Part 3 Building the Canoe

A long series of operations is involved in the building of a birchbark canoe, from assembling the frame to caulking the joints and tips. The various steps are described here in chronological order.

Assembling the Frame

The first step is to put together the main gunwales and the three temporary thwarts. This structure is used as a building frame to establish the general outline of the canoe. It is first placed flat on the bark so as to mark the shape of the bottom, and is later raised to its final position at gunwale height, where it becomes an integral part of the frame.

The gunwale members are 11 ft 9 in. long, and rectangular in cross-section so as to accept more readily the lengthwise curvature of the canoe. They taper toward the ends so that they can be more easily bent up into the curve that defines the sheer of the hull. Measuring 1⅛ in. by ¾ in. at mid-length, they taper to a ½ in. square about 2 ft from each end. At the ends of the canoe, they assume the form of a half arrowhead (split lengthwise) with the points coming together at each end to make a flat, neat joint (see figure 3). The ends are wrapped together with cord or root lashings. The undersides of the gunwales are bevelled and rounded off for the insertion of the ribs at a later stage.

The length of the central thwart, and hence the distance between the gunwales at that point is 2 ft 3½ in.; the other two thwarts are 1 ft 7¾ in. long, and are placed 2 ft 7 in. away from the centre. The ends of the thwarts fit into the mortises in the gunwales, and are held in position by vertical wooden pegs. These thwarts are only temporary stretchers and will be replaced later by finished pieces, which will be lashed to the outwales and main gunwales, and in the case of the end thwarts (not yet installed) to the gunwales, outwales and gunwale caps.

Weighting the Frame and the Bark on the Building Bed

The builder selects his building site with care. The soil must be soft enough so that it can be levelled, but firm enough to hold a shape. Slightly sandy ground is preferred.

The building bed is 13 ft long and about 3 ft wide, the approximate finished dimensions of our canoe. The ground is cleared of stones or other hard objects that could cause difficulty, stirred up with the feet, and then levelled with a straight plank, earth being thrown in to bring any low spots up to grade. The building bed is flat across its width, but drops about 1½ in. at the ends. Stakes are driven into the ground at each end, carefully centred, and a line-level is stretched between them to gauge the curvature of the bed. The slightly convex shape assures the canoe a flat bottom for almost its entire length. At a later stage, the ends of the canoe will be shored up on a 3-in. plank placed on its side crosswise on the bed, to correct the droop and raise the bow and stern slightly.

The builder then unrolls the bark over the building bed, inside surface down, taking care to centre it exactly, with the middle of the bark at the highest point of the bed. He then centres the building frame on the bark. This step is important for it ultimately determines the general lines of the canoe, and the final position of the bark over the sheathing and ribs.

Next, he slips planking under the thwarts to protect the bark from the weight of the stones that will be used to hold the building frame in position. Split planking is also placed on top of the thwarts. Then stones, some quite large, are added. They will not only hold the frame in position, but will keep the bottom of the canoe flat during the next stage of construction.

Shaping the Sides

The builder now proceeds to make nine slashes in the bark along each side of the canoe. He does not use a gauge to determine the exact distance between the slashes, but makes the first cut near the central thwart and four others at more or less equal distances toward each end of the canoe. In some cases, a slash will be positioned so as to coincide with a fault in the bark that the builder wishes to correct. The cuts run upward from the edge of the bark to a point near the edges of the building frame. Next, the builder places 3-in. planks crosswise under each end of the canoe so as to raise the ends slightly and fix the sheer of the hull.

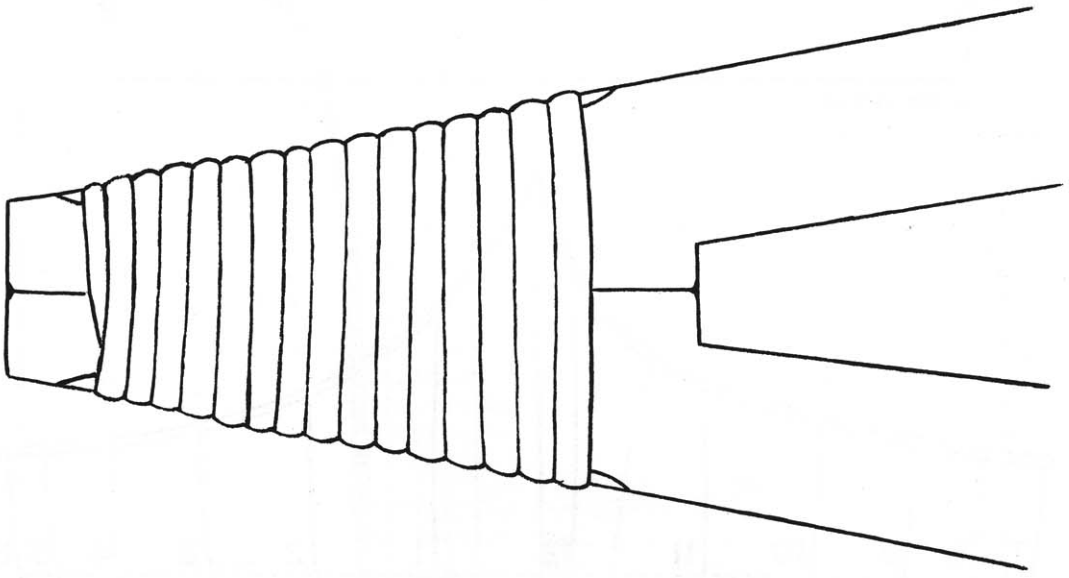

Figure 3
Ends of the gunwales lashed together

Meanwhile, he has prepared 14 stakes about 4 ft long; these are driven into the ground on either side of the building frame, after the bark has been pulled up over the stones. There are 7 stakes on each side, arranged symmetrically in line with the thwarts but not directly opposite them. The distance between the central thwart and its neighbour is 2 ft 7 in., between the second and the third 2 ft 6 in., and between the latter and the tip of the canoe 12 in. Thus, the last two stakes are very close together.

