seventh WOAM Conference, ICOM-CC*, Grenoble, 1998. Grenoble: ARC-Nucleart, 1999.
- Mallis, Arnold. *The Handbook of Pest Control*, 7th ed. Cleveland, Ohio: Franzak and Foster, 1990.
- Miklin-Kniefacz, Silvia. *Zur Restaurierung der Vieux-Lacque-Tafeln in Schönbrunn: Wissenschaftliche Reihe Schönbrunn, Band I*.
- Milam, Billie, and Hélène Gillette. "X-radiography in the Study of Oriental Lacquerware Substructures." In Bromelle and Perry, eds., *Urushi*, 199–226.
- Munroe, Alexandra, ed. *Spectacular Helmets of Japan: 16th–19th Century*. New York: Japan House Gallery, 1985.
- Nagasawa, I., T. Shida, H. Oshima, Masako Koyano, and Frank D. Preusser. "Polychrome Wooden Buddhist Sculptures in Japan." In preprints of the 12th triennial meeting, International Council of Museums—Committee for Conservation, Lyon, 29 August–3 September 1999, 2:434–47. London: James and James, 1999.
- Nicolaus, Knut. *Handbuch der Gemälderestaurierung*. Cologne: Könemann, n.d.
- Niimura, Noriyasu, and Tetsuo Miyakoshi. "Identifizierung fernöstlicher Lacküberzüge mittels Pyrolyse-Gaschromatographie/Massenspektroskopie / Identification of Oriental Lacquer Films Using Pyrolysis-Gas Chromatography/Mass Spectrometry." In Kühnlenthal, ed., *Japanische und europäische Lackarbeiten*, 123–34.
- Nishikawa, Kyotaro. "Dry Lacquer Statues of Japan." In Bromelle and Smith, *Urushi*, 127–31.
- . ed., *Conservation of Urushi Objects: International Symposium on the Conservation and Restoration of Cultural Property, November 10–12, 1993*. Tokyo: Tokyo National Research Institute of Cultural Properties, 1995.
- Nishimura, Kocho, Toshio Honma, et al. "A

- Traditional Japanese Lacquer Method for Repairing Wood Buddhist Statues." In *Conservation of Wooden Objects*, 87–96. Vol. 2, preprints of the IIC Conference on the Conservation of Stone and Wooden Objects, 7–13 June 1970, 2nd ed. London: International Institute for Conservation of Historic and Artist Works, 1971.
- Norman, Jane, and Stephen Koob. "Attention to Lacquer at the Freer Gallery of Art and the Arthur M. Sackler Gallery." *Newsletter of the Working Group of Lacquer of the ICOM Committee for Conservation* (February 4, 1994): 5–6.
- Okada, Jo. *Pageant of Japanese Art*. Tokyo: 1954.
- Organ, Robert. *Corrosion and Metal Artifacts*. Special Publication no. 479. National Bureau of Standards.
- Piert-Borgers, Barbara. *Restaurieren mit Urushi. Japanischer Lack als Restaurierungsmittel*. Monograph no. 6. Cologne: Museum für Ostasiatische Kunst, 1987.
- . "Aspects and Problems of the Application of Urushi in the Restoration of Objects from European Collections." In Nishikawa, ed., *Conservation of Urushi Objects*, 147–65.
- . "Traditionen der Verpackung und Aufbewahrung von Lackarbeiten in Japan ausgehend vom Shoso-in / Protecting and Storing Lacquerware in Japan: The Tradition of the Shoso-in." In Kühnenthal, ed., *Japanische und europäische Lackarbeiten*, 102–19.
- . "Untersuchungen zum Fassungs-aufbau von Koromandellacken—Vorüberlegungen zu einem Projekt." In Kühnenthal, ed., *Ostasiatische und europäische Lacktechniken*, 1:93–106.
- Raychaudhuri, Michele R., and Peter Brimblecombe. "Formaldehyde Oxidation and Lead Corrosion." *Studies in Conservation* 45 (2000): 226–32.
- Riederer, Josef. "Restaurieren mit Kunstharzen in Japan." *Maltechnik-Restaur* 85, no. 2 (1979): 118–26.
- Sakakibara, Kozan. *The Manufacture of Armour and Helmets in Sixteenth-Century Japan* [*Chukokatchu Seisakuben*]. Translated by T. Wakameda. Revised by A. J. Koop and Hogitaro Inada, 1912. Revised and edited by H. Russell Robinson, 1962. Rutland, Vermont, and Tokyo: Charles E. Tuttle, 1963.
