REPLICATING GRAGG

Donald C. Williams

The pantheon of historic American furniture designers and makers is populated with well-known names the likes of Peter Scott, the Goddard/Townsends, the Seymours, John Shaw, Harvey Ellis, Charles and Henry Greene, Charles and Ray Eames, and a host of others including the enigmatic Boston chair maker Samuel Gragg. Many of the preceding figures are well known for their lives both inside and outside the workshop. John Shaw, for example, was a prominent public official in Annapolis for a half century, but such is not the case with Samuel Gragg.[1] Thanks to the excellent recent research by Michael Podmaniczky and Patricia Kane, we know much more about Gragg than a mere few years ago, although there is clearly much left unknown.[2] Fortunately, he left a small inventory of his work that reveals he was a fearless technical master and aesthetically gifted artisan.

Figure 1 Gragg chair missing only the intermediate seat slats.

Gragg's repertoire of chairs has captivated connoisseurs and craftsmen alike over the past two centuries. Aesthetes have long admired the elegant, sinuous grace of his "elastic" chairs, an idiosyncratic interpretation of Greek klismos chairs that was enhanced by an exuberant polychrome finish, often including a gilded peacock feather up the center of the back. Artisans have marveled at his manipulation of materials, as Gragg worked at the very edge of what can be accomplished with wood (fig. 1).

There were at least three distinct iterations of his chair forms, but the differentially-curved bent wood strips comprising the chair back and bottom remained at the core of the design and structure. These back and bottom components, with their symmetrically paired elements following slightly different curvatures, provided a complex spring-like character to the chair, effectively making them ergonomic rocking chairs despite the lack of a curved rocker (fig. 2). All of Gragg's known chairs sit squarely on four feet. The pinnacle of Gragg's portfolio was the continuous-leg/continuous-arm "fully elastic" chair, of which a scant few remain. To the best of my knowledge, there are only three, one each at the Baltimore Museum of Art, The Carnegie Museum of Art in Pittsburgh, and the Smithsonian's National Museum of American History.

After nearly two decades of strategizing to examine and reproduce these chairs, I recently had the opportunity to do just that. Rather than a rote recitation of the historic artifacts, I modified Gragg's original techniques, making some important improvements over his inspired but flawed construction, and included different fabrication schemes to accomplish the same end.

The first version was built very closely to his original technique with traditional steam-bent oak members. A second version was made as if in the hands of the Eames', formed from laid-up and glue-laminated veneer strips. A final attempt used timber bamboo instead of oak for the steam-formed curves. Though a bamboo aficionado, I clearly have much room to grow in the bamboo arts and that effort has yet to yield success.

My decorative finishing scheme was based on Gragg's originals. While not identical, they were all finished in flamboyant polychromy and gilded decoration, although the details of the design are not precisely exact.

REPLICATING AND IMPROVING GRAGG'S ORIGINAL TECHNIQUES

Gragg's chairs are technological first cousins of the standard Windsor chair, with individual steam-bent elements interspersed with straightforward bench-built fastened assemblies. As such, they are a fascinating mélange of elegant style and exquisite lines, proportions, and material-craft virtuosity. The half-blind dovetails on the short seat slats (fig. 3) and the delicate mortise-and-tenons where the vertical elements intersect the crest rail (fig. 4), for example, are combined with mundane half-lap joinery and copious use of metal fasteners whenever components are affixed to one another.

In the absence of expository construction documents, I relied on reverse engineering for many of the construction details as well as Podmaniczky's and Kane's previous scholarship. This is where in-person examination of the three extant examples provided invaluable instruction. The result of my inquiries was a portfolio of approximately 300 images and a set of chair patterns.

Once I derived the necessary templates, the individual steam-bent components were accomplished with fairly standard bending techniques, with only a few idiosyncratic methods employed. Not being a boat builder or Windsor chair maker, this was the most extensive bending exercise I had attempted. My initial practice with stock from my lumber pile resulted in almost three dozen pieces of really nice kindling. In the end, I used self-harvested oak, split, rived, and shaved to the approximate dimensions before bending (figs. 5 & 6).

Figure 2 The slight variations of the back splat profiles allows the structure to act as an integrated leaf spring, each slight element reinforcing the others.

