Article: Sitting on history: Conservation and reproduction of 19th century auditorium seats
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SITTING ON HISTORY: CONSERVATION AND REPRODUCTION OF 19TH CENTURY AUDITORIUM SEATS

Daniel Kurtz, Thomas L. Heller and Susan Glassman

Introduction and Background

How do you go about conserving objects when their physical context and setting within a historic framework are as important as the artifacts themselves? This is the central problem in approaching conservation at the Wagner Free Institute of Science, and the challenge presented to every conservator who works there.

Founded in 1855 and occupying its original Civil War-era building, the Wagner Free Institute of Science is perhaps the best-preserved example of a Victorian natural history museum in this country. It is a rare case where everything - from the collections and furnishings to the exhibit

Figure 1. The Wagner Free Institute of Science, at the opening of the building in 1865.

arrangement and the building itself - has survived as an unaltered ensemble from the end of the 19th century. In the skylighted exhibit hall, every aspect of the original display remains in place, from the wood cabinets to the hand-written labels prepared by the museum's first curator.

Like many museums of the period, the Wagner Free Institute of Science began as the vision of a single individual, William Wagner[1]. Born in 1796 to a prosperous Philadelphia family, Wagner was from his boyhood an avid naturalist and collector. Although he spent three decades as a businessman, he devoted all of his free time to his scientific interests. His apprenticeship as a youth to Stephen Girard, the great Philadelphia merchant and financier, gave him the opportunity to collect specimens from places as remote as India and China, where he traveled as an agent on Girard's trading ships. By the early 1840s when he settled with his new wife Louisa Binney on an estate just north of the city, he had a collection sufficiently large to merit building a structure to house and display it.

Wagner was not interested in amassing material solely for his personal enjoyment. His goal was to make scientific knowledge and emerging ideas about the natural world available to anyone, particularly those in "the working classes"[2], whose opportunities for scientific education were extremely limited. In this Wagner mirrored his time, and the enormous growth in the first half of the century of educational institutions of all types. It also reflects the influence of Girard, who left his personal fortune to found a school for orphaned boys.

The educational programs of the Institute began as informal talks given by Wagner on the subjects he knew best: geology, paleontology, mineralogy, and malacology (shells). In 1855, Wagner applied to the state for a charter and hired a faculty to expand the course offerings to include the full range of the sciences, as well as lectures on architecture, and for a time, elocution. From the inception, the courses were held in the evenings to allow working men and women to attend, and were open to all without fees for admission. The lecture series, now in its 145th year, is the oldest program devoted to free adult education in the United States.

The educational programs and Wagner's collections are housed in the building he erected for them between 1859 and 1865. It contains three principal spaces, a lecture hall and library on the ground story, and a soaring exhibit hall that occupies the entire upper level of the building and rises to the exposed trusses of the arched roof. The interior finishes, and the museum display itself, are the result of renovations undertaken by the Institute in the 1880s under the auspices of some of the country's leading scientists. Most notably Dr. Joseph Leidy, a biologist of international importance, expanded the collections and oversaw the installation of a "systematic" arrangement of the specimens. The display, with its glass and wood cases and taxonomic organization, is a unique survivor of a system that was the standard for its day, but which has long since been replaced in nearly all museums.

The Institute's lecture hall was built to serve the free education mission and renovated along with the museum in the 1880s and 1890s. The current seats were installed in 1895, according to a

receipt in the Institute's archives. It records that 500 "Concert Hall" seats were purchased for $200.[3] The origin of the seats was the Philadelphia Concert Hall, which was erected in 1852 and opened the following year for concerts, lectures and other entertainments. The Concert Hall was the site of Charles Dickens' public readings in 1868 but by 1890 it had closed as an entertainment venue and in 1895 was altered to house the Main Branch of Philadelphia's new Free Library.[4] The seats were then sold to the Wagner Free Institute of Science and installed in its lecture hall, where they have been in daily use for the past 105 years.[5]

The lecture hall remains the primary location for the Institute's educational programs. While the Institute still offers free science courses for adults, the heaviest use of the lecture hall is for programs that serve children. It is rare that the room is filled for a program but a century of heavy use has nonetheless taken its toll, especially on the seats in the center section. The curved, laminated construction of the seat bottoms makes them particularly vulnerable to wear (there are numerous "historic" repairs) and several years ago we began to formulate a plan to address the problems.

In a historic house the approach to conservation and preservation is clear. Furnishings and interior spaces are cordoned off; active use of objects is eliminated or, at least, severely curtailed. But the Wagner is not a historic house and the goal is to maintain and preserve the collections in situ, including the furnishings, building and the delicate interrelationship of the parts, while continuing to use it as an active museum and educational institution.

Over the past ten years, the Board and staff have worked together with a team of conservators, architects, engineers and various collection specialists, to develop a systematic, long-range plan that will preserve the Institute as a living piece of history. It was designated as a National Historic Landmark in 1990 and work is proceeding slowly and cautiously on its conservation, with the goal of retaining and preserving as much original fabric as possible. In 1992 the Institute completed conservation surveys of the building and collections through the Conservation Assessment Program of the National Institute for the Conservation of Cultural Property (now Heritage Preservation).[6] In 1995 and 1996, an architectural master plan and a comprehensive conservation plan were completed. Implementation of these plans is now in its initial stages.

The approach to the work in the auditorium included replication of seats as a matter of necessity. A number had already failed and been replaced with poor quality replicas, and others were beyond repair. The recommendation in the collection component of our CAP report, completed by Catharine Hawks who serves as an ongoing consultant on collection conservation, was to replace the seats in the area of heaviest wear and tear - the front rows of the center section - with high quality replicas and to preserve the rest, which get much less use.

The Wagner is a singular place in its degree of historic integrity and in continuing to serve its original mission. But what makes it truly special is that it is not simply an artifact of the past. Its continuing appeal is evident in the reactions of visitors. Children particularly love it. They

experience the richness of the museum and its collections directly, not filtered through the marvelous but distancing recognition that the Institute is a survivor from another era. They see what one of them called "stones and bones and scientific wonders," things that many of them might not otherwise encounter. For them it is alive with meaning, and that meaning is conveyed not only in the contents of building, but in its arrangement, which offers a direct physical encounter with the tangible world of 19th century science. And in a world of images and ideas, such tangible evidence is all the more powerful.

Figure 2. William Wagner (1796-1185), founder of the Institute

Figure 3. The Institute's exhibit hall occupies the entire upper level of the building and is circled by a U-shaped gallery. Photograph courtesy of Tom Crane.

Figure 4. A view of the lecture hall from the demonstration table. Photograph courtesy of Tom Crane.

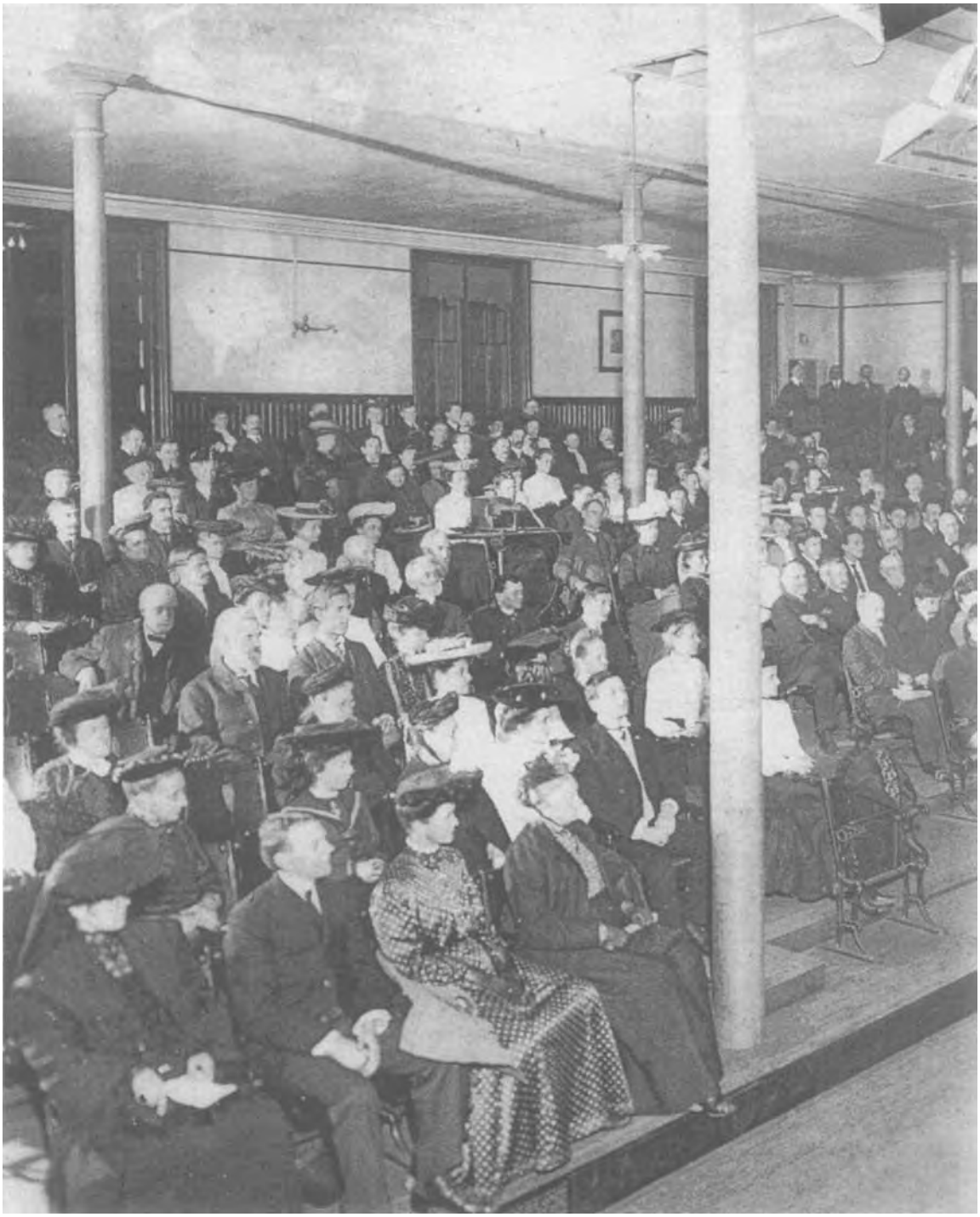

Figure 5. An evening lecture program at the Institute, circa 1905.