Before the stakes are lashed together in pairs across the canoe, a long lath is slipped between them and the bark so as to align the sides of the canoe; another lath goes between the inside surface of the bark and the stones. The stakes are driven in at an angle, and then pulled upright by a cord that attaches each stake to the one across from it. This operation serves to bend the bark at right angles at the base of the frame. At this point, to prevent the bark from splitting, the builder may have to sprinkle it with hot water to soften it and make it more flexible.

Parallel to the first row of stakes, a row of 2-ft stakes is placed inside the canoe between the bark and the stones, to hold the bark in the proper upright position. These stakes are attached at the top to the outside stakes, and the bottoms are bevelled so as to fit snugly between the bark and the outer face of the gunwales.

Before tying the two rows of stakes together and securing the bark firmly between them, the builder adjusts the overlap of the bark at each joint. The sheer and curve of the hull will necessitate some overlapping of the bark when it is folded upward, but this overlapping is not a haphazard matter. The rule followed is this: at either end of the canoe each overlap is adjusted with the edge of the bark that is nearer to the centre of the canoe on the inside, thus minimizing the resistance of the canoe to the water when moving in either direction. Once the overlaps at each joint have been properly arranged, the internal and external stakes are bound tightly together. Small wedges are also placed between the posts along the upper inside edge of the bark, to hold it firmly upright.

Now the women can proceed to lash the joints. Albert left this job to his sister, who used no more than two or three stitches for

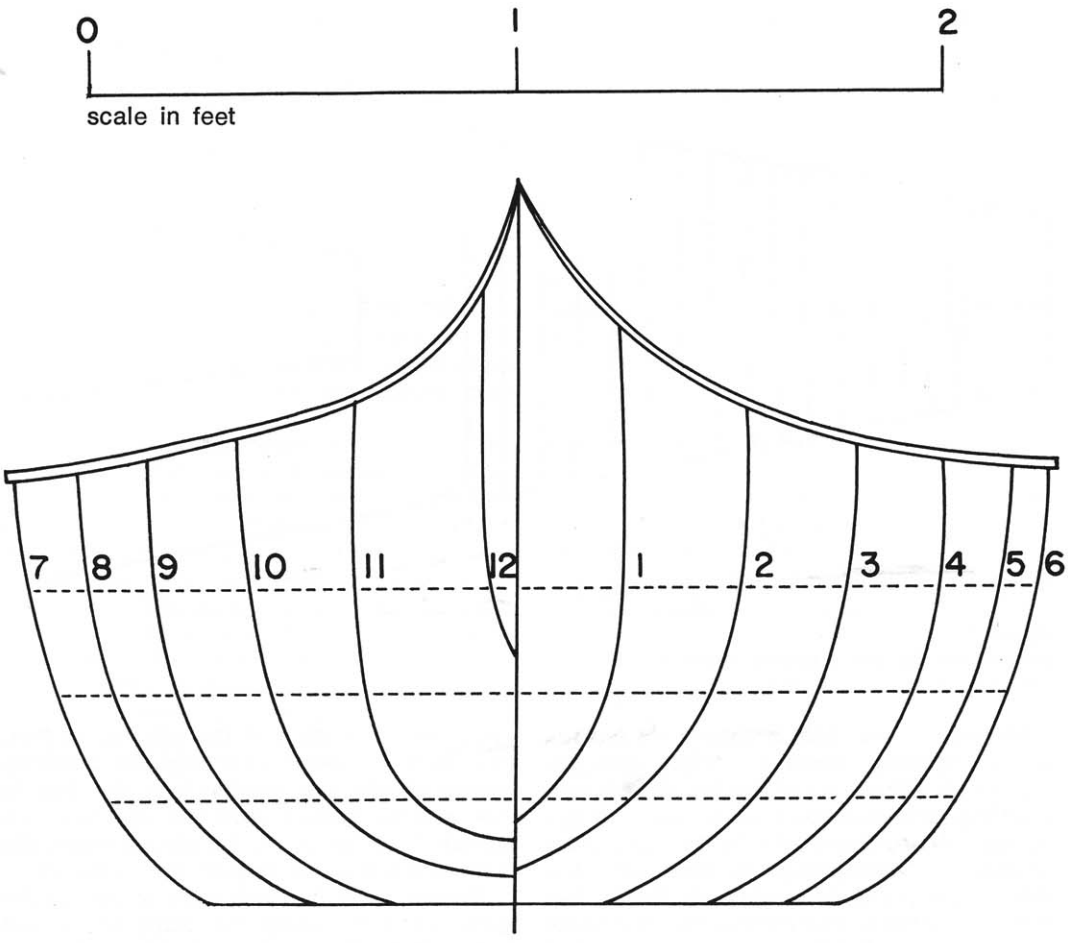

Figure 4
Plan of the canoe built at Weymontaching, summer 1966; front view

each joint. Secured with a stop-knot, the thong crosses the joint and then runs up the inside of the bark to the next stitch.