Figure 5 Stock was wrought with traditional tools and techniques; splitting the logs with mauls and wedges, followed by riving with a mallet and froe. Photo by Daniela Gross.

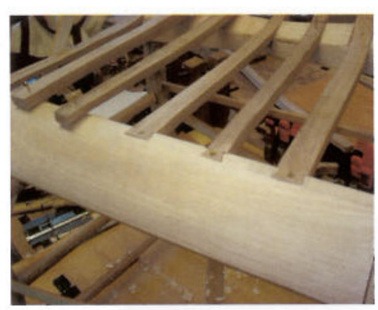


Figure 3 Seat slats are affixed to the rails primarily via half-blind dovetails.

Figure 4 The crest rail is joined to the vertical back slats by delicate mortise and tenon joints.

Figure 6 Stock was prepared for steam bending with a drawknife on a shaving beam, followed by spokeshaves and hand planes.
Photo by Juliane Derry.

It is clear that Gragg dealt with the extreme bending stresses, whether *ex-ante* or *ex-poste* of his initial efforts remains unclear, by thinning and tapering the bent elements at their area of highest stress, probably before the pieces were even inserted into the steam box. This suggests a fairly detailed set of patterns or measurements in prepping the stock.

From looking at the original chairs and building replicas, I am convinced that much of the final shaping of the chair components was accomplished only after the assembly was complete, or at the very least after the steam bending was accomplished and the structural fitting was complete. Drawings are useful, templates are vital, but the visual feel of the elements individually and composition as a whole are what yield the elegance of the chair form.

To initiate this project, I built a new steam bending system with a simple 2x lumber steam box wrapped with ½" foil-faced polyisocyanurate insulation and a wallpaper steamer as the steam source. A small steam box with heavy walls allows for a better maintenance of high temperature steam and I routinely held 200 degrees—sometimes a bit more—for as long as needed (fig. 7).

The bending was accomplished using forms constructed on a sheet of plywood with individual braces screwed to follow a traced pattern of the pieces with allowance for springback. By using individual braces rather than solid bending forms, the contours of the bend could be adjusted quickly by unscrewing the brace and moving it to the appropriate place. The contact surface for the bent item was usually a strip of ⅛" plywood between the brace and the workpiece. I steamed the pieces for twenty to thirty minutes before bending them around the forms.

My initial practice efforts confirmed the need to use straight-grained split wood, preferably on the green side, or air-dried at the least. I first tested the steam bending system with a slab of ash cut into ½" x ½" strips with way too much runout (in some locations it was 1:10), and probably case-hardened kiln dried to boot. Out of the 30 or so initial samples, I suffered a 100% failure rate. A newly-fallen oak tree in my yard provided plenty of preferred stock, and eventually, success.

The continuous leg/stile elements and the deeply curved arms are quite the problem to bend without breaking, especially the main leg/stile elements as they require a serpentine bend of two fairly tight (~6" radius) opposite curves of nearly 90° little more than a foot apart. The dimensions of these curves demanded using metal bending straps affixed on opposite sides of the steamed strip in order to make the bends into the form without suffering fracture. The thinness of these components—roughly ½" thick and 1⅛" wide—meant that the thermal mass was very low and the pieces would cool off within seconds after removing them from the steam box. It was problematic to pull a steamed strip out of the box, clamp on two separate bending bands, and yank the strip into shape on the forms before it chilled too much to bend easily.

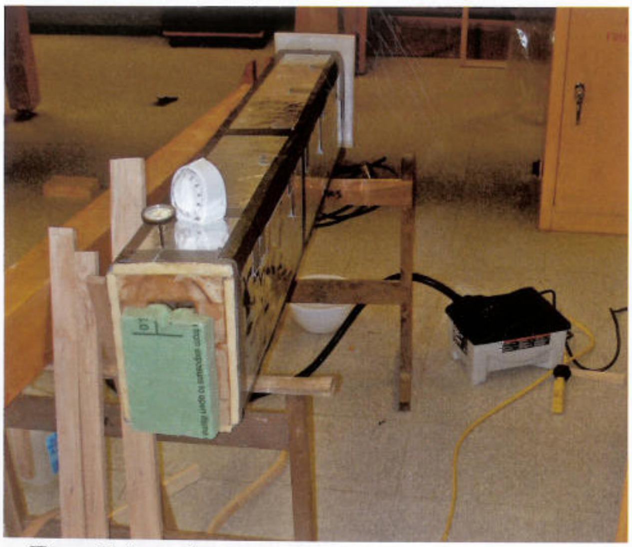


Figure 7 Steam box setup.