- Sano, Chie. "Scientific Research on Urushi in Japan." In Nishikawa, ed., *Conservation of Urushi Objects*, 211–24.
- Schlombs, Adele, ed. *Im Licht des Groben Buddha, Schätze des Todaiji-Tempels, Nara*. Cologne: Museum für Ostasiatische Kunst, 1999.
- Sharma, V. C., Uma Shankar Lal, and Tej Singh. "Method for Stabilization of Leaded Bronzes Affected by Corrosion of Lead." *Studies in Conservation* 48 (2003): 203–209.
- Speiser, Noémi. *The Manual of Braiding*. Basel: privately printed, 1983.
- Stalker, John, and George Parker. *A Treatise of Japanning and Varnishing*. 1688. Reprinted London: Alec Tiranti, 1971.
- Strahan, Donna. "The Walters Chinese Wood-and-Lacquer Buddha: A Technical Study." *Journal of the Walters Art Gallery* 51 (1993): 105–20.
- Swaddling, Judith, Andrew Oddy, and Nigel Meeks. "Etruscan and Other Early Gold Wire from Italy." *Jewellery Studies* 5 (1991): 7–21.
- Takao, You. "Kinsei Makieshi Meikan." *Kobijitsu Ryokusyo* 20 (July 1996): 107.
- Tennent, Norman, James Tate, and Linda Cannon. "The Corrosion of Lead Artifacts in Wooden Storage Cabinets." *Journal of the Scottish Society for Conservation and Restoration* 4, no. 1 (February 1993): 8–11.
- Thornton, Jonathan. "Minding the Gap: Filling Losses in Gilded and Decorated Objects." In S. Budden, ed., *Gilding and Surface Decoration*, 12–17. London: UKIC, 1991.
- Toishi, Kenzo, and Hiromitsu Washizuka. *Characteristics of Japanese Art that Condition its Care*. Tokyo: Japanese Association of Museums, 1987.
- Tokyo National Research Institute for Cultural Properties. *Project for Conservation of Works of Japanese Art in Foreign Collections*, vol. 2. Tokyo: Tokyo National Research Institute for Cultural Properties, 2000.
- Waller, Robert. "A Risk Model for Collection Preservation." In CAC Abstracts, 29th annual conference, Victoria, Canada.
- Wang, Shixiang. *Xiushilu jieshuo* [The annotated "Lacquer Decoration"]. Beijing: Wenwu Chubanshe, 1983.
- Watanabe, Osamu, and Katsutoshi Nagai. "Internal Structure and Photodegradation of Oriental Lacquer Film." *Nippon Kagaku Kaishi* [The Chemical Society of Japan] 2 (1999): 113–21.
- . "Photodegradation of Lacquer Tree Paint Films and Their External Appearance." *Nippon Kagaku Kaishi* [The Chemical Society of Japan] 2 (1999): 123–30.
- Watt, James C. Y., and Barbara Brennan Ford. *East Asian Lacquer: The Florence and Herbert Irving Collection*. New York: Metropolitan Museum of Art, 1991.
- Webb, Marianne. *Lacquer: Technology and Conservation*. Oxford: Butterworth-Heinemann, 2000.
- Wilson, Dawn M. "Paraloid B-72 Infilling Systems for Wooden Artifacts." *Newsletter, The Ethnographic Conservation Working Group of the International Council of Museums—Committee for Conservation* 18 (October 1998): 9–11.
- Wright, Edward Reynolds, and Man Sill Pai. *Korean Furniture: Elegance and Tradition*. Tokyo: Kodansha International, 1984.
- Zhang Lan. "Research on a Special Technique of Making Lacquerware in the Song Dynasty." In *A Collection of the Shanghai Museum Theses on Science and Technology of Cultural Relics*, 485–502. Shanghai: Shanghai Science and Technology Literature Press, 1995.
- . "The Principle and Methods of Conservation of Waterlogged Wood and Lacquerware." In *A Collection of the Shanghai Museum Theses on Science and Technology of Cultural Relics*, 502–30. Shanghai: Shanghai Science and Technology Literature Press, 1995.
- . "A Note on the Conservation of a Thousand Year Old Boat." *Studies in Conservation* 40 (1995): 189–93.
- . "The Conservation of a Song Dynasty Lacquer Box." *Newsletter of the Furniture Lacquer Working Group of the International Committee for Conservation* 5 (1995): 12.
- . "The Conservation of Waterlogged Lacquerware in China." In *Proceedings of the Seventh WOAM Conference, ICOM-CC, Grenoble, 1998*. Grenoble: ARC-Nucléart, 1999.