Positioning the Gunwales, and Trimming and Lashing the Bark

Once the joints have been stitched, the bark is rigid and strong enough for the stones and internal stakes to be removed. The frame composed of gunwale members and temporary thwarts is then raised to sheer height, and held in this position by supports under each thwart near the gunwales. The ends of these supports rest directly on the bark, and they are cut with squared butts so as not to pierce it. The length of the supports, and thus the height of the frame, is determined by means of a measuring stick, or *tsimotsigən*.

The builder then trims the bark down flush with the gunwales, beginning at the centre and working outward to within 2 ft of the tips. Before determining the sheer of the hull, which is a delicate operation, he will install the outwales so as to increase the rigidity of the assembly.

The outwales are 12 ft 6 in. long—longer than the main gunwales, which stop about 4 in. from the stempieces. The outwales rest against the stempieces. Like the gunwales, they are tapered from mid-length toward each end, so that they will be easier to bend. They measure about ½ in. by 1 in.

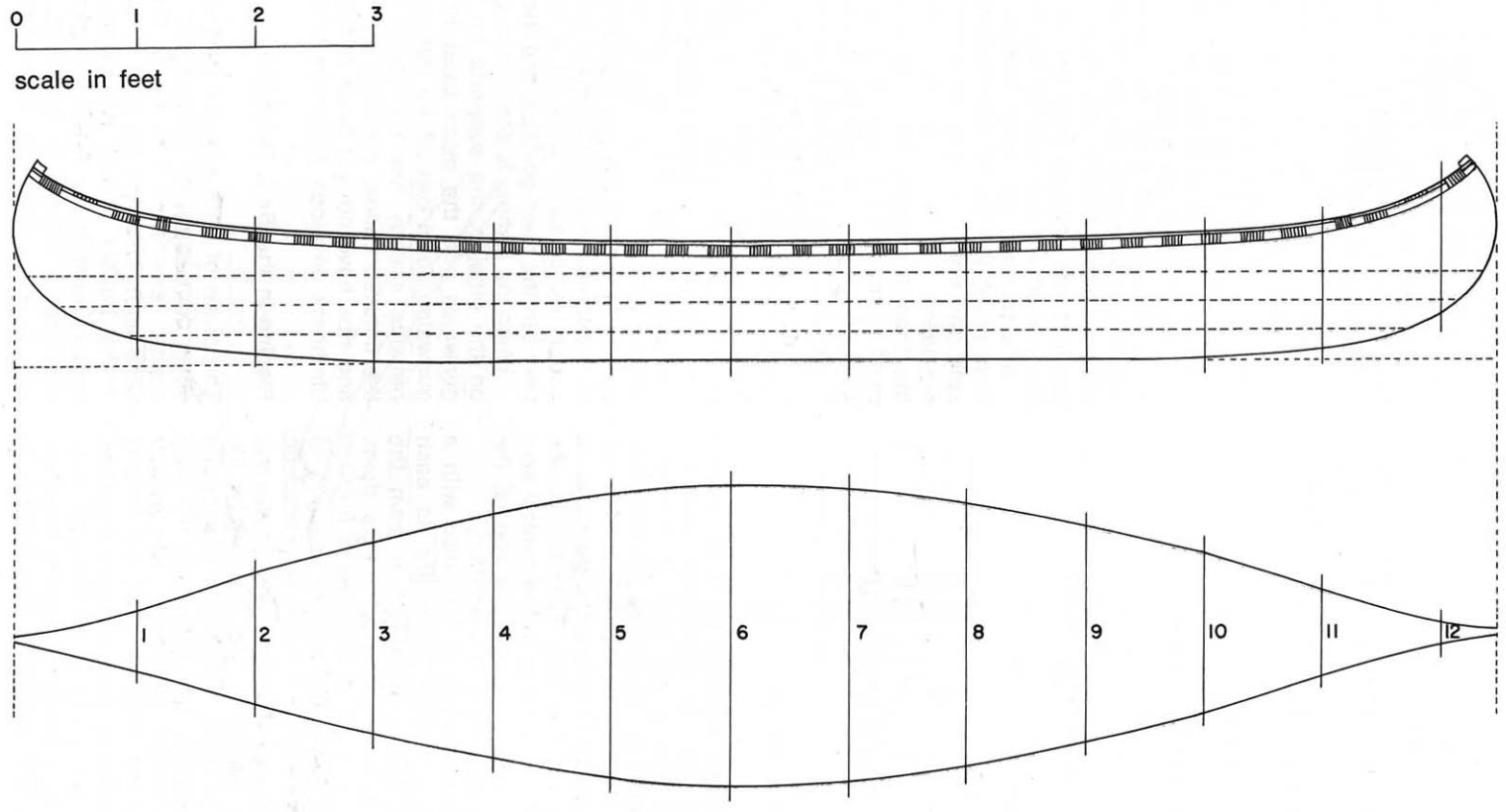

Figure 5
Plan of the canoe built at Weymontaching, summer 1966

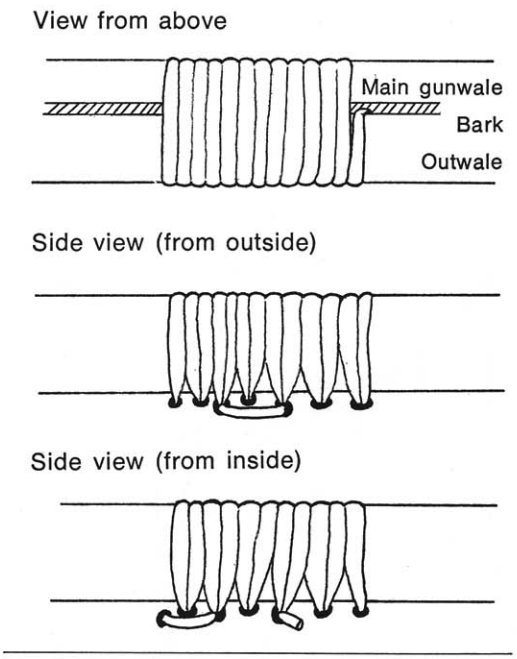

Figure 6
Bark-to-gunwale lashings

in cross-section, tapering to ½ in. square for the last foot at each end, and are pressed flat against the bark in line with the main gunwales. Gunwales and outwales are pegged together as the bark is trimmed. It becomes easier to shape the gunwales at the ends once they are fastened to the bark and to the outwales in the central section of the canoe. However, a special device is required for this operation.

The builder attaches a bark disc with a knotted thong through its centre, to each side of the canoe about 1½ ft from the end of the gunwales and 1 ft below them. The free end of the thong passes through the bark to the inside and is attached to the gunwale. Enough tension is exerted on the thong to pull the gunwales downward; the ends of the canoe are, meanwhile, being held at a higher level by the supports mentioned earlier. This step gives the gunwales the desired curvature. The builder then finishes trimming the bark, and fastens the main gunwales and outwales together. Everything is now ready for the next step, lashing the bark and the gunwales together.