Figure 8 Clamping collars with pairs of tapered wedges hold the bending bands in place.

Figure 9 Tines were cut on the curved front stretcher after a tenon was cut on the full-sized element.

While some of the bending attempted with this method was successful, I also tried a technique to counteract this problem. I fabricated metal collars from box beam stock, wedged them tightly to the strips with the bending bands in place, and inserted the cold oak strips into the steam box with the bands and clamps already in place. All it took was a little careful measuring for the collar locations and a couple of extra minutes in the steam box to compensate for reducing the available surface area being permeated with the steam. I fabricated a few clamping collars from aluminum box beam stock and used rosewood wedges for the task (fig. 8).

While this process increased the success of the steam bending, it did not reduce the failure rate to zero, and reminded me of Bruce Hoadley's well-known anecdote about steam-bent lacrosse sticks. Bruce was advising a manufacturer for these sports accessories who was frustrated by high failure rates until he saw another expert steam bender suffering the same fate. At that point, the manufacturer did not feel so discouraged.

The arms and continuous seat slats were completed through similar steam bending means, as was the front rung. In the latter instance, the voids on either end of the rung were cut after the bending to make sure that the individual tines would not distort during the bending process (fig. 9).

Once the side compositions were bent and dried, the three pieces—serpentine leg/rail/stile, the rear leg, and the arm—were screwed together temporarily. At this point, I introduced my divergence from Gragg's original construction technique.

Figure 10 Through tenons were cut on the ends of the round chair rungs, and inserted through mortices in the legs.

For the chair fabrication, I reconsidered and redesigned the stretchers tying the bottom of the chair together. Gragg originally used what is essentially ¾" dowel stock as the rails, which is also what I used, although some of Gragg's side and back rungs exhibit a slight tapering at the ends and are joined by drilling a hole all the way through the legs, inserting the round rung ends, and gluing and/or pinning them. This joint is frequently a locus of failure, which is not surprising when you contemplate an approximately ¾" hole being drilled through a ½" x 1⅛" element at a point of very high stress.

For the side rungs, I cut a 3/16" wide vertical tenon at each end of each rung and a corresponding mortise in each leg. For the front and back rungs, I thinned the tenons even further to ⅛". This approach resulted in a slight reduction in glue surface area, but a substantial increase of the material remaining in the leg, a trade-off I was more than willing to make (fig. 10). I glued the tenons into the mortises with hot animal hide glue and added brass pins through the leg and the mortise in keeping with Gragg's method of using metal pins through the crest rail/back splat elements. The front bent rung was treated in essentially the same manner. It was in fact the original front rung that led me to this improvement, as the ends of each tine were reduced dramatically to make the holes in the legs smaller.

The front and rear seat rails and the crest rail were sculpted out of solid lumber stock rather than manipulated by steam. For these three parts, any sturdy clear-grained hardwood works fine. I recommend starting with tulip poplar. The seat slats that traversed only the distance between the front and rear seat rails were shaped out of oak strips prepared when the rest were shaved. In this case, I did what was evident in the original chairs and used a spokeshave to sculpt the tops to conform to the overall seat profile.

The front seat rail was the easiest part of the entire chair to execute as it was straight along its length (the chair width) and configured to mimic the leg curve. This was a simple matter of transferring the surface contour and the splay angle from the templates I had already created. The "joinery" between the front seat trail and the continuous sides was a curved rabbet, again transferred from the template. Once the fit was acceptable, I followed Gragg's example and screwed the rail in place from below (figs. 11 & 12). In the final assembly, it was glued and screwed.

I presume that Gragg employed hot animal hide glue as part of the assembly process, but have not confirmed this myself as none of the museums owning Gragg chairs would allow me to disassemble them. Regardless, I used hot glue at all contact points for the assemblies, even if screws or nails were used.[3]

It is worth noting that our modern sensibilities would have us fussing over the screw size and length to make sure we provided the maximum fastening power without having the screw protrude through the opposing surface. Gragg was apparently under no such constraints as he used large and long screws that protruded through the opposite surface to an undetermined degree. Once the assembly was complete, he sawed and/or filed the screw shafts level with the surface as they were going to be covered in paint (fig. 13). To make that job easier, I used countersunk brass screws.

