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CONTENTS

Continuous Horseshoe Arms
And Half-Lapped Pressure-Peg Joins

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In functional joinery, the craftsman of Suzhou manifests his respect for the spirit of the wood and his command of line, curve, and cubic proportion.

Gustav Ecke, *Chinese Domestic Furniture*

One of the more graceful chair designs is that in which the back rail and arms form a continuous semicircle, gently descending toward the front with the terminals of the arms bent slightly back in a rhythmic, yet reserved curve (figs. 1, 2). Often coupled with tapered, S-shaped side posts, the effect is of a spherical void being gently cradled, simultaneously giving a sense of emptiness and wholeness. These inspired forms grew out of the rich tradition of Chinese craftsmanship, and the integration of aesthetic preferences with the science of joinery. The techniques that enabled artisans to fashion these beautiful rails evolved and were perfected during the golden age of furniture-making in the Ming dynasty.

Chinese furniture is constructed along the same principles as Chinese architecture, with variations on a basic grammar of forms and types. Although joins for furniture are somewhat simpler than those used in timber architecture, and have fewer structural demands, their craftsmanship must be precise to ensure the stability of the entire piece. In architecture as well as in furniture-making, one of the most difficult wood connections is the fastening of end grain to end grain. As a result, Chinese timber framers—who often had to

lengthen beams to span a space—developed an elaborate system of scarf joins based on the simple lap join. In a lap join half a board or beam is lapped over half another board or beam. As tools and techniques were improved, these joins became more precise and complex and more capable of withstanding the destructive lateral forces caused by gales and earthquakes. The addition of mortises and tenons and other mechanical interlocks resulted in strong scarf joins, successfully mating end grain surfaces to stronger long surfaces. Both the mantis-head scarf join and the overlapping clutch join (fig. 3a) had been developed by the time of the Northern Song dynasty. By the Yuan dynasty, further advances had been made, allowing the Chinese carpenter to splice and lock together beams, sills, and lintels into a unified whole no force could easily shake loose (fig. 3b).

The half-lapped pressure-peg join is another variation of a scarf join that has been used for centuries to splice members together to create both longer and circular members. Variations of this join have been used not only in architecture but in furniture-making, boat-building, and the fabrication of other circular wooden mechanical devices, such as waterwheels and animal-powered mills and irrigation devices.

There are three basic methods of making curved or circular parts from wood. One can (1) bend a piece of wood to the correct curvature, (2) cut the curved element from a large piece of wood, or (3) fabricate a curved element from short segments spliced together.

A few types of wood bend well when steamed and formed to a curved mold. Another method of bending wood uses modern glues to laminate thin layers of wood to curved molds; this technology, however, did not exist before the twentieth century. Much of the ubiquitous bamboo furniture seen throughout China has bent bamboo elements that would have required either steam or heat to form their sharply radiused corners. The Chinese did not seem to bend wood other than bamboo, choosing more often to use wood with naturally curved grains for curved elements.

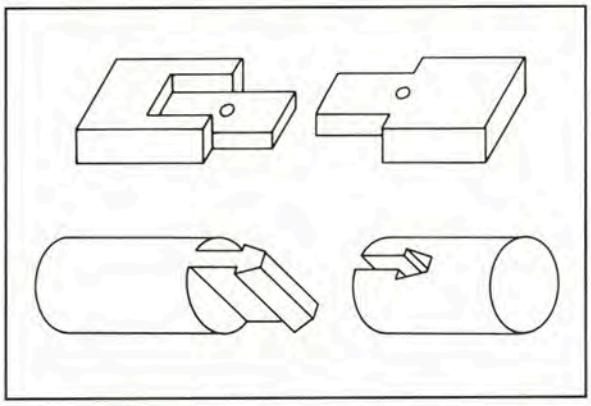
A curved element can be cut from a wide plank, but this proves to be both inefficient in the use of material and structurally problematic. Because wood grain is essentially straight, when a curved piece