This task is delegated to the women, in this case Albert's wife and sister. As we shall see, their techniques differed slightly. First, the builder must mark the spacing of the ribs and lashings, which alternate along the gunwales. The marks are made on the lower edge of the inner gunwale with the *tibwehitaban,* which is designed specifically for this purpose. For a 12-ft canoe, this measuring gauge is about 3 ft long and has pencil marks every 2¼ in. The builder transfers these marks to the inner gunwale. The space in line with the central thwart is marked for a lashing, the spaces either side of it for a rib, and so on. There are 14 lashings and 14 ribs on either side of the central thwart. The spaces for the lashings are marked with an "X" so that the women will not confuse the two.

In a process described earlier, the roots from which the thongs are made have been split and boiled to give them the required resilience and flexibility. The women take the thongs straight from the pot as they need them. With an awl, they punch holes in the bark just beneath the gunwales, and thread the thongs through, sharpening them to a point if they are too thick. In some cases, the thong passes through the same hole two or three times. Each lashing requires about ten turns, and if the thong is long enough, it is passed along underneath the gunwale to the next space. These women did not use stop-knots; they had a variety of techniques for fastening the end of the thong, wedging it either into a hole, under two or three turns of a lashing, or between the main gunwale and the outwale.

When the lashing is completed, the stakes on the outside, the supports for the main gunwales and the discs used to pull the gunwales down can all be removed. What remains already has the rough shape of the finished canoe, although the sheathing and ribs have not yet been added and the birchbark envelope sags here and there.

Piecing-in the Bark Extensions

The piece of bark was not long enough to cover completely the frame of the proposed canoe; extensions had to be installed at each end. This was the next step.

The builder bends the extensions and installs them inside the main bark covering, overlapping them 5 in. and 3 in. fore and aft. In each case the extensions project