The rear seat rail was more problematic as it was curved on both axes to reflect the inverted bombé shape of the seat slat/back splat configuration. The rear seat rail also provided the "joinery" between the continuous side elements and the rear legs (fig. 14). I fitted the ends (the intersection of the rear seat rail, the continuous side element, and rear leg) of an oversized rectangular block that I attached again with large screws through the rear leg and continuous rail/stile. I then shaped the rear seat rail mostly in-place with a spokeshave, rasps, and chisels (fig. 15). Once the general shapes were correct and the rungs (or spacers tacked to the legs), and the front and rear seat rails temporarily installed with screws,

Figure 11 The front rail joinery was the only straightforward portion of the whole project.

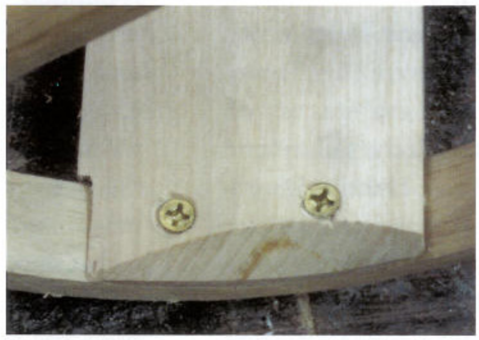


Figure 12 Gragg used screws and nails wherever two pieces intersected or were joined, such as these large screws from the underside of the front seat rail.

Figure 13 Large screws protruded through the face of the presentation surface and were simply filed flush.

Figure 14 The joinery for the rear seat rail/leg junction was nearly impossible to get right the first time. It cannot be laid out precisely and must be sculpted to fit the spaces.

Figure 15 The rear seat rail, curved along all axes, was formed primarily with spokeshaves.

Figure 16 Front rail/seat slat half-blind dovetail, pre-assembly.

Figure 17 Rear seat rail dado for receiving the continuous back/seat slat.

Figure 18 The narrow mortices for the splats are chopped into the crest rail.

it was ready for the true joinery to be cut for the half-blind dovetails and dadoes of the seat slats and back splats (figs. 16 & 17). These pieces were cut and fitted but not finally assembled yet as they were necessary only for establishing the chair's shape and would be joined at the crest rail in the final steps of the chair's assembly.

The seat bottom elements must be assembled in a particular order beginning with cutting the dadoes in the rear seat rail. If that is done incorrectly, neither of the ends—whether the half-blind dovetails at the front seat rail or the diminutive mortise/tenons at the crest rail—will be successful without a tremendous effort. I tried cutting the dovetail second and the tenons last, and then reversed the order, but found no particular advantage either way.

Figure 19 The ultimate elegance of the chair is in part due to relieving and rounding all the edges of the chair elements with a tiny spokeshave.

The crest rail was one of the most vexing portions of the project. Like both seat rails, it was fastened rather than joined to the side elements, fitted with rabbets, and shaped to the correct rough configuration (fig. 18). At this point the small mortises (1/8" wide x 1/2" deep) were cut into the underside to receive the tenons on top of the continuous slats/splats, which were simultaneously cut to fit into the mortises.

The visual evidence on the chairs suggests that the final shaping of the crest rail, and in fact the shaping of all the elements, was completed after the assembly was finished. Templates are helpful, but in the end, a pleasing result is dependant on the craftsman's eye and hand guiding spokeshaves, rasps, and chisels.

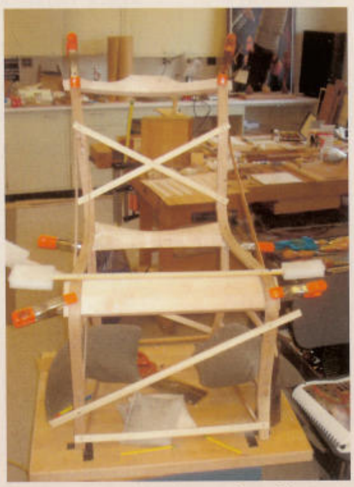
REFINING THE LINES

After the initial assembly was complete, I disassembled the chair and addressed the lines and edges to achieve the desired aesthetic. Practically every element of the chair is slightly oval in cross section, with the resulting visual effect of a chair even lighter than it was already (fig. 19). Numerous details such as a pseudo-ogee at the bottom terminus of the bent arm and the final relieving of the crest rail completed the construction.