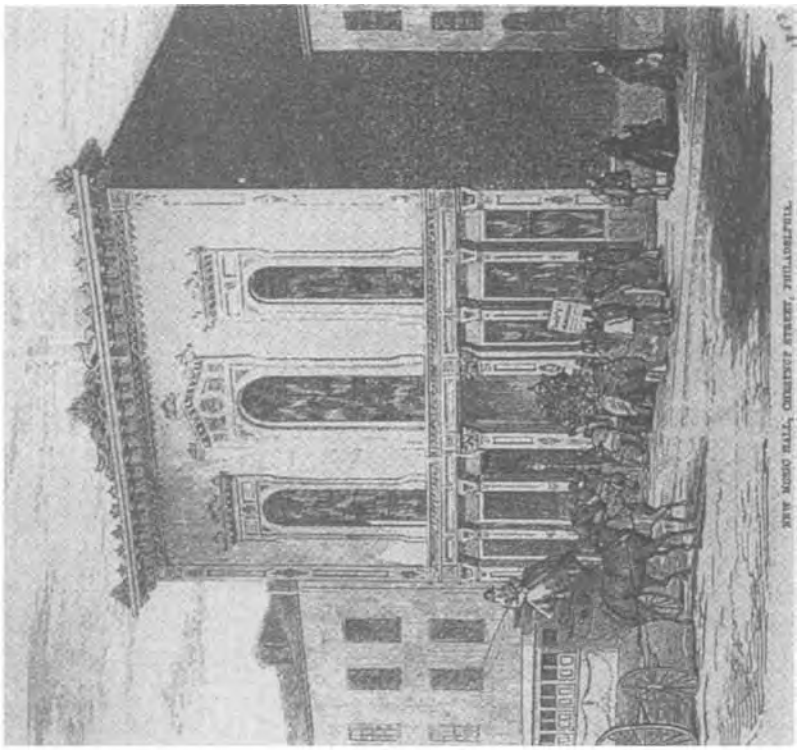

Figure 7. The concert hall in 1853. This illustration appeared in Barnum's Illustrated News soon after the building opened.

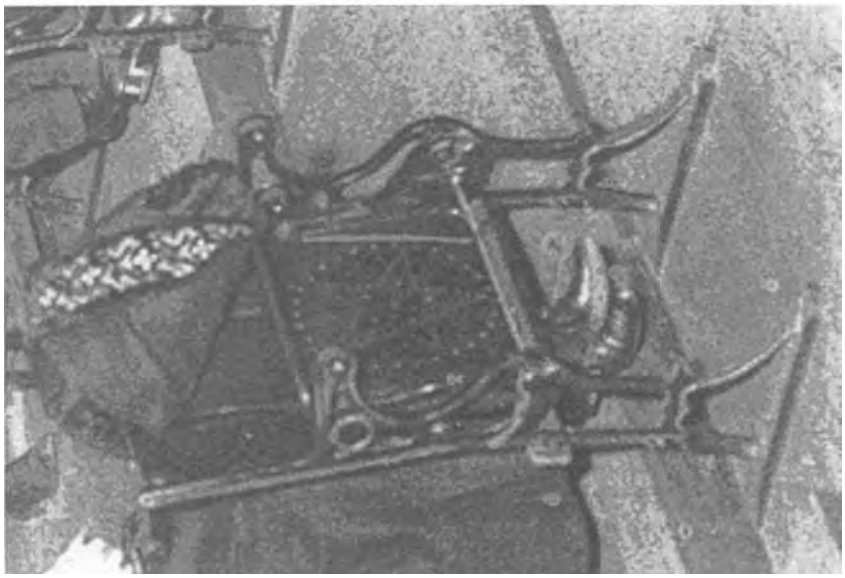

Figure 6. Detail of the seats, from the c.1905 view.

Conservation

A major aspect of the conservation plan for the auditorium seats at the Wagner was the treatment of the original seats. The total number of seats to be treated and the continuing use of the auditorium, throughout the duration of the project and in the future, impacted our choice of methods and materials as well as requiring an organized approach to the project. At all times, there had to be enough seats in the sections of the auditorium that get the most use to accommodate the ongoing programs at the Wagner. At the same time, enough of the seats needed to be at the LCA facility to be treated efficiently in order to complete the entire project by the Grant deadline. There are a total of 476 seat openings in the auditorium, each of which required a minimum of a thorough cleaning, touch-up, and waxing.

Figure 8. A view of the auditorium from the entrance.

Examination

Lexington Conservation examined the auditorium seats in August 1998 and prepared a treatment proposal for submission by the Institute as part of a grant application for a two-year Keystone Historic Preservation grant from the Pennsylvania Historical and Museum Commission. The

grant was awarded to the Wagner and work began in August of 1999.

Construction

The auditorium chairs are made of cast iron sections that form the arms and seat/back supports of the chairs. These supports are screwed to the auditorium floor. The backs and seats each attach with four screws, with grommets, and nuts to secure the assembly. The backs are made of a top and bottom cross piece with three separate splats and the seat decks are made of five plys of veneer with a complex bent contour. A pattern of decorative air holes is drilled through the seat in the shape of a star inside of a circle. There is a metal wire hat rack attached to the under side of the seats with wooden battens at the back to make the seats more rigid. There are also two wooden rails along the back of the assembly that appear to serve as foot rests for the row behind. Several campaigns of repairs to the seats are evident. The earliest repairs were made by padding the seats with a thin layer of cotton batting covered with black oilcloth attached to the seat top with brass tacks. There are remnants of paper in the surface of some of these sections of oilcloth (an artifact of manufacture) including a section of a calendar dated 1922. There were some later repairs executed using a vinyl cloth over batting that was wrapped over the seat edges and tacked underneath. Several of the seats had a self- adhesive "contact" paper on the top surface. There were also a number of modern seat replacements, circa 1980's. During the examination phase, it was determined that there were, in fact, two different sizes of seats – a 19 inch wide variety and an 18 inch wide variety. It is unclear why this is the case, as the seats are scattered randomly throughout the auditorium.

Surface Appearance

The iron supports are painted black, with some rows having details highlighted in gold. The wooden elements are stained a semi-opaque red/brown color and are coated with a semi-clear varnish. The varnish fluoresces a yellow-green when examined under longwave ultraviolet examination, characteristic of a natural resin varnish. Some of the chair backs have letters painted on them in a gold paint. These letters are upper case and approximately 4" in height. The chairs with these letters are scattered randomly around the auditorium, and most likely relate to the previous installation of these chairs in the Concert Hall on Chestnut Street.

Condition Summary

The chairs were generally stable overall considering their age and the amount of use they receive. The main area of concern was the seat decks, which varied considerably in condition, ranging from cosmetic problems to seats that were completely missing.

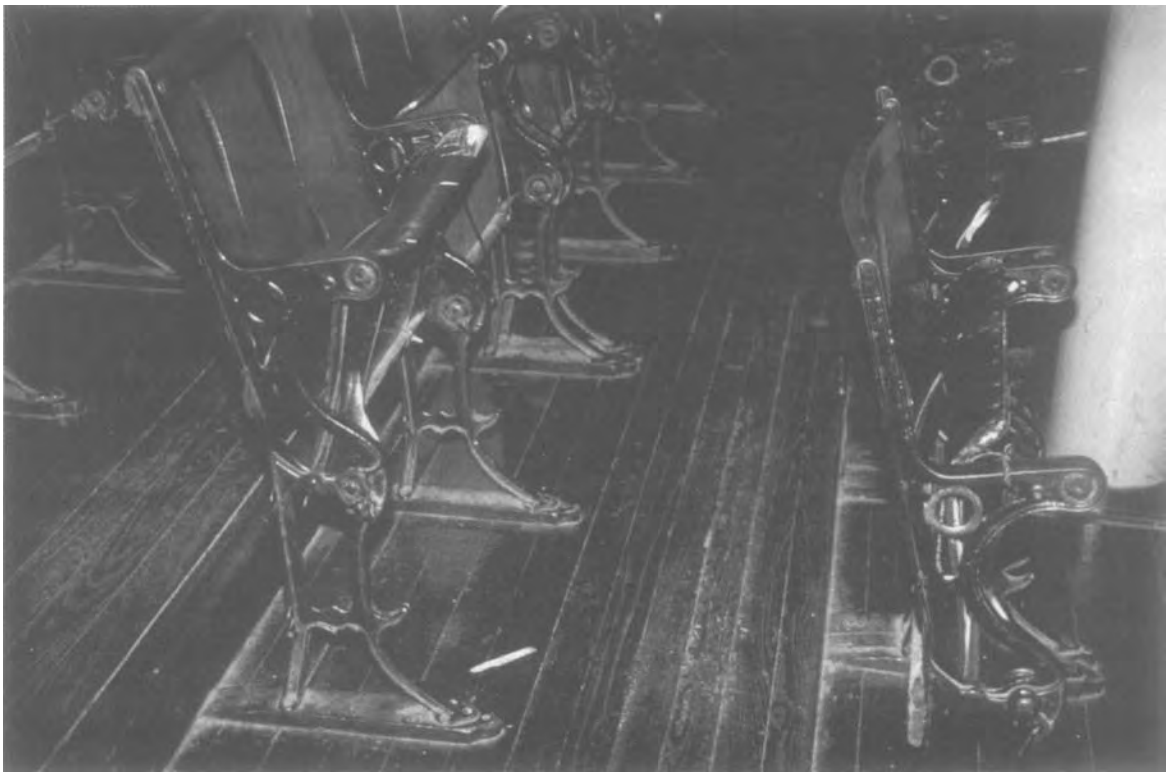

Figure 9. Detail of chairs in the auditorium

Structure

As mentioned, the chairs were in varying states of structural repair, especially the seats. The iron supports and the backrests were generally stable. The following six condition categories were established to describe the original seats.

Category 1: Minor cosmetic work needed. These seats were determined to have no structural problems. The main concern with these seats was the dirt and grime on the surface and other cosmetic problems such as chewing gum and scratches in the finish.

Category 2: Minor veneer repair needed. These seats had small losses (less than 2" x 2" in size covering no more than 15% of the total surface area) to the outer veneer layer on either the top or bottom of the seat.

Category 3: Major veneer repair/minor structural repair needed. These seats had large losses (more than 2" x 2" in size covering no more than 60% of the total surface area) to the outer

veneer layer on either the top or bottom of the seat and/or areas of delamination of the veneer layers.

Category 4: Major structural work needed/unrepairable. These seats had one or more of the following problems: loss of more than 60% of the outer veneer layer on either the top or bottom of the seat, significant delamination of the veneer layers, loss of large sections of the seat (such as the corners), large complex breaks running through all the veneer layers compromising the structural integrity of the seats.