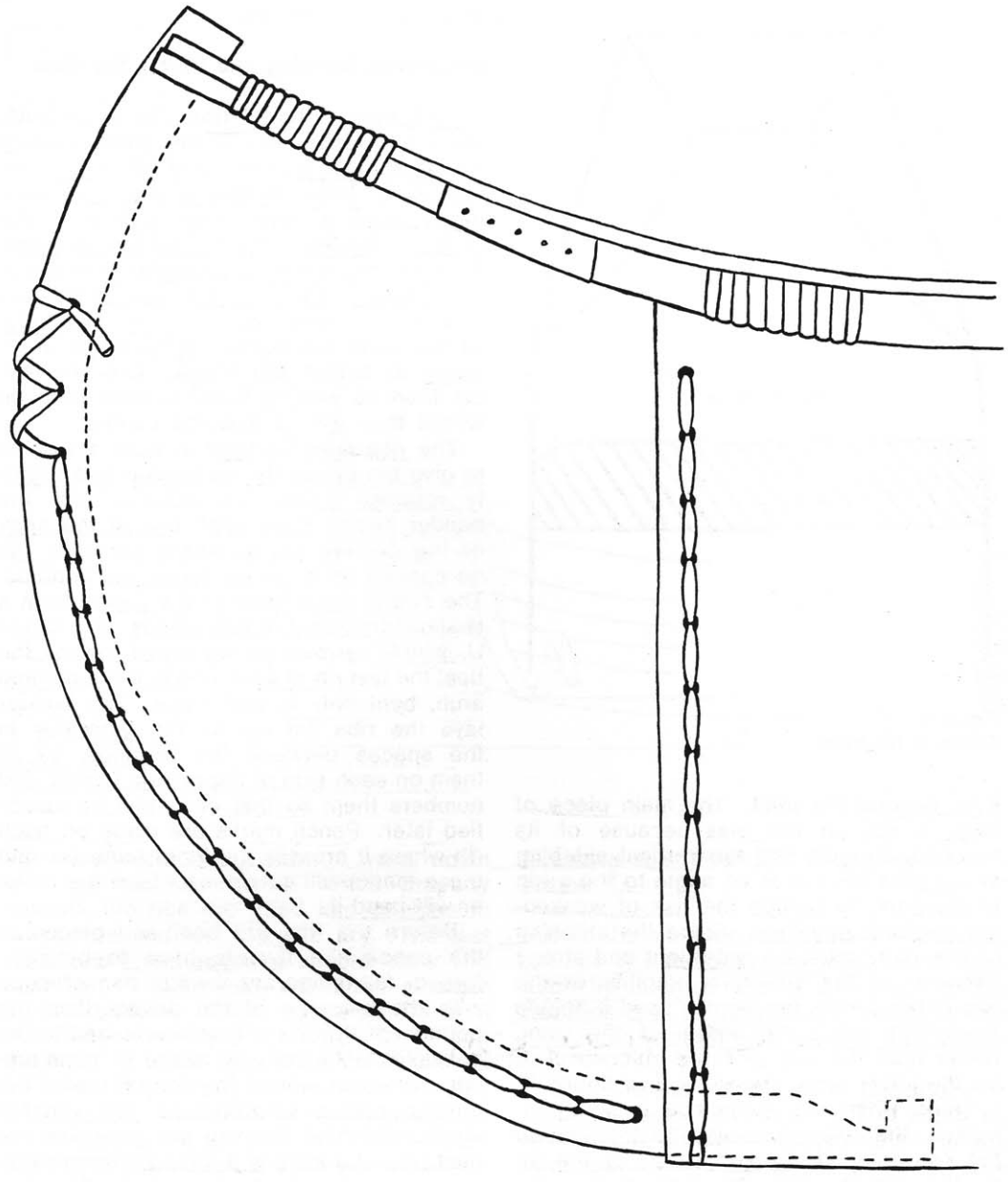

Figure 7
Lashings of extension and stempiece

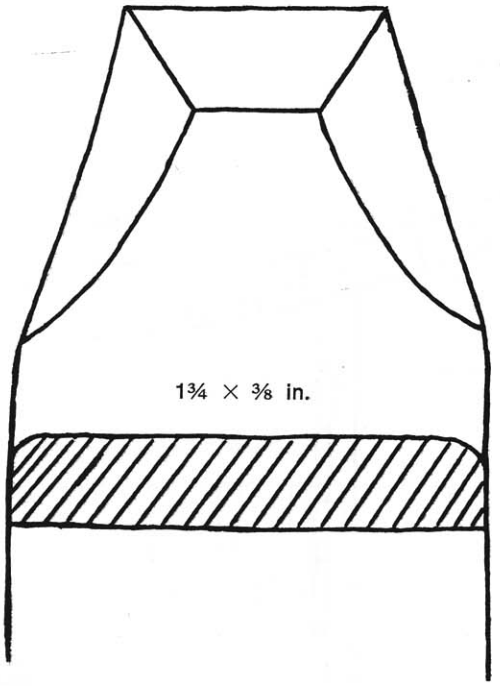

Figure 8
Shape of rib ends

8 in. beyond the joint. The main piece of bark is cut on the bias because of its tendency to split, and the vertical stitching at the joint will run at an angle to the grain of the bark, to reduce the risk of weakening the bark envelope. Since the stitching at this point must be watertight and strong because of the structural fragility of the tips of the canoe, the women used a double in-and-out stitch the length of the joint, rather than the two or three stitches used for the joints along the sides (see figure 7).

Later, when the stempiece is being installed, the extensions will be trimmed to the characteristic curved shape of the tip of the canoe. For the time being, the builder clamps the edges of the extensions together with two strips of wood bound together above and below. The two outwales rest on a wooden peg that passes through both sides of the extensions; these outwales continue the line of the inner gunwales, bringing the curve of the hull forward and upward. The shaping of the tip of the canoe will continue after the bending and drying of the ribs.

Measuring, Shaping and Drying the Ribs

A 12-ft canoe has 28 ribs. To begin with, each wood strip is cut the same size—4 ft long and 1¾ in. wide, and between ¼ in. and ⅜ in. thick, slightly rounded on their upper surface, and chisel-shaped at the ends to facilitate their insertion between the bark and the main gunwales (see figure 8). Shaped with the crooked knife, the ribs are all remarkably uniform in shape. At this point the builder immerses them in water to soften the fibres; later he will cut them to varying lengths, depending on where they will fit into the canoe.

The ribs must be bent in such a way as to give the canoe its flat bottom and slightly rounded sides. To achieve this, the builder has to mark each one at the apex of the desired curve, where pressure will be applied by his knee during the bending. The ribs in the middle of the canoe form a shallow arch bent in two places, or a broad U, which narrows as we move toward the tips; the last rib at each end is like a pointed arch, bent only in one place. The builder lays the ribs flat across the gunwales in the spaces between the lashings, 14 of them on each side of the central thwart, and numbers them so that each can be identified later. Pencil marks are made on each rib where it crosses the inner gunwale, and these marks will determine where the builder will bend it.

Before the ribs are bent and placed in the canoe, the thwarts have to be reinforced, for temporary thwarts cannot cope with the pressure of the driven ribs; the permanent thwarts will not be lashed to the gunwales until the next stage in construction. On each side of the central thwart the builder places athwartships two wooden sticks, attaching them to the gunwales. At each end, he installs a third reinforcement, consisting of a short piece of wood slotted in the middle and forced over the tip of the canoe to clamp the gunwales together.