Fig. 1, facing page. Horseshoe-back armchair, Ming dynasty (1368-1644). One of a pair. Huanghuali; *height 101.5 cm, width 62.5 cm, depth 50.5 cm. Museum of Classical Chinese Furniture, Renaissance, California.*

Fig. 2, left. Small continuous horseshoe-back armchair, Ming dynasty (1368-1644). One of four. Huanghuali; *height 86 cm, width 55.5 cm, depth 42.5 cm. Museum of Classical Chinese Furniture, Renaissance, California.*

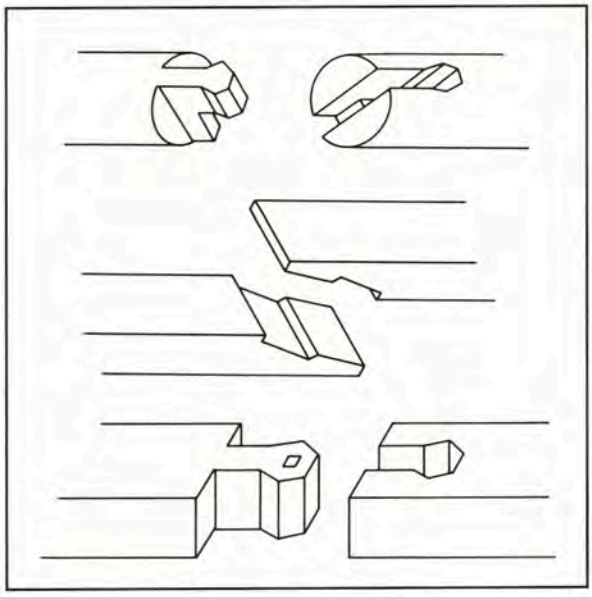
is cut from a board there is a critical point at which the grain begins to run across the tangential axis (fig. 4), and here the grain approaches its weakest structural moment. Wooden parts are strong when the wood grain runs parallel to the long axis of the piece and weak when the grain runs across it.

Because of the difficulty of constructing a circu-



lar element from a single piece of wood, joinery systems were developed that spliced shorter straight grain segments, thus minimizing the structural problems of cross grain. From simple lap joins more elaborate and complex scarf joins evolved, able to withstand spiral grain twisting and resist the tension forces and bending stresses to which the completed parts would be subject. In mechanical devices, where the forces were great, additional metal reinforcements were often required.

In Chinese furniture we find the half-lapped



pressure-peg join used mostly in the round back rails of horseshoe armchairs and occasionally in the round floor stretchers of incense stands. It has also been used for restoration, as in the repair of a broken leg on a round-leg half table in the collection of the Museum of Classical Chinese Furniture in Renaissance, California. Here, rather than replacing the entire leg, a new section is spliced above the break with the standard join in its straight linear form (fig. 8). At least three variations of the half-lapped pressure-peg join exist.

The most common variation is the standard half-lapped and tenoned join with a wedge-shaped peg driven in from the convex side toward the center radii (fig. 5), which forces the members tightly together and simultaneously locks the join into place. The wedge is then trimmed and finished flush with the shaping of the rail. This join is typical of at least eighty percent of round back rails. The standard proportion of the half-lap to the diameter of the rail is 1 to 1.5. The width of the tenons and the wedge-shaped peg ranges from ten to twenty percent of the rail diameter.

A less common variation of this join incorporates blind tenons and thus requires a higher level of mastery (fig. 6). The standard join can be fitted in the rough and then shaped to its final contour and section. When blind tenons are used, however, the craftsman does not have nearly as much latitude and must be very exacting in his calculations, lest he risk exposing a tenon. When properly fitted with its tenons locked into their mortises, this join is the strongest of the three. Visually it is also a quieter impression, hiding its complex strength internally.

A third variation, even more rare, appears in a small pair of horseshoe armchairs in the collection of the Museum of Classical Chinese Furniture (fig. 2). Here the tenons are blind on one side and exposed on the other (fig. 7). Although this join has no apparent advantages, it demonstrates the Chinese genius for subtle variation upon basic themes.