A NOTE ON ASSEMBLING A GRAGG CHAIR

Assembling a Gragg chair is about what you would expect from a project made from 25 pieces, none of which was square or even angular. Most were tapered and swelled along two axes, mostly curvilinear, and only six (the dowel-like rungs) were straight. The slight, sinuous elements, each unique and ever so slightly different than the template, do not lend themselves to assembly templates or jigs, and bevel squares are only marginally useful.

No matter how flawless the wood nor careful the craftsmanship, the chair's parts will emerge from the bending process with some differences ranging from 1/64" to 1/2". If crisp rectilinear joinery is your furniture-making goal, building a Gragg chair may not be for you. There is almost no clean joinery layout, and much of the fitting and overall composition is improvisation. Rather than seeking precision or symmetry, you must strive for compositional and structural balance. In addition, until you get near the finish line, the whole thing is unstable. My advice is to lay up a pile of triangulation bracing strips and a bucket of spring clamps to keep the chair as symmetrical as possible when fitting and assembling. Keep a small block plane, a fine rasp or float, pencil, and a small round bottom spokeshave close by. You will use them continuously as you compile the 25 pieces of individual sculptures into an integrated whole.



Since nothing about the chair is rectilinear, it is useful to screw small triangulation braces to the structure as it is assembled.

GRAGG À LA CHARLES AND RAY EAMES

Making the Eames' version of the chair began with tracing the contours of the chair onto a plywood sheet that served as the molding platform. Additional lines were drawn to represent the molded cauls needed to complete the laminations. I fabricated a number of clamping blocks from ½" Baltic birch plywood scraps that differed from those in the earlier constructions in that some of these had flanges on both the base and the face to provide purchase for clamping. These plates were screwed to the plywood sheet in the appropriate places to accommodate the cauls, laminated element, and backing cauls.

I cut strips of ⅛" aircraft grade plywood to serve as the serpentine cauls. Using gentle pressure, I forced two plywood strips to conform to the curve of the chair element. The plywood was a bit too brittle and several pieces were fractured before I achieved success. Were I to do it again, I would probably instead use multiple strips of plastic laminate for the caul, although a brief stint in the steam box was helpful for the plywood. Once I was assured of curving the caul elements to the form, I laminated them with cold liquid hide glue of my own making, bent them to shape, and screwed them to the clamping plates. I added as many spring clamps as I had close by to ensure that the two pieces were in perfect proximity and would adhere completely and retain their shape when dry. I left the entire assembly in place over night, although two days would probably have been better.

Hide glue, especially cold liquid hide glue, has a fairly well deserved reputation of letting go if the moisture conditions are not conducive to continued cohesion of the glue line. Under optimal conditions, hide glue is considerably stronger than epoxy, but optimal conditions are not always present. If the ambient moisture increases too much, the glue line adsorbs water from the atmosphere and can begin to swell and creep to the point of slippage and adhesive line failure. If the moisture content falls to the point where the glue line is desiccated, it will become exceedingly brittle and prone to fracture, causing an attendant adhesive failure.

One strategy to addressing these limitations is to make the dried glue line less susceptible to the effects of moisture variability. Many routes are possible, such as adding integral water-soluble plasticizers, but in this instance I chose to make my hide glue cross-link in place. I accomplished this by first saturating the veneer sheets with a dilute solution of photographic gelatin hardener and allowing it to dry completely.[4]

When the veneer was dry, I cut it into 1¼" strips, both parallel to the grain and at a 45° bias (fig. 20). Once an adequate supply of veneer strips was ready, I cut a strip of cling wrap the same length as the strips and about 4" wide. I placed this flat on the work surface and began to lay up the veneers. I started with two layers of straight grain, wetting the gluing surfaces thoroughly with the cold liquid hide glue. I followed this with a strip of veneer on a 45° bias, another straight, another one with the opposite 45° bias, another straight, another first bias, etc., until I achieved the thickness I wanted with two final strips of straight-grained veneer.