Meanwhile the ribs have been sprinkled repeatedly with boiling water. Now the builder takes them two at a time and bends them over his knee, starting with those that will fit into the centre of the canoe. He then fits them into the frame; if they do not

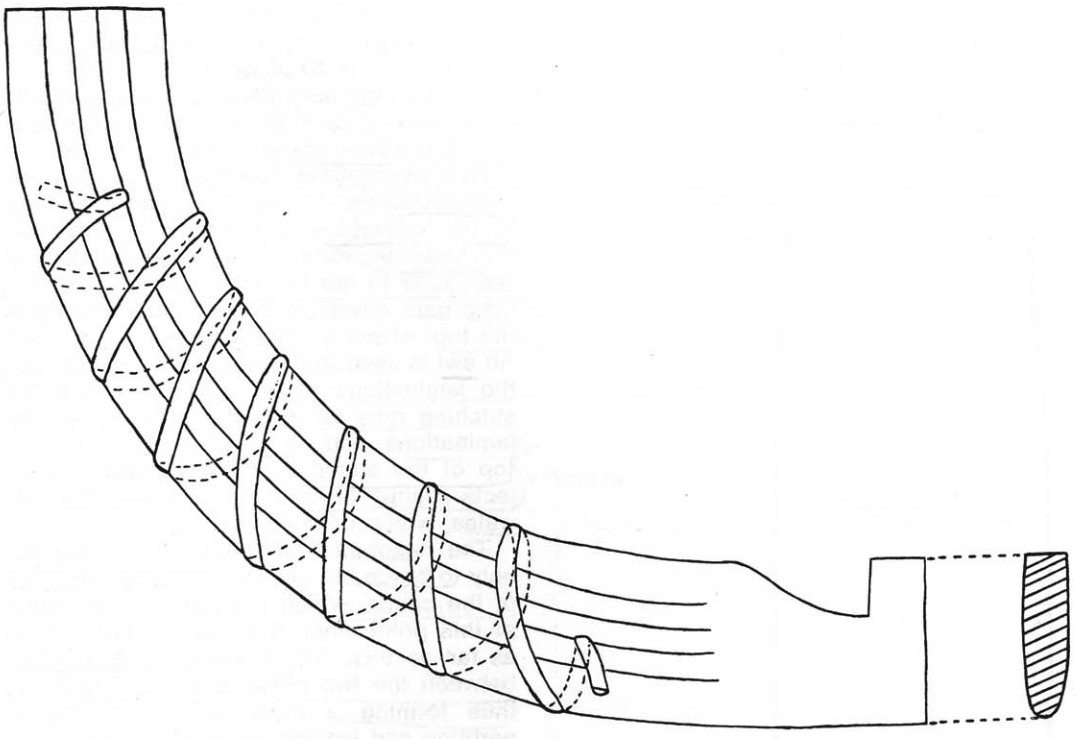

Figure 9
The laminated stempiece

fit, he sprinkles them with hot water again and corrects the curve. Once properly shaped, the ribs are fitted into position in the canoe and left there to dry. The last rib at each end requires special care and experienced judgement as to the strength of the material. These ribs must be bent until they are almost V-shaped to fit into the tapering tips of the canoe, yet care must be taken not to break them in the process.

The ribs are now left in the canoe to dry into shape in the open air, which takes at least a day. After that they can be removed from the canoe without losing their shape. Before he removes them, however, the builder makes a pencil mark on each one, level with the top edge of the gunwales, where he will have to cut them in order to fit them between the bark and the main gunwales.

While the ribs are drying, the builder cuts wood to shape for the sheathing.

Finishing the Tips and Strengthening the Frame

Before the sheathing and ribs are installed, the tips and the gunwales must be finished. Each tip is fitted with a stempiece and a headboard to support the gunwales, and is reinforced with an *apitowan,* or bark covering.

Like the headboard, the stempiece is made of cedar. It measures 2 ft by ½ in. by 1½ in. Its outside edge is rounded where the bark reinforcement will cover it. The builder splits it lengthwise into five laminations to within 5 in. of its heel; the laminations will make it easier to shape the piece into the required gentle arc. A notch is cut an inch from the end to hold the foot of the headboard (see figure 9).

To shape the stempiece, the builder first treats it with hot water, then bends it over his knee; the piece is fragile, and this

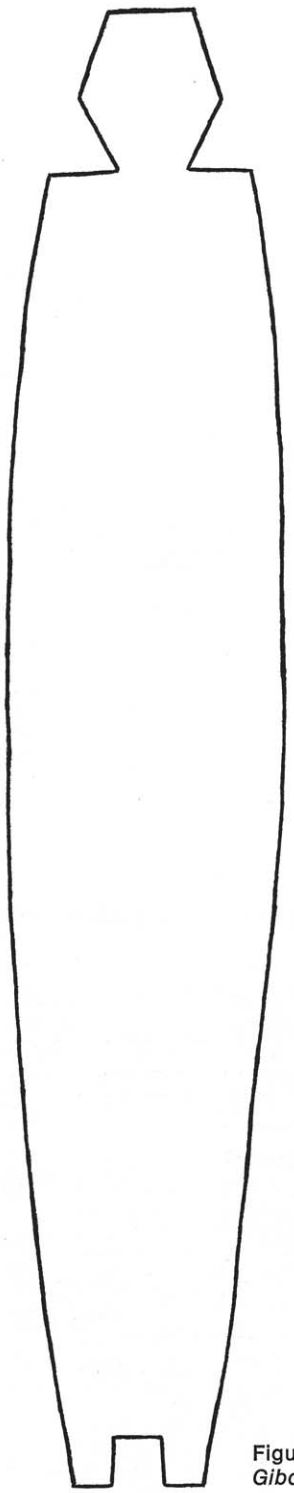

Figure 10
GiboorUn, or headboard

operation requires a great deal of care—a little too much pressure, and the whole process must begin again. While the stempiece is drying, which takes at least a day, its curvature is fixed by a cord holding its two ends together. Later a root thong will be wound spirally around the laminations, with the ends tucked in between them.

Now the builder inverts the canoe over two sawhorses, in order to attach the bark to the stempiece and trim it to follow its finished curvature. The same stitch that was used to lap the bark extension to the main bark envelope is used here, except at the top, where a spiral cross-stitch is used. An awl is used to guide the thongs between the laminations of the stempiece, and the stitching runs up from the point where the laminations end to about 4 in. from the top of the stempiece. The stempiece projects slightly beyond the bark and the outwales, which bear against its sides.

The headboard, or *giboorUn,* serves not only to brace but also to reinforce the sides of the canoe, which are particularly fragile at this point since the ribs do not extend as far as this. The headboard is inserted between the two sides and supports them, thus forming a more or less triangular partition and leaving an empty space about 6 in. from the stempiece. Sheathing will be jammed in between the headboard and the bark covering later.

The headboard is shaped into a 15-in.-long curve, narrower at the foot than at the head, with the peak of its curvature about three-quarters of the way up (see figure 10). It measures 2½ in. across at its widest point and 1¼ in. at the foot, with a uniform thickness of ¼ in. It is notched at the bottom so that it can be fitted into the corresponding notch in the stempiece. To position it, the builder treats it with hot water, inserts the end of it into the notch in the stempiece and then bends it until the top snaps into position between the inner gunwales, whose ends then bear on its upper edges. Thus, when installed the headboard follows a curve parallel to that of the stempiece.

Having installed the stempiece and the headboard, the builder further reinforces the tips of the canoe by placing a gusset cut from a piece of bark *(apitowan),* over the gunwales between the top of the headboard and the lashing adjacent to the stempiece

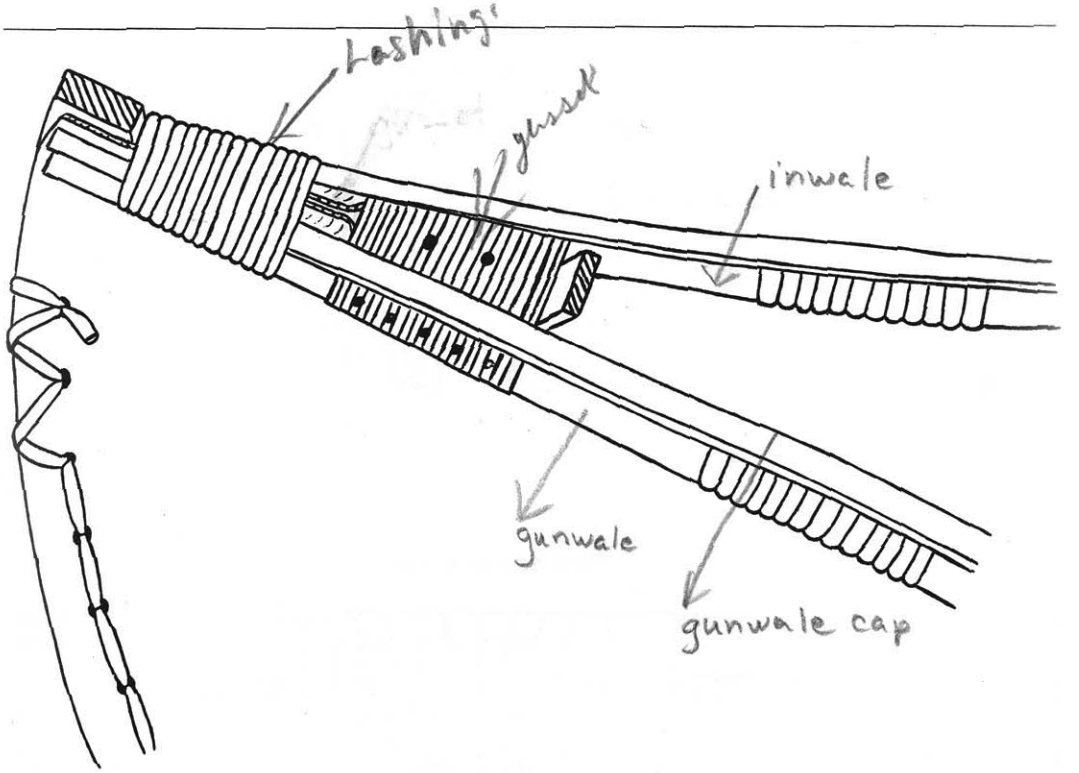

Figure 11
Finished tip of the canoe

(see figure 11). The gusset passes over the inner gunwales and is nailed to the outer edge of the outwales. Measuring 2½ in. by 4 in., with its shorter side laid lengthwise to the length of the canoe, it hangs down below the outwales. Later it will be trimmed flush with their bottom edges.

The builder now shapes the permanent thwarts. The central thwart measures 2 ft 3½ in. between the gunwales, with its upper edge slightly convex and its lower edge straight. It varies in thickness from ¼ in. at the ends to ¾ in. at the centre, and in width from 1¾ in. to 1¼ in. at the centre; it begins to taper about 5 in. from the gunwales. Two holes are bored at each end for the thongs that will secure it to the gunwales.

The next pair of thwarts are placed on either side of the central thwart and 2 ft 7 in. away from it. Each of these is 1 ft 7¾ in. long, measuring 1½ in. by ¼ in. at the ends and 1¼ in. by ½ in. at the middle. A single hole for the thongs is bored at each end of this pair.

The second (and last) pair of thwarts are placed 2 ft 6 in. from the other pair; they are 4 in. long, 1½ in. wide and ¼ in. thick. They are not attached until after the installation of the gunwale caps, since they will be attached to these caps as well as to the main gunwales and outwales (see figure 12). The gunwale caps need firm support at this point, for it is here that their curvature begins.

Next comes the installation of the gunwale caps. They are the same length as the outwales, 12 ft 6 in., and measure 1¼ in. by ⅜ in., tapered to ½ in. wide at the ends to make them easier to bend. Laid flat on top of the outwales and main gunwales, they cover them both. Near the ends of the canoe the caps are lashed to the gunwales and the bark in several places. The end thwarts are then lashed to the gunwale caps, main gunwales and outwales. The

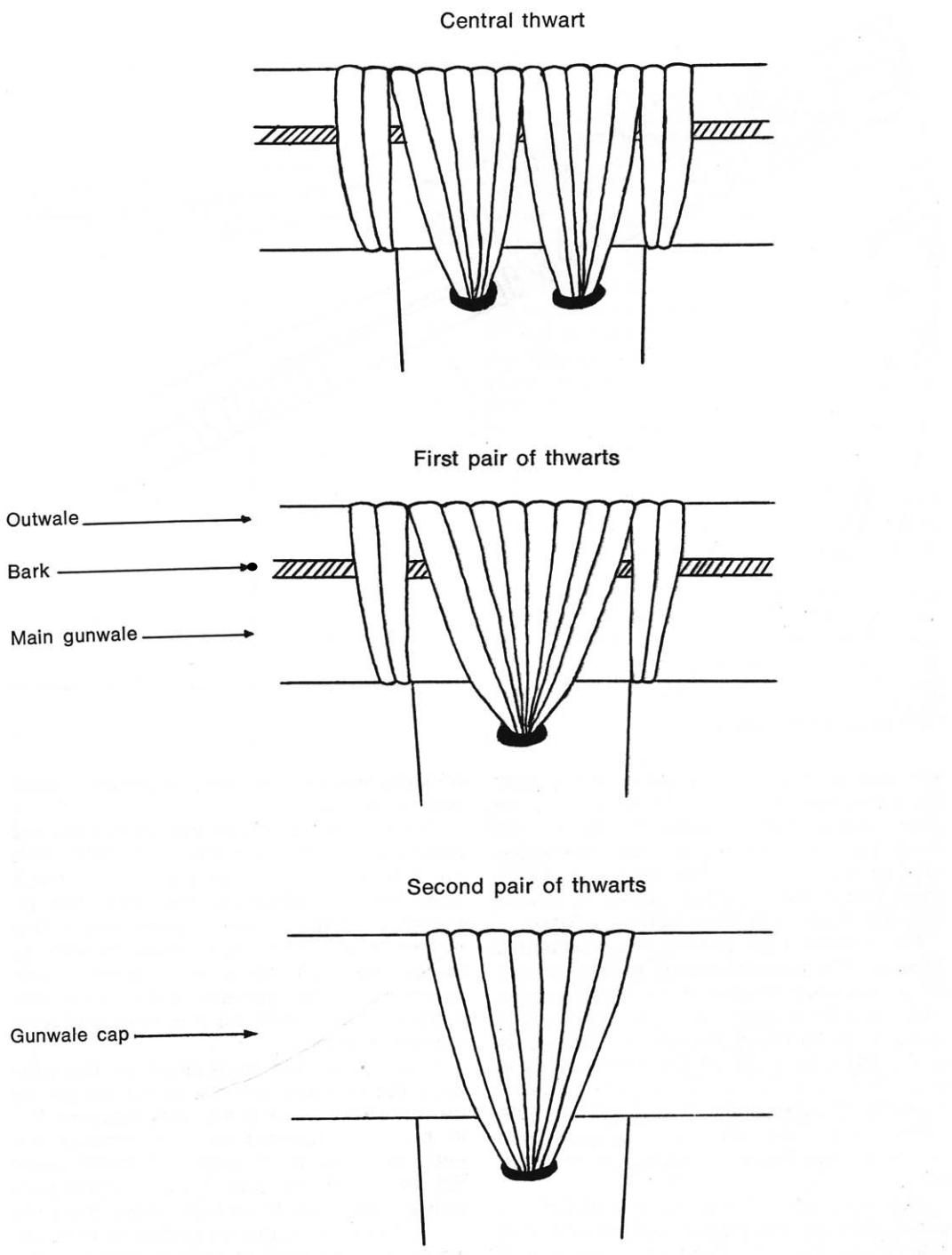

Figure 12
Lashings of the thwarts