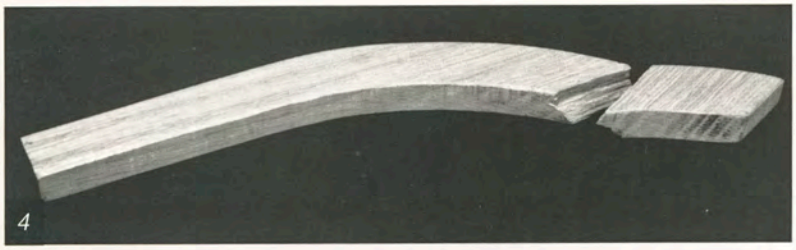
Fig. 3a, above. Song dynasty joins.

Fig. 3b, left. Yuan dynasty joins.

Fig. 4. Example of the weakness of cross-grain in a curved member.

Figs. 5, 6, 7. Three variations of the half-lapped pressure-peg join.

Fig. 8. Leg of half table repaired with a half-lapped pressure-peg join.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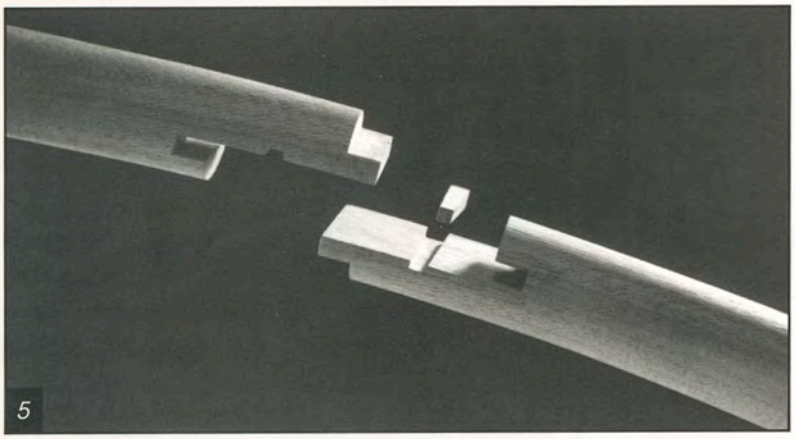
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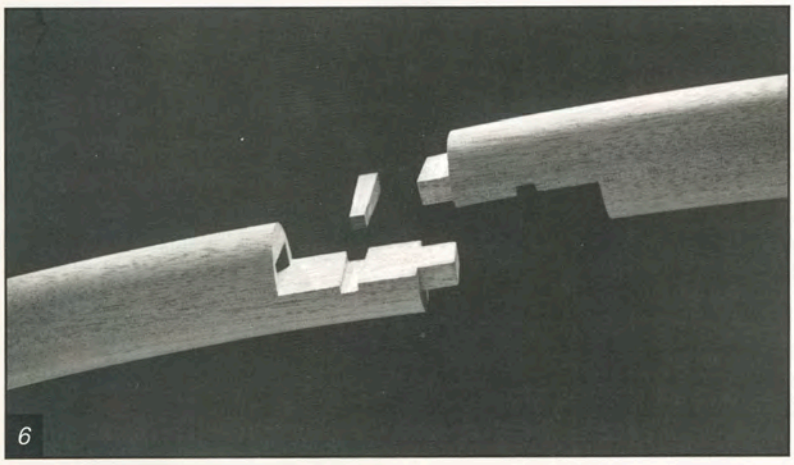
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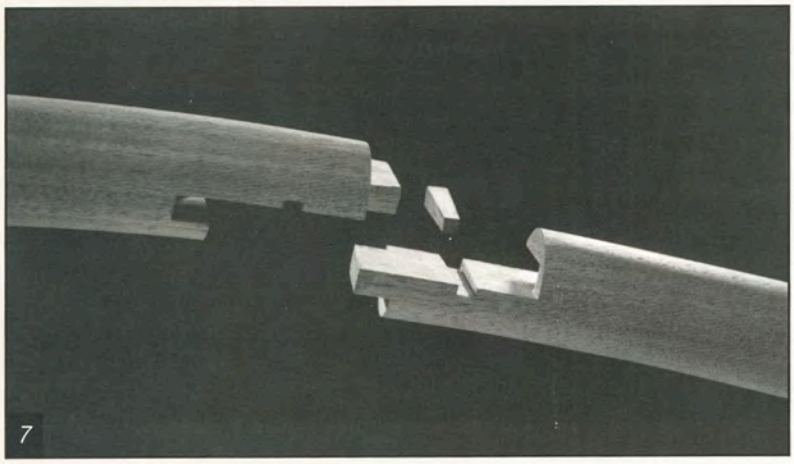
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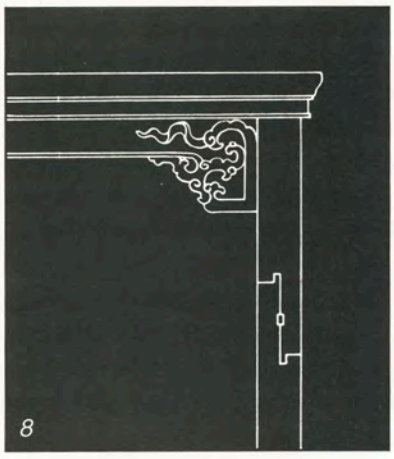
Ordinarily the two members of a join can be classified as male or female. In these lap joins, however, the two members are identical, so their relative positions determine their gender. In the sloped horseshoe rails, the lower join (female) provides a supporting bench upon which the upper join (male) rests. The topmost segment of the rail has male joins on both ends.