Once the thickness was adequate, I wrapped cling wrap around the entire bundle to make it easier and cleaner to handle. Gently pressing it up against the form cauls and clamping it and the backing cauls together with spring clamps took less than a minute. When I was sure that the configuration was correct, I sliced open the top of the shrink wrap package to allow the moisture to escape, and left it to dry for at least two days just to make sure. Even after removing the lamination from the forms two days later, I allowed several more days for the excess moisture to evaporate completely (fig. 21).

As with the original construction method discussed above, I fashioned the front and rear seat rails and crest rail from solid stock, used dowel stock for the side and rear rungs, and assembled the chairs in the same manner.

DECORATION

The surfaces were worked with tools to achieve the desired lines and profiles. The original chairs reveal tool marks and there is no way to know at this point whether there was any preparation beyond a gentle scraping. Any sanding marks would be long buried underneath the paint layers, so I stopped after a light scraping and scouring with a corn straw burnisher (fig. 22). I did observe areas of grain tear-out on the original chairs underneath the paint, but there is no way to know if this was the result of the original riving or subsequent tool work.

Gragg employed a complex polychromy for decorating his chairs (fig. 23). Many routes for replicating this historical decoration are viable, whether traditional gesso-based japanning, oil/resin varnishes and glazes, or distemper.[5] For the original-method chair, I selected an aqueous gesso-based primer and paint system, beginning with a 10% glue mixture to penetrate and seal the surface, followed by a couple of brushed coats of the primer, smoothed with 220-grit sandpaper, and

Figure 20 Laying out the veneers prior to laminating.

Figure 21 The assembled laminae, between two cauls and a plastic membrane.

Figure 22 A corn straw burnisher is an ancient tool for final prepping of the surface before finishing.

MAKING COLD LIQUID HIDE GLUE

As a general working habit, I prefer to make my own cold liquid hide glue rather than purchase it. That way, I can make it exactly as I want it to be with no concerns over formulation ingredients or shelf life. My usual approach to a completed batch begins with soaking 192 or 251 gram strength glue in distilled water, 1:1 by volume. My personal preference is M&H 192 Special (available from www.milligan1868.com), which is transparent amber and has extremely high initial tack.

I allow the glue granules/water solution to soak overnight at room temperature and then cook it in a double-boiler until completely melted in my fondue crock (purchased at a yard sale for $1) as my glue pot. Once melted, I allow it to cool to room temperature then refrigerate it overnight. The next day, I cook it until completely melted again. While the glue is hot I add pickling salt, usually between ¼ and ⅓ part by volume of the original hide glue granules, stir, and allow to sit and the salt to settle for several hours. Once the concoction cools and settles and I confirm that the glue remains liquid, I decant the glue into a condiment dispenser, leaving any excess salt remaining at the bottom of the original container. I am finding that the actual amount of pickling salt required to suppress the gelling step is closer to a ¼ proportion. Sometimes I make it even leaner, requiring the glue bottle to reside in my apron pocket to be liquid at body temperature but slightly gelled at room temperature.

If I choose to add glycerin as a plasticizer, I do it at this point, adding between 5-10% by total volume. If I use low molecular weight polyvinyl alcohol resin as my plasticizer, I have to make the original aqueous solution with PVOH before the glue granules are introduced to the soaking solution. It is a fussy process but exceedingly useful in some circumstances. I generally begin with approximately 1–5% of the polyvinyl alcohol as a ratio to the weight of the dry glue granules, introduce the PVOH to the water bath, and allow to sit overnight under heat and agitation. I begin soaking the glue granules the next morning in this solution and follow a typical preparation scheme.

This procedure yields cold liquid hide glue very much to my liking. It performs wonderfully—although its 48–72 hour hardening time is a problem in some situations—and has no shelf life limit that I can determine unlike commercial glues made with urea as the gel suppressant. I have yet to experience a batch that was troublesome to make or use, or that went bad before I used it unless I added too much salt, in which case the glue needed several extra days to dry completely while remaining very moisture sensitive. *-D.C.W.*

Figure 24 The author's interpretation of Gragg.

followed by another couple of coats of the gesso primer with pigments added to achieve the creamy yellow ochre base color. I followed this with a brisk rubbing with linen to leave the surface amenable to the oil gilt feather "eyes" and the water-based decoration to follow.