Category 5: Missing seats. These seats were completely missing or had been previously deinstalled due to significant structural damage.

Category 6: Modern seat. These seats were modern (circa 1980's) plywood replacement. They were reasonable approximations of the original seats; however, they were not as sturdy, were slightly larger, had a different surface appearance, and did not have the decorative pattern of holes drilled in them.

Figure 10. Category 1 seat: minor cosmetic work needed.

Figure 11. Category 2 seat: minor veneer repair needed.

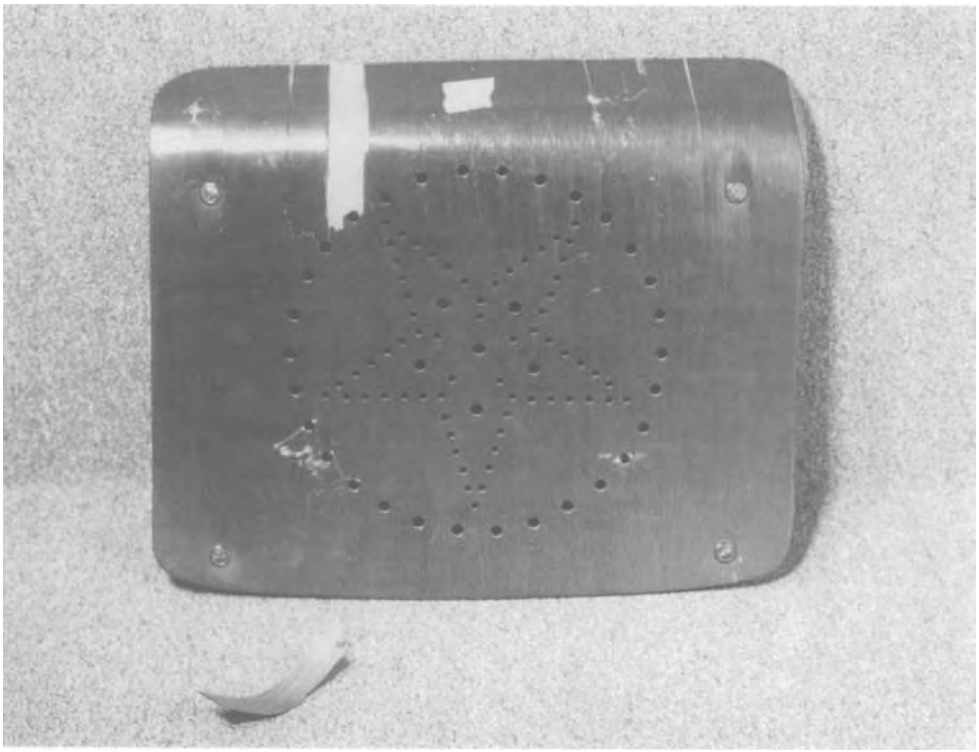

Figure 12. Category 3 seat: major veneer repair/minor structural repair needed.

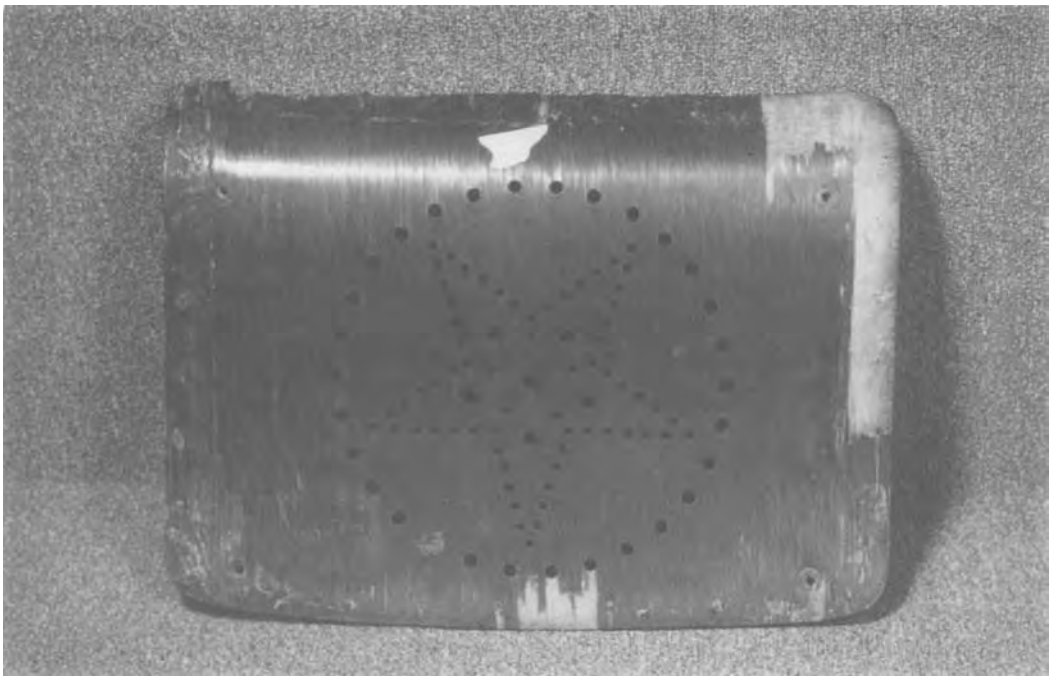

Figure 13. Category 4 seat: major veneer/minor structural repair needed.

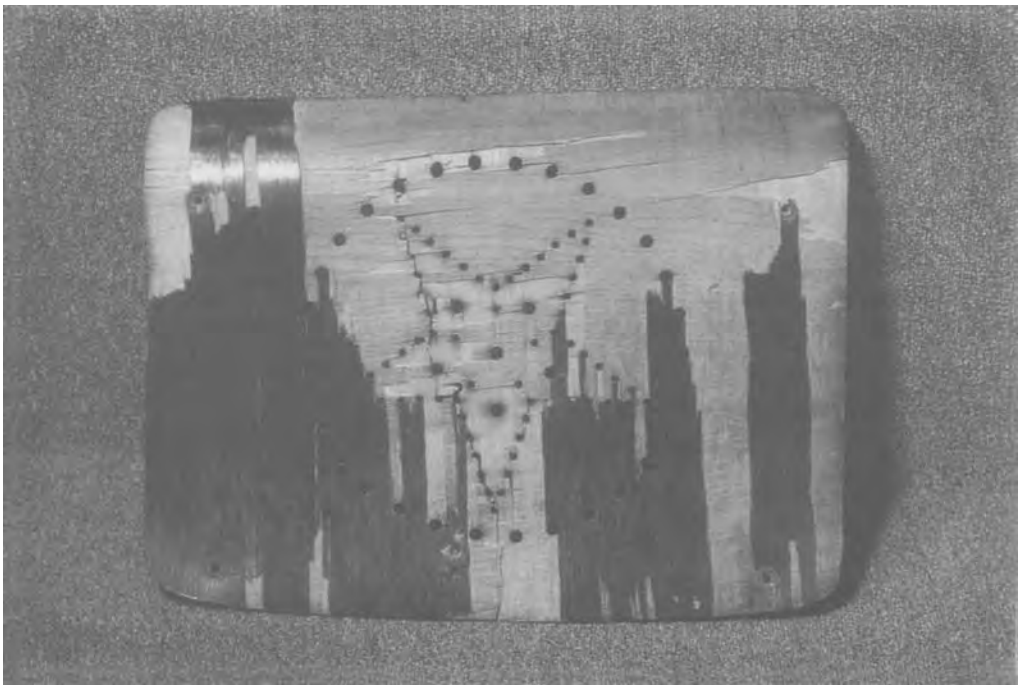

Figure 14: Category 4 seat: unrepairable.

There were some additional structural concerns with the auditorium seating including the following: approximately 75 missing or broken battens under the seats at the rear, 1 missing back assembly, and several missing or broken "foot rests."

Surface Condition

There was a layer of dirt and grime on the chairs overall. The paint on the iron supports was abraded and worn unevenly overall. The finish on the wooden elements had darkened but had an overall even appearance under normal illumination. When examined under longwave ultraviolet light it becomes apparent that where the coating is more exposed to light it is more degraded.

Treatment Goals

General: The seats represent an integral part of the institution overall. The Wagner Free Institute Long Range Conservation Plan, updated June 1996 points out the importance of treating objects such as these chairs. It reads, "Originally not included in the accessioned and documented collections, the original furnishings, fixtures, and cabinetry in the building are now included as an important part of the collection because they are the physical embodiment, along with the collections, of this unique nineteenth-century scientific and educational institution...Therefore, conservation of the institutional integrity is as important as conservation of individual specimens or collections of specimens." Treatment of the auditorium chairs represented an important step in achieving the goals set forth by the institution.

Specific: The main goal of the treatment was to address the structural concerns of the seats. Some degree of cosmetic work was desired to improve the overall appearance of the seats without doing a complete restoration.

Treatment

A graphic chart of the auditorium was created and each seat labeled with a three-digit code. These codes indicated the section, row, and seat number. As seats were deinstalled they were labeled with this code. In most cases, the seats were replaced in the same location from which they were removed. The exception was the seats in the two sections of the auditorium that receive the most use. Initially, the original seats in this area were removed and replaced with the existing modern replacements and seats with old repairs (second campaign covers on the surface). This was done to minimize additional damage to seats that were to be conserved. After conservation, the period seats were reinstalled in other areas of the auditorium and the new reproductions placed in the high use areas.

The seats were deinstalled in groups of 30 to 50. A drop of penetrating oil was put on the threads

of each of the four screws to help break the nut free and make them functional. A cordless drill/driver with a 12 mm, 12-point socket bit was used to speed up the deinstallation process, and it was found that approximately 10 seats could be removed per hour, per person. Reinstallation was a slower process, with an average of only 6 seats per hour, per person.

After the seats were deinstalled they were taken to the LCA facility where they were generally sorted by category and then treated.

Category 1 seats were surface cleaned with a dilute mild detergent in water and/or degreased with solvent as needed. Losses to the finish were touched up with Blendal Powder Stain extra fine ground dry pigments in Behlen's A.C. Garnet Shellac, 1 ½ pound cut in denatured alcohol. A light pad application of shellac was applied to the surface to even out the gloss overall. The seats were waxed with Behlen's Blue Label brown Paste Wax and buffed to an appropriate gloss.

Category 2 seats were surface cleaned with a dilute mild detergent in water and/or degreased with solvent as needed. Any areas of loosed/delaminating veneer were consolidated by injecting hot hide glue with a syringe and clamping until set. The losses in the veneer were filled in two manners. Losses smaller than ¼ inch x ½ inch were filled using Ciba Specialty Chemicals Araldite AV 1253 Carvable Paste. Larger losses were filled using patches of birch veneer chosen to match in grain pattern and type. Veneer patches were inpainted/infinished using a combination of materials including: Blendal Powder Stain extra fine ground dry pigments in Behlen's A.C. Garnet Shellac, 1 ½ pound cut in denatured alcohol; Orasol dyes (Brown 2GL, 2RL, 6RL; Black RLI; Red 3GL, Yellow 2GLN) in shellac; Winsor & Newton water colors; and artist's oil paints. The finish on the fills was built up using shellac. Losses to the finish were touched up with Blendal Powder Stain extra fine ground dry pigments in Behlen's A.C. Garnet Shellac, 1 ½ pound cut in denatured alcohol. A light pad application of shellac was applied to the surface to even out the gloss overall. The seats were waxed with Behlen's Blue Label brown Paste Wax and buffed to an appropriate gloss.

Category 3 seats required more extensive work than those of Category 2 (e.g. larger patches, more consolidation) but the methods and materials were similar. Seats were surface cleaned with a dilute mild detergent in water and/or degreased with solvent as needed. Areas of loosed/delaminating veneer were consolidated by injecting hot hide glue with a syringe and clamping until set. The losses in the veneer were filled in two manners. Losses smaller than ¼ inch x ½ inch were filled using Ciba Specialty Chemicals Araldite AV 1253 Carvable Paste. Larger losses were filled using patches of birch veneer chosen to match in grain pattern and type. Veneer patches were inpainted/infinished using a combination of materials including: Blendal Powder Stain extra fine ground dry pigments in Behlen's A.C. Garnet Shellac, 1 ½ pound cut in denatured alcohol; Orasol dyes (Brown 2GL, 2 RL, 6RL; Black RLI; Red 3GL, Yellow 2GLN) in shellac; Winsor & Newton water colors; and artist's oil paints. The finish on the fills was built up using shellac. Losses to the finish were touched up with Blendal Powder Stain extra fine ground dry pigments in Behlen's A.C. Garnet Shellac, 1 ½ pound cut in denatured alcohol. A light pad application of shellac was applied to the surface to even out the gloss overall. The seats were

waxed with Behlen's Blue Label Paste Wax and buffed to an appropriate gloss.

Category 4 seats presented the largest challenge. Many had extensive structural problems such as large areas of loose surface veneer, and delamination of the inner plys requiring significant repair. The complex curved shape of the seats made it difficult to get the required clamping pressure in all areas. An attempt was made to use a vacuum press (see section on fabrication of new seats for a detailed discussion of the vacuum press set-up) to reglue these seats but the heavy bag did not allow the water in the hide glue to evaporate, keeping it from fully setting and leading to the formation of biological growth. This led to new approaches, including the development of several cauls and clamping methods to consolidate these seats.

The losses in the veneer were filled in two manners. Losses smaller than ¼ inch x ½ inch were filled using Ciba Specialty Chemicals Araldite AV 1253 Carvable Paste. Larger losses were filled using patches of birch veneer chosen to match in grain pattern and type. Veneer patches were inpainted/infinished using a combination of materials including: Blendal Powder Stain extra fine ground dry pigments in Behlen's A.C. Garnet Shellac, 1 ½ pound cut in denatured alcohol; Orasol dyes (Brown 2GL, 2 RL, 6RL; Black RLI; Red 3GL, Yellow 2GLN) in shellac; Winsor & Newton water colors; and artist's oil paints. The finish on the fills was built up using shellac. Losses to the finish were touched up with Blendal Powder Stain extra fine ground dry pigments in Behlen's A.C. Garnet Shellac, 1 ½ pound cut in denatured alcohol. A light pad application of shellac was applied to the surface to even out the gloss overall. The seats were waxed with Behlen's Blue Label brown Paste Wax and buffed to an appropriate gloss.

Figure 15. Seat with historic oilcloth covering, before treatment.

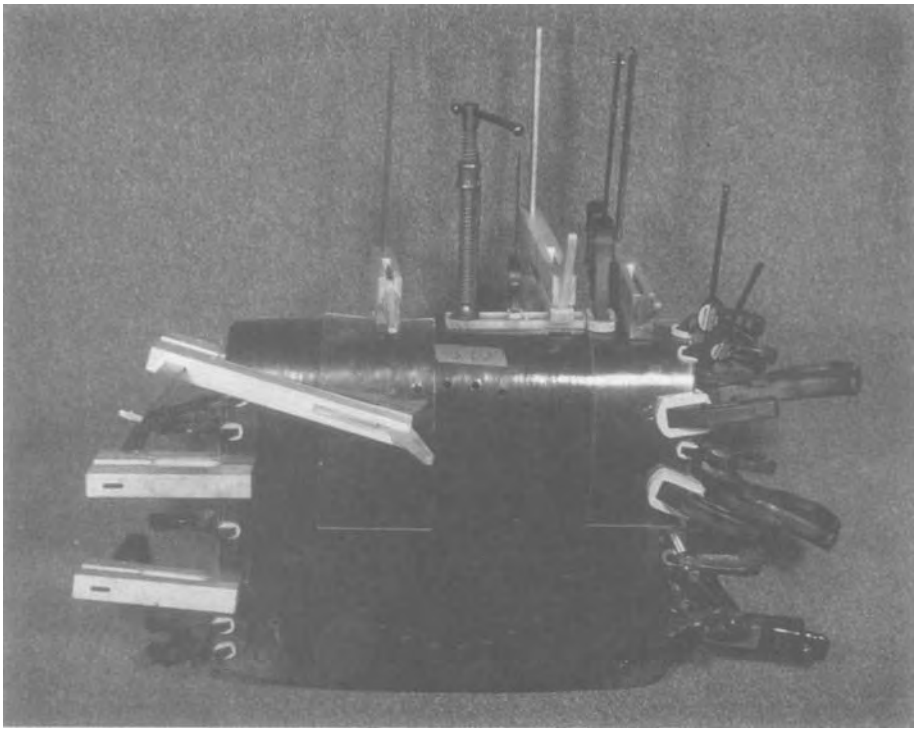

Figure 16. Seat during treatment: consolidation of loose/delaminating veneer.

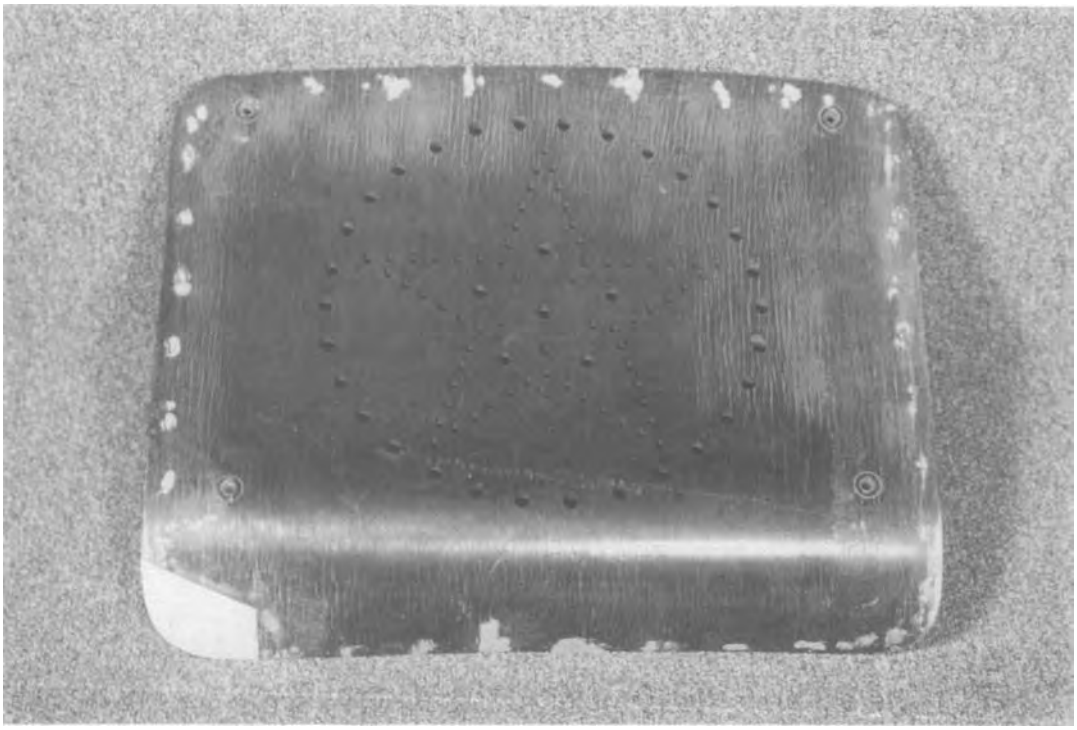

Figure 17. Seat during treatment: veneer and epoxy fills.

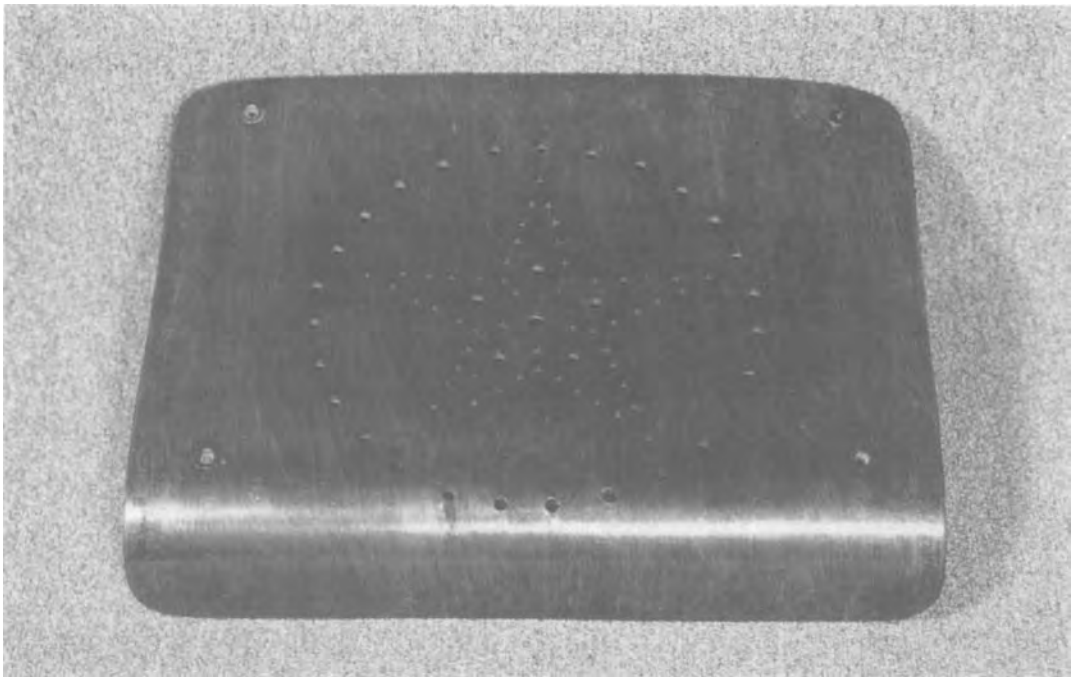

Figure 18. Seat after treatment.