Of the existing horseshoe armchairs, most of the curved armrests are constructed with five segments, with perhaps less than twenty percent made with three segments. Figures 9a and 9b help to demonstrate why rails with three segments are more rare. On a five-piece rail the grain crosses the tangential axis of the join at approximately twenty-two degrees (fig. 9a). On a three-piece rail of equal diameter, however, the angle at which the grain crosses these joins doubles, making it extremely vulnerable to damage. A three-piece rail also requires approximately seventy-five percent more wood (fig. 9b), and fine hardwoods were increasingly scarce by the end of the Ming dynasty.

The amount of repair and restoration on these joins is proportionate to the degree of cross grain.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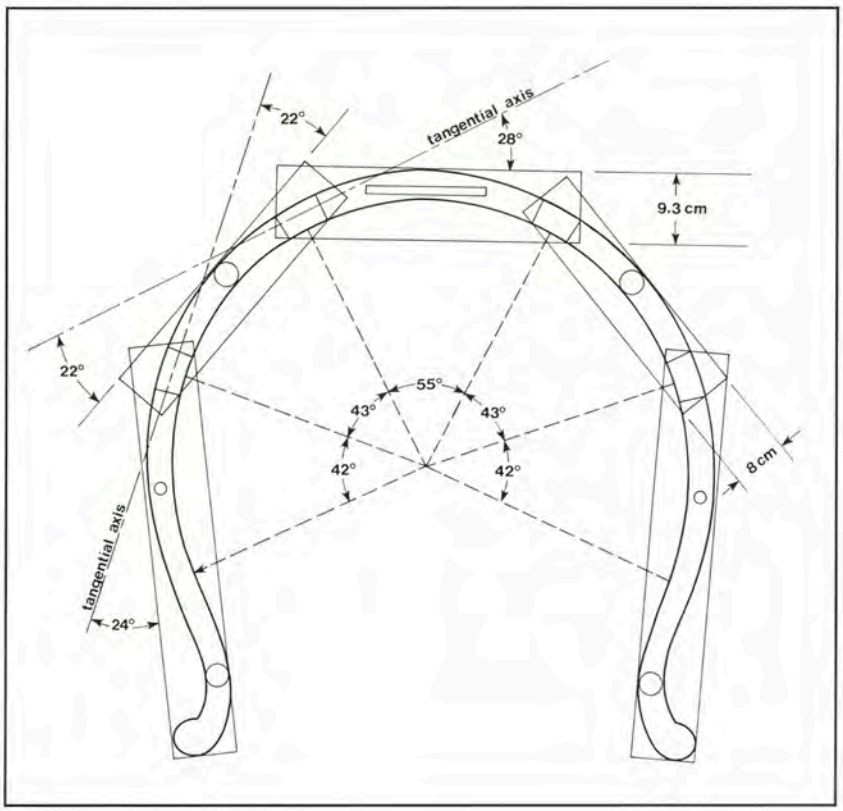