Colleagues Daniela Gross, Juliane Derry, and I recreated an exuberant decorative scheme faithful to Gragg's intent. Rather than using glue/pigment distemper or oil glazes for the decorative pattern, we employed standard craft store artist's gouache for most of the work. Once we had practiced and become comfortable with the visual vocabulary, we diluted the gouache with waterborne shellac to bind the decorative paint scheme in place and allow for a subsequent oil-resin varnish seal coat without any incident. I rubbed out the top coat with 0000 steel wool to yield a pleasant sheen (fig. 24).

The Eames' version of the chair was decorated with oil-based primer and base coat paints, followed by oil paint diluted with mineral spirits to allow for thinner applications of the decorative patterns and glazes.

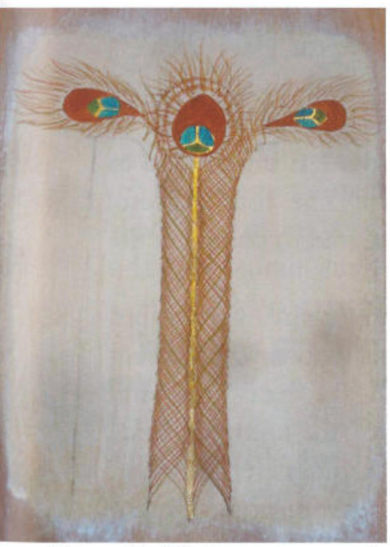


Figure 23 The prototype peacock feather for ornamenting the rear center splat and crest rail.

Figure 25 Sixty pounds of contemporary cast steel, definitely derived from the designs of Samuel Gragg 200 years earlier.

A TIMELESS DESIGN

Like all designers, Gragg clearly drew on the furniture forms of the past to create his own interpretation, a process that has continued unabated ever since. Bentwood and other sweeping curvilinear chair forms have come into and gone out of fashion countless times, with renewed popularity as molded manufacturing became the norm, and the designers' imaginations were the only limit.

Last year while attending my younger daughter's college graduation, a chair form caught the corner of my eye while we were frantically trying to empty her dorm room before the 4 o'clock deadline. Yes indeed, there on the patio outside the dorm were several 60-pound cast steel deck chairs whose original inspiration had to be Gragg. Over two centuries after its creation, the lines of the Gragg chair still cause heads to turn (fig. 25).

ABOUT THE AUTHOR

Don Williams is Senior Furniture Conservator at the Smithsonian Institution's Museum Conservation Institute in Suitland, MD. He has a personal studio in Monterey, VA.

ENDNOTES

1. Elder, William Voss, and Lu Bartlett. *John Shaw, Cabinetmaker of Annapolis*. Baltimore, Md: Baltimore Museum of Art, 1983.
2. Podmaniczky, Michael. "The Incredible Elastic Chairs of Samuel Gragg," *The Magazine ANTIQUES*, May 2003, pp. 138-145 and Kane, Patricia E. "Samuel Gragg: His Bentwood Fancy Chairs." *Yale University Art Bulletin*, Autumn 1971, pp. 26-37. A virtual exhibit of Gragg chairs can be viewed on the Chipstone Foundation website. (http://www.chipstone.org/framesetspecialprojects.html).
3. 192 gram weight strength (special grade) animal hide glue from Milligan & Higgins, Maple Avenue, P.O. Box 506, Johnstown, NY 12095. (http://www.milligan1868.com/glue.html)
4. NH5 Hardener, manufactured by Heico Chemicals Inc., Delaware Water Gap, PA, can be purchased online at Amazon or from any large photography supply retailer.
5. Williams, Donald C. "The Art of Japanning;" *American Period Furniture* 2009, pp. 4-11.

American Period Furniture

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ON THE COVER: Reproduction of the famous 'Edenton Armchair' by 2011 Cartouche Award recipient Ben Hobbs. The original chairs, made in Edenton, North Carolina, 1745-1765, feature a splat design not found elsewhere in the Colonies.

American Period Furniture

Journal of the Society of American Period Furniture Makers

Benjamin C. Hobbs 2011 Cartouche Award Recipient