Category 5 & 6 seats were replaced with new reproductions manufactured by LCA as described below.

Replication of Seats

A major portion of the overall auditorium seating project was the replication of approximately 100 seats. The replicas were to match the originals as closely as possible in terms of shape, wood choice, and color. Harry Alden of Alden Identification Service carried out wood identification on a sample of veneer from one of the category 4 seats. It was identified as Birch (*Betula* sp.). In order to better understand the fabrication process, research was undertaken into both the process and history of this technique.

Brief History of Bent Laminated Seating Forms

Samuel Gragg, of Boston Mass., received a patent in 1808 for his 'elastic chair', unlike the Windsor style chair, whose bent components such as the hoops, arm rests, and crest rails are all comprised of individual pieces, Gragg appears to be the first American maker to utilize continuous bent components as primary structure and perhaps even foresaw what was to come? Michael Thonet, by the 1830's, was experimenting with bent laminated components used as chair parts and received a patent in Vienna in 1842. In 1856 John Henry Belter received a patent for a

bedstead comprised of laminated veneers. Additional patents in 1858 and 1860 indicate Belter's continuing work with bent laminated forms. In 1872 Gardner and Company of New York received a patent for a platform rocker. Utilizing pierced bent laminated components the work of Gardner appears very similar to the Wagner's auditorium seating. Unfortunately, no attribution can be made regarding the manufacturer of the Wagner's seats, what is clear, however, is the popularity of bent furniture components from the mid nineteenth into the twentieth century.

Figure 19. Elastic Chair. Samuel Gragg, Boston, Mass., 1808.

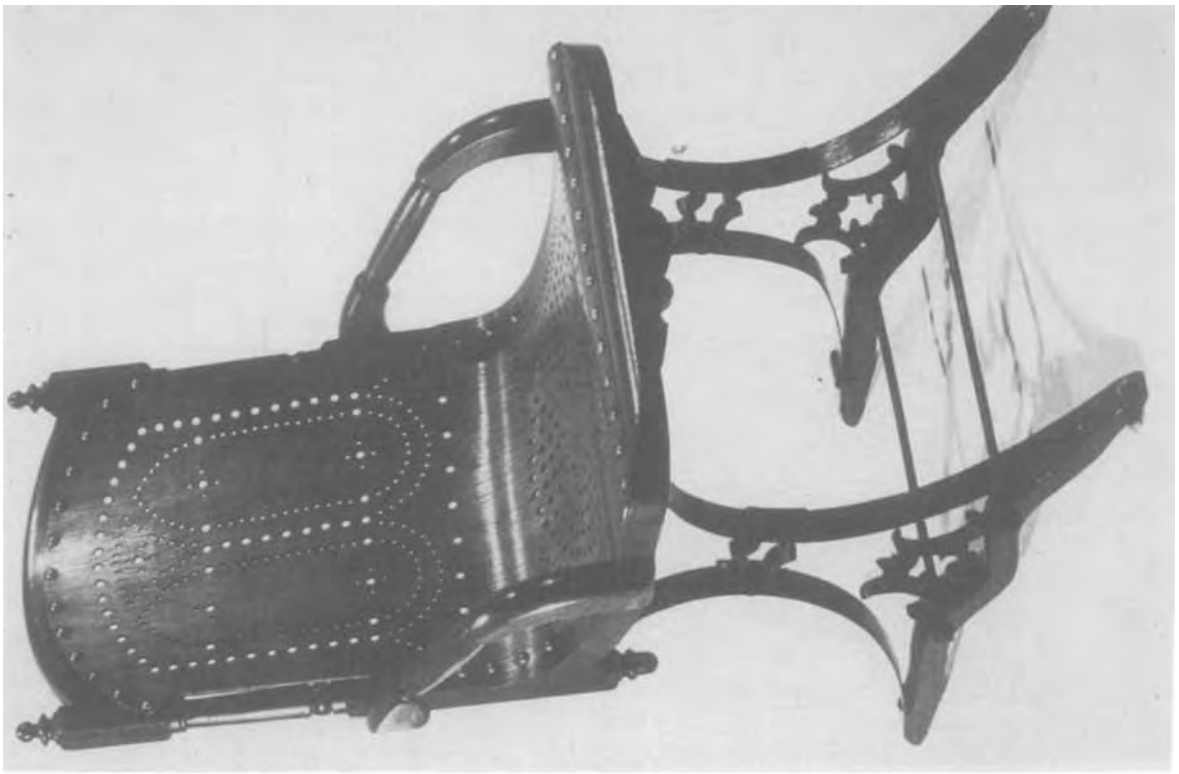

Figure 21. Platform rocker, Gardener and Company, New York, 1872.

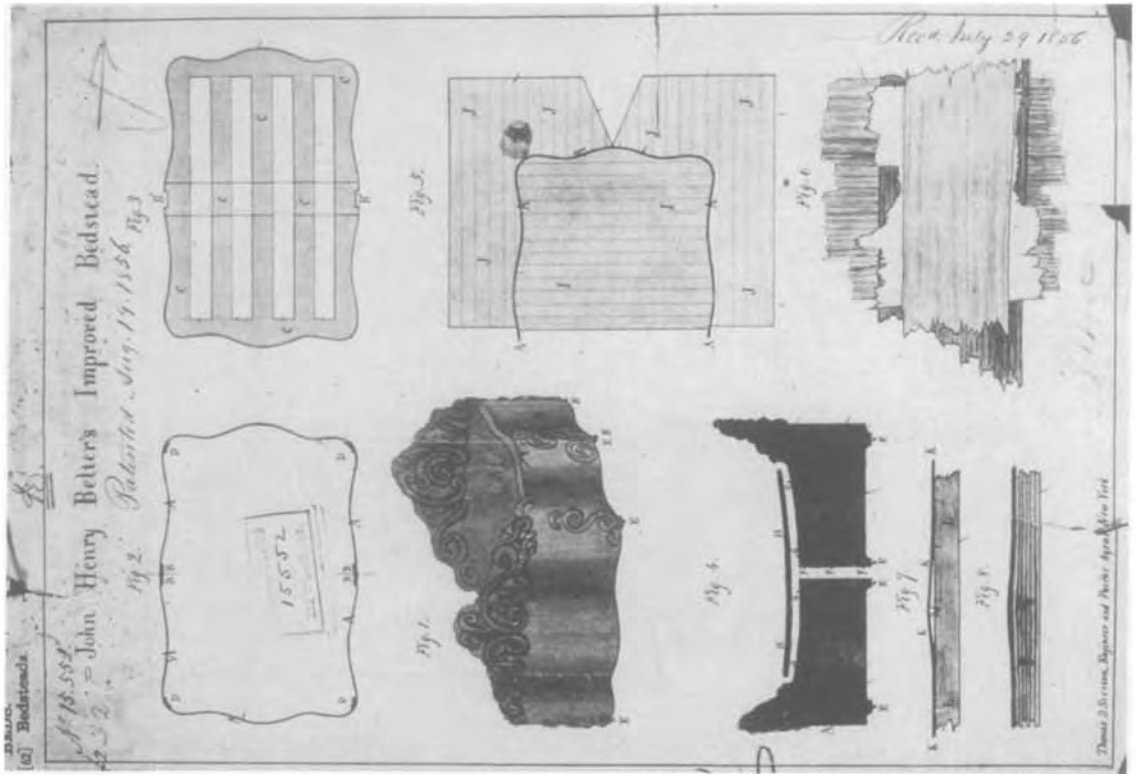

Figure 20. John Henry Belter patent for a bedstead.

Fabrication of replicas

After scouring old issues of Fine Woodworking magazine for articles on bent laminated furniture techniques, we decided upon a system utilizing a vacuum press, which has proven to work out rather nicely. The pump maintains a vacuum of between 21 and 25 inches of mercury, or approximately 1,764 lbs. per square foot and was purchased from Vacuum pressing systems, New Brunswick, Maine. The original seats are comprised of 5 plys and the seats' total thickness is approximately ¼ inch. After much searching, we were fortunate to locate a mill in Canada, Veneer Products of New Brunswick, that was able to supply us with 1/20 of an inch birch veneers. Urea formaldehyde resin glue was chosen as the preferred adhesive for several reasons; budget, stiffness, working properties and the lack of conservation related concerns with this specific application. The original seats were made using hide glue, but prototypes utilizing hide glue proved problematic; the glue gels quickly, water evaporation in the press is very slow and this, no doubt, contributed to the excessive mold formation that was found after removing the prototype from the press. Additionally, urea resin glue will aid in segregating the replicas from the period seats in future years. Although the glue does contain formaldehyde only 0.8 grams of free formaldehyde is present in each seat after the glue cures (90-95% of the formaldehyde is consumed in the curing process), additionally free formaldehyde off-gasses quickly and the seats were not installed until several months after fabrication. The manufacturer, National Casein, conforms to all EPA and OSHA threshold values and formaldehyde is most dangerous when burned or in powder form; therefore respirators were worn while mixing the glue. Additionally, the size of the auditorium and the amount of air exchange (as a result of old leaky nineteenth century double-hung window sash) should negate any possible detrimental effects of the formaldehyde.

The first step in the process was the fabrication of cauls or forms shaped to the necessary profile. Templates for cutting the form section pieces were made with ¼ inch plywood. The profiles were traced onto the 1 inch particle board pieces and then rough cut on the band saw. The templates were then stapled to the roughed particleboard and the profiles are refined with a flush-trim bit and router. Twenty pieces of particle board were prepared in this manner and the individual sections were glued and nailed to comprise a form 20 inches wide.

Our replicas also consist of 5 plys each, as do the original seats. The odd number is necessary for maximum strength; the grain of all plys must be oriented perpendicular to the adjacent ply(s).

Initial experiments attempting to bend straight veneer pieces to the final shape proved unsuccessful, and it was discovered that the individual plys needed to be pre-bent. A jig, that we call the pre-press jig, was devised to accomplish this. The individual plys are soaked briefly, placed in the jig wet, and allowed to dry. After the wood has dried, the plys retain the desired shape and will now nestle nicely onto the bending forms.

The adhesive, mixed 400 grams of resin to 240 grams of water, is spread over the contact surfaces of each ply with a roller as they are laid on the form. Plastic sheeting is carefully placed

overtop of the veneer and a section of bendable plywood placed on top as an upper caul. The plastic is to prevent glue contact with the vacuum bag and platen. The forms are placed in the vacuum bag where the laminates will remain, under compression, for at least twelve hours.

The next step requires profiling the corners of the seat and the rear edge of each seat. Another jig, which we refer to as the seat plan jig was designed so that the radiused corners and the curved back edge of the seat could be traced onto the seat blank. The seat is rough cut at the band saw and sanded to the pencil line on a 6" belt finishing machine. Minor irregularities can be corrected with files and sand paper.

After fabrication of several seats, we wondered, "How strong are they?" One seat was taken out to the parking lot and a Subaru station wagon slowly driven over it. The seat withstood the pressure until the full weight of the vehicle was on it. However, only the bottom two plys broke and the seat still retained its shape.

After shaping the seat profile, the pierced seat pattern is created. This is done by marking the pattern onto the seat using a Mylar template taken from an original seat. The holes are then carefully drilled on an extra seat to minimize tear-out.

The last production step before the application of finish is sanding the seat blank with a palm sander and 150 grit paper.

A sealer coat of garnet shellac in ethanol was brushed on to both sides of each seat. The seats were then hand sanded with 220 grit paper. The color was achieved using Orasol dyes applied with a spray system. Two distinct colors, a lighter undertone (Red 3GL, Brown 2GL, Yellow 2GLN Black RLI) and a darker toning layer (Black RLI Red, 3GL) were applied. The seats were then given several applications of garnet shellac as a top coat. The shellac layers were lightly sanded between coats and the final coat steel wooled. The seat surfaces were then waxed.

The completed seats were taken to the Wagner and the necessary holes for mounting the seat to the chair frame were drilled on site. Additionally, the hat rack hardware and rear batten were attached during installation.

Conclusion

After all the seats were conserved/fabricated and installed, a regular maintenance schedule was established. Frequent inspections for new damage are scheduled and rapid repair of any problems is anticipated. The protective wax coating will be updated as needed. It is hoped that this will enable at least another 100 years of programming in this wonderful auditorium

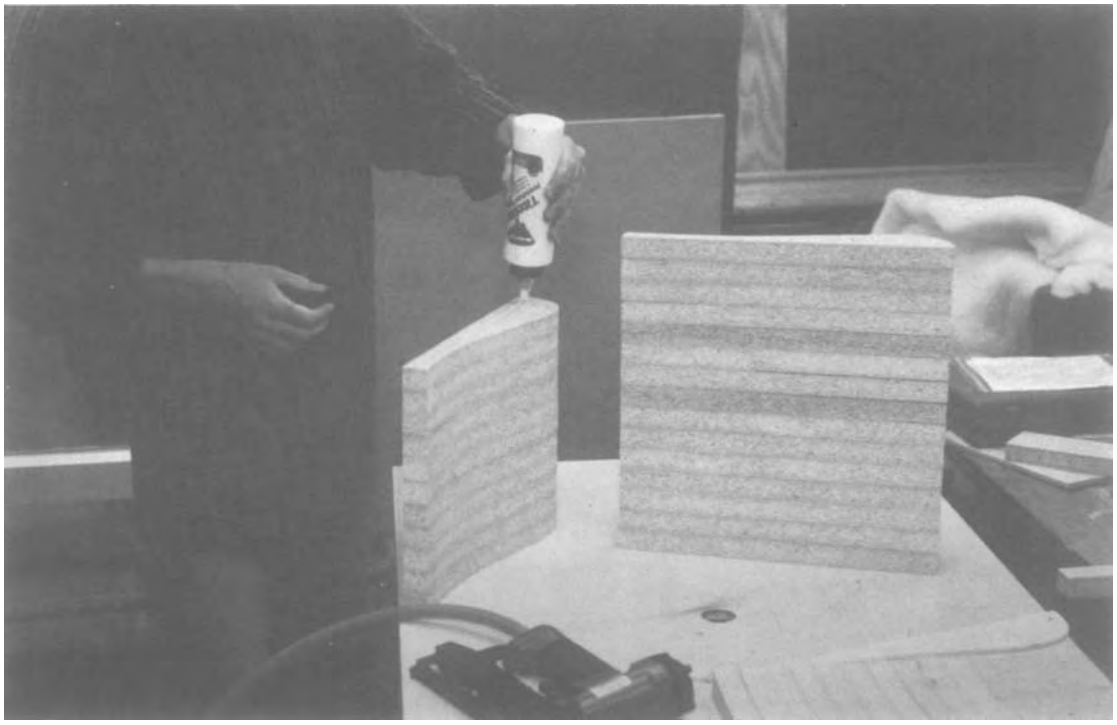

Figure 22. Fabrication of forms.

Figure 23. Soaking veneers.

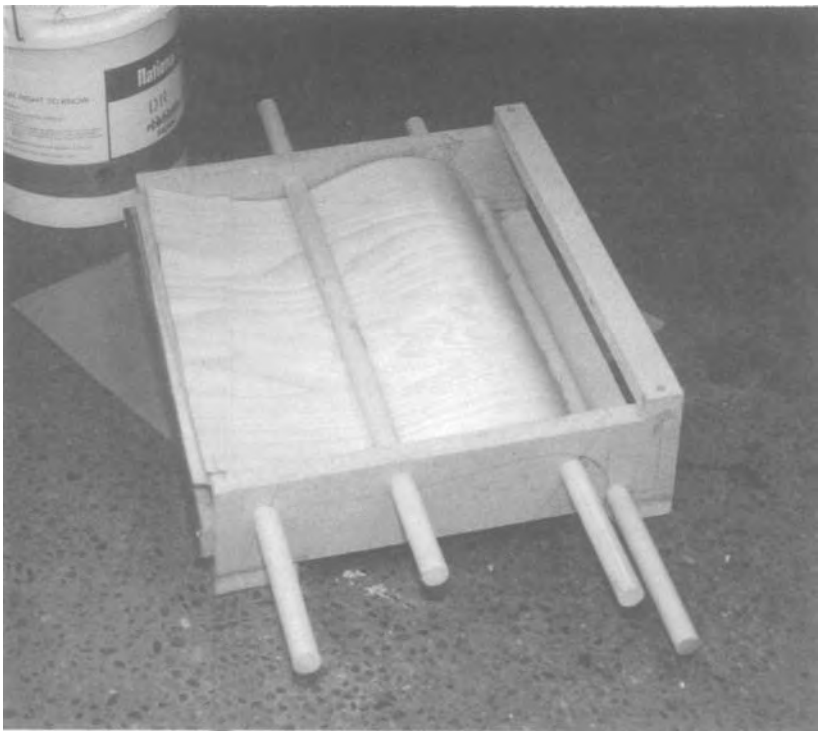

Figure 24. Veneer in pre-bending jig.

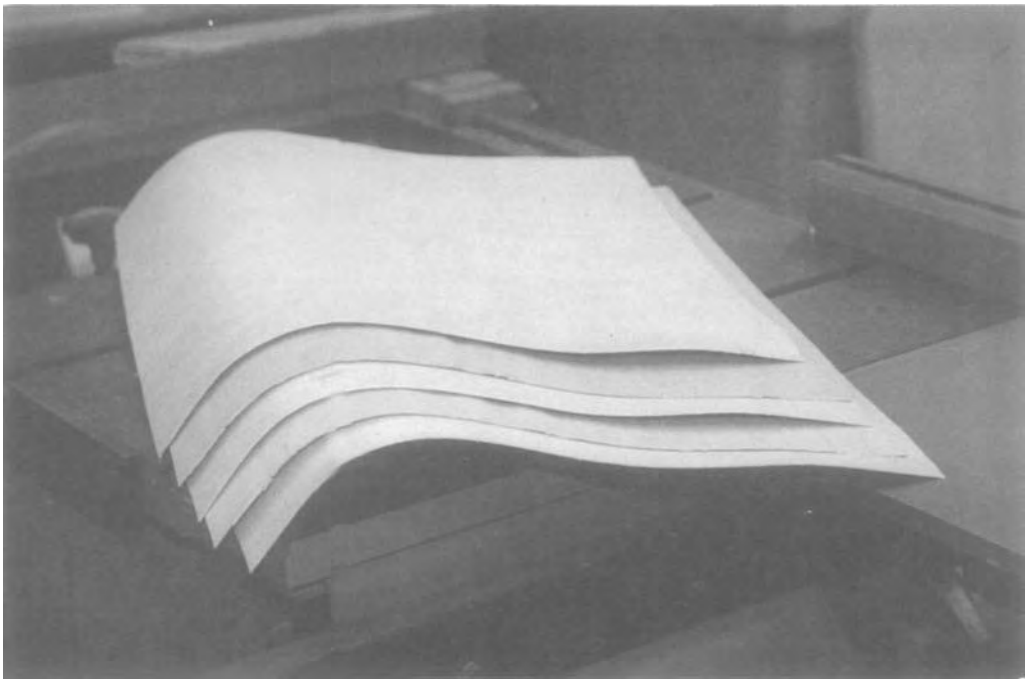

Figure 25. Pre-bent veneers.

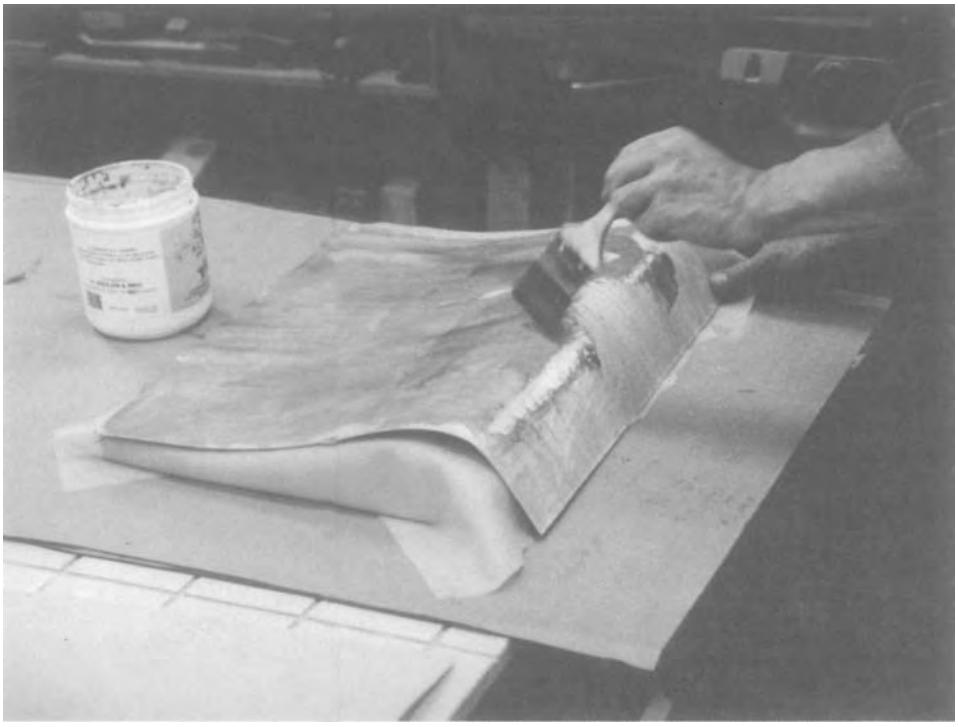

Figure 26. Application of urea-formaldehyde resin adhesive.

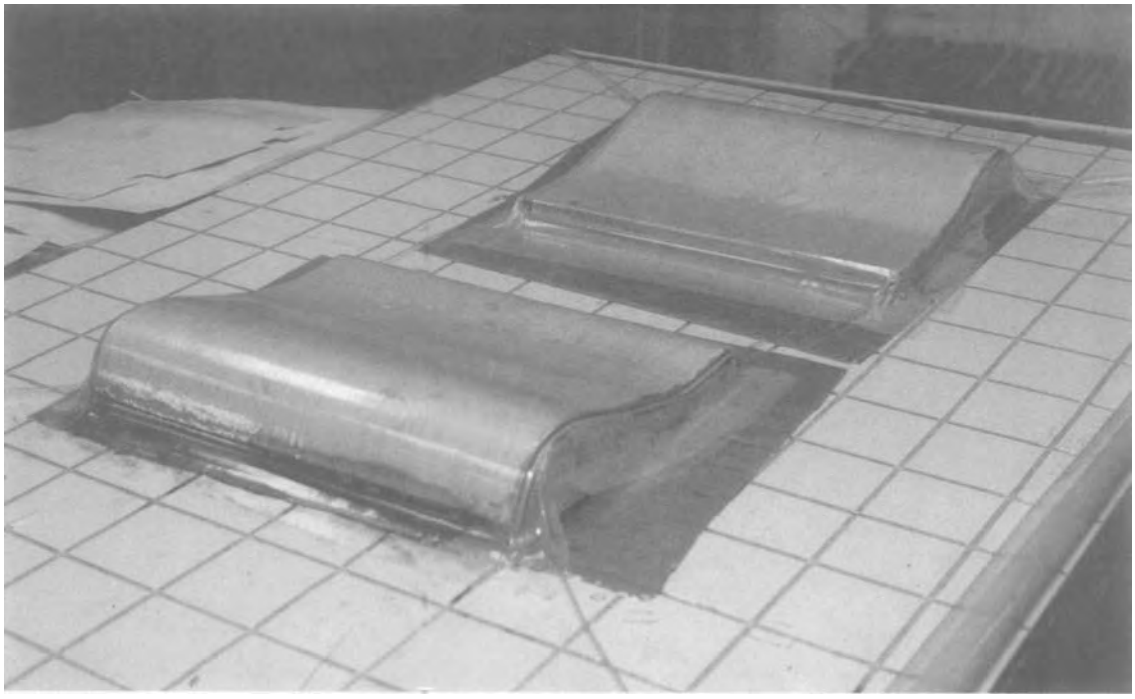

Figure 27. Fabricating seats in the vacuum press.

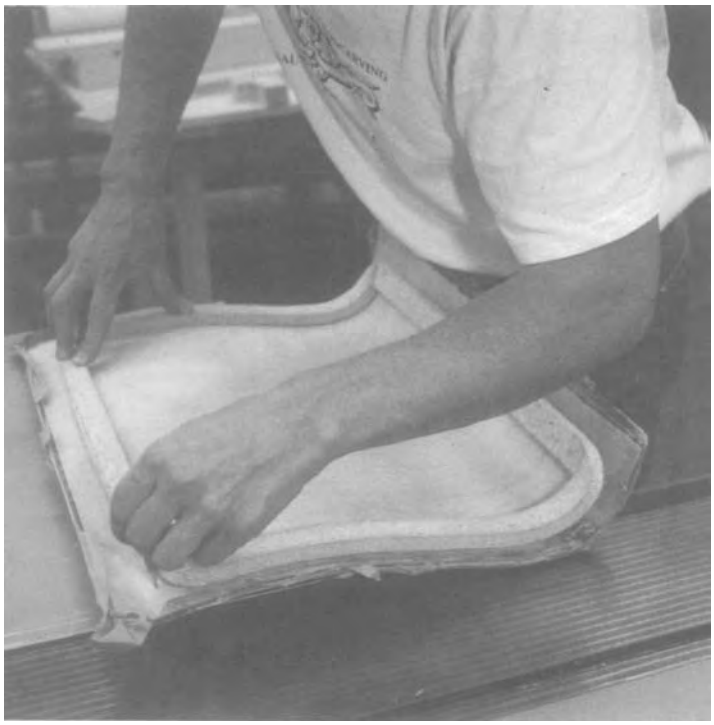

Figure 28. Tracing the seat plan jig on a seat blank.

Figure 29. Cutting a seat to shape with a bandsaw.

Figure 30. Sanding a seat to the final shape.

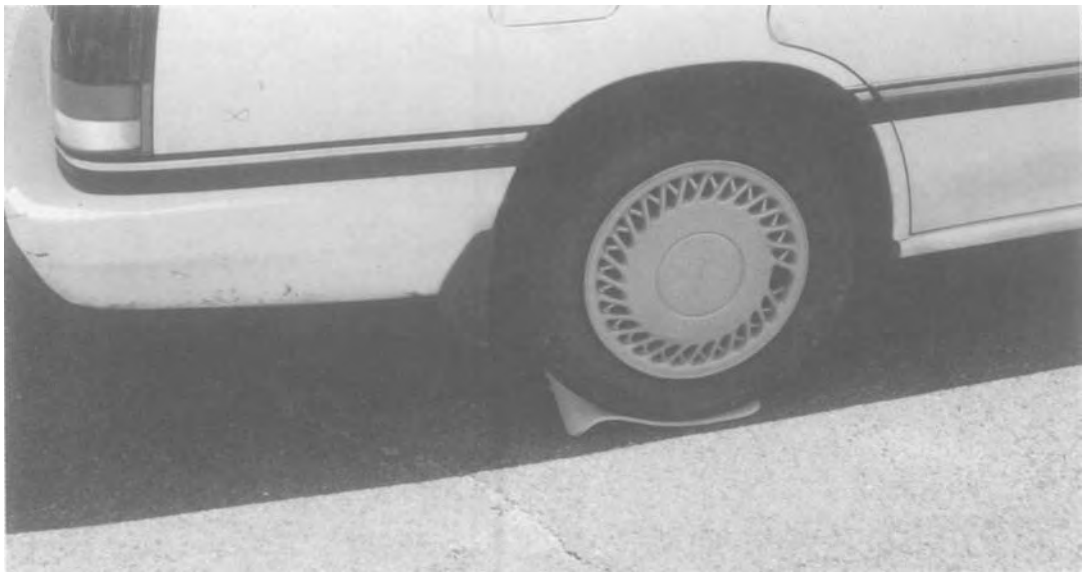

Figure 31. Strength test.

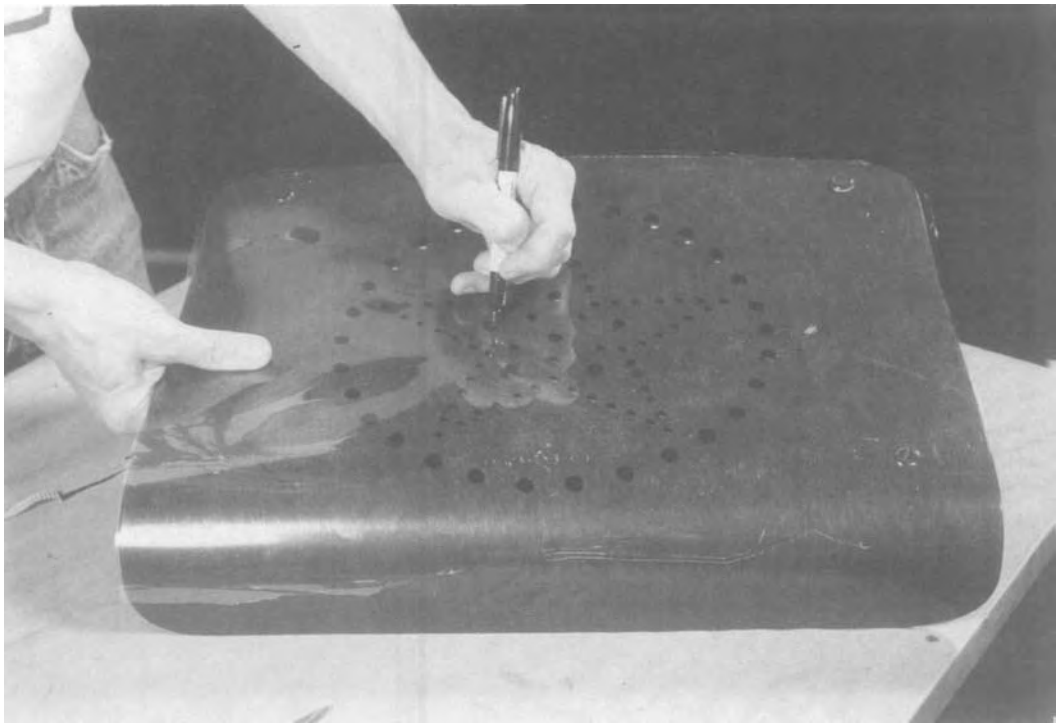

Figure 32. Making a Mylar template for drilling holes.

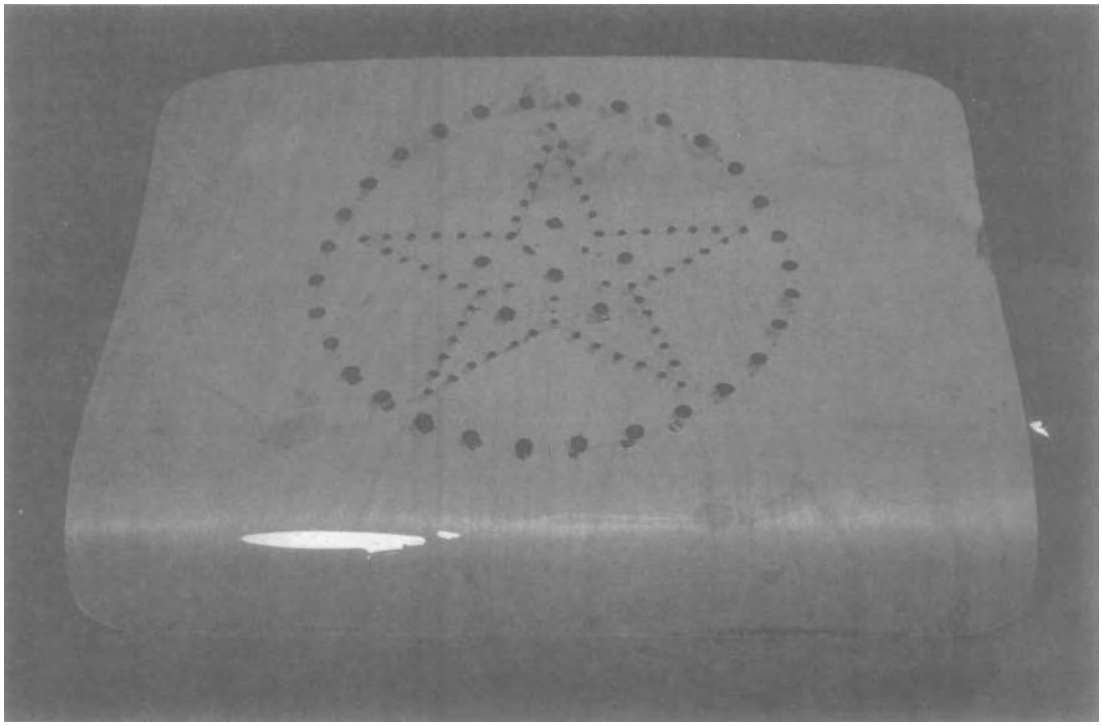

Figure 33. Transferring the hole pattern to a seat blank.

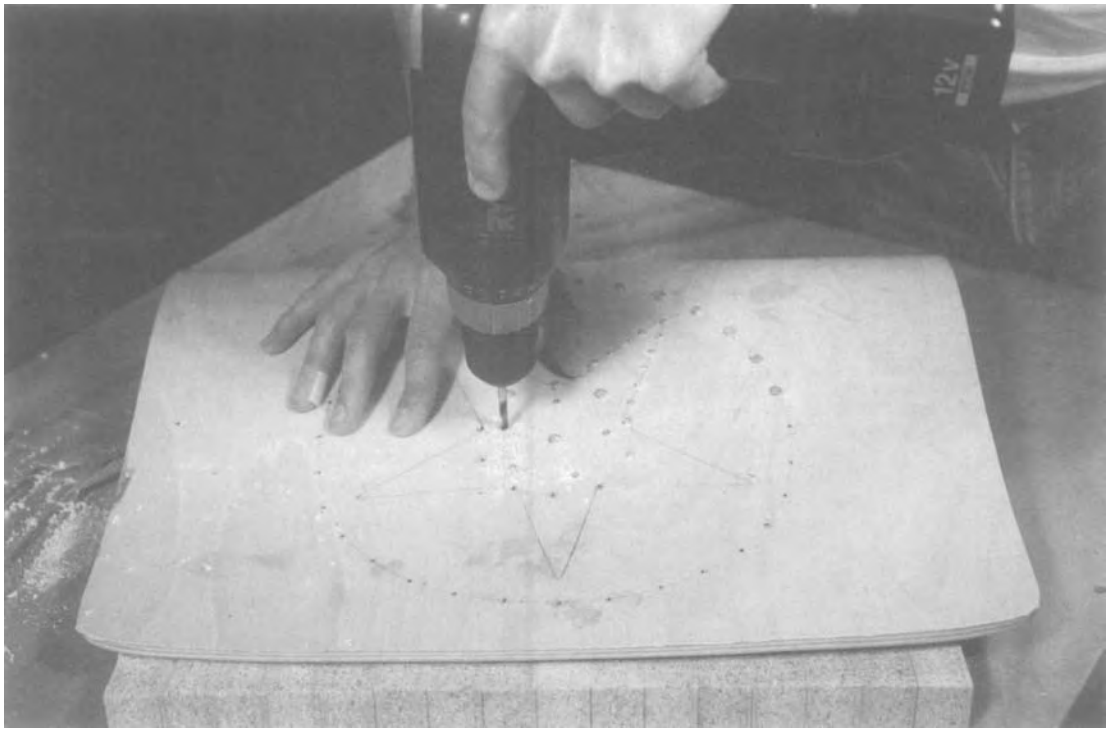

Figure 34. Drilling holes in a seat.

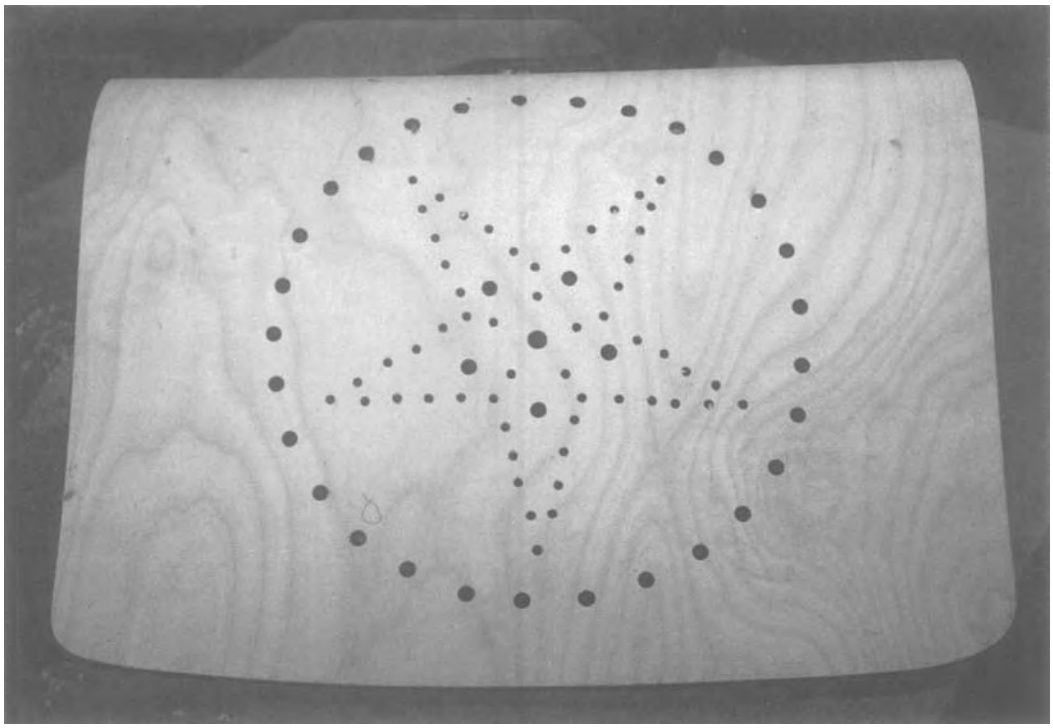

Figure 35. Seat after fabrication, but before application of finish.

Figure 36. Completed seat with chair assembly, including iron supports, wooden back and coat rack with batten.

Acknowledgements

The authors of this paper would like to thank the following people for their help and support with this project: Dawn Heller, Paul Koenig, Lisa Kurtz, Greg Landrey and Melissa McGrew.

Endnotes

1. Information on William Wagner and the history of the Institute are drawn from primary sources held by the Archives of the Wagner Free Institute of Science. See also Bolt, Eugene and Susan Glassman. 1990 Wagner Free Institute of Science Historic Landmark Nomination.

2. Wagner Free Institute of Science. Act of Incorporation, March 9, 1855; Supplementary Act of Incorporation, March 30, 1864, and Deed of Trust of William Wagner and Wife, May 30, 1864, Philadelphia: Wagner Free Institute of Science, 1920.

3.The receipt records that the seats were received from the Meade Post, a chapter of the Grand Army of the Republic veteran's group. Dr. Anthony Waskie and Eric Schmincke of the G.A.R. Museum provided assistance in tracing the Meade Post at the time the seats were purchased.

4. A short history of the Concert Hall is given in Joseph Jackson's *Encyclopedia of Philadelphia*, Harrisburg: The National Historical Association, 1931. Vol. II, pp. 512-513. Photographs of the Hall during the period that it housed the Free Library appear in Robert F. Looney, *Old Philadelphia in Early Photographs, 1839-1914*. New York: Dover Publications, 1976.

5. The first branch of the Free Library of Philadelphia opened at the Wagner Institute in 1892. This connection may have facilitated the exchange.

6. Conservation Assessment, Catherine Hawks, Conservator, November 1992. Conservation Conditions Survey and Planning Analysis, William Stivale, Building Conservator, November 1992.

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Materials

1. Adhesives:
   Hide Glue

   Urea-Formaldehyde Resin: National Casein of New Jersey, 401 Martha's Lane, Riverton, NJ 08077

2. Fill Materials/veneer:
   Araldite AV 1253, Carvable Paste Wood: Ciba Specialty Chemicals, Performance Polymers

   Birch veneer, 1/20" Rotary cut Birch: Veneer Products of NB (1981) Ltd., 12 Alpha St., Napadogan, NB E6B1Y6 Canada

3. Finishing Materials:
   Ciba-Geigy Orasol dyes
   Windsor & Newton Artists Oil paint
   Windsor & Newton Artists Water Colors
   Mohawk Blendal Stain Concentrated Dry Pigments
   Belen A.C. Garnet Shellac Flakes
   Belen Blue Label Paste Wax

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