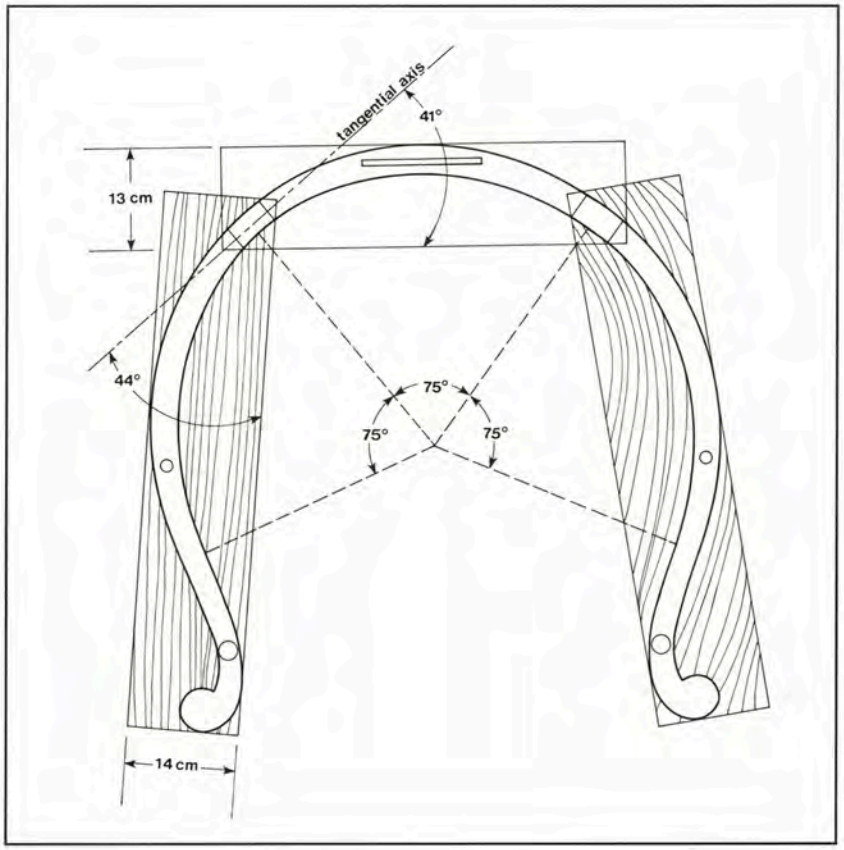

Many of these curved armrests have suffered damage during China's perilous history, and are now heavily restored with pins or have been reinforced with metal. The metal reinforcements on folding horseshoe armchairs, however, are often original, as it was understood that in this more flexible and portable medium the joinery required additional support.

In making the curved armrest of the horseshoe chair, the sensitive craftsman attempted to select wood with a naturally curved grain that would follow the curvature of the rail, ensuring that the grain would be straight and strong at the join. These armrests pushed furniture makers to the very limits of their materials, and, even so, full advantage was taken of every natural feature to yield the best possible result. As in all art forms, it is the application of the craftsman's understanding of his materials as well as the quality of workmanship and refinement of scale and proportion that make one piece superior to another.

SELECT BIBLIOGRAPHY

Hoadley, R. Bruce. *Understanding Wood.* Newton, Conn.: Taunton Press, Inc., 1980.

Hommel, Rudolf. *China at Work.* Cambridge, Mass., and London: M.I.T. Press, 1969.

Institute of the History of Natural Sciences, Chinese Academy of Sciences. *History and Development of Ancient Chinese Architecture.* Beijing: Science Press, 1986.

Fig. 9a, above. Drawing of rail with five segments.

Fig. 9b, left. Drawing of rail with three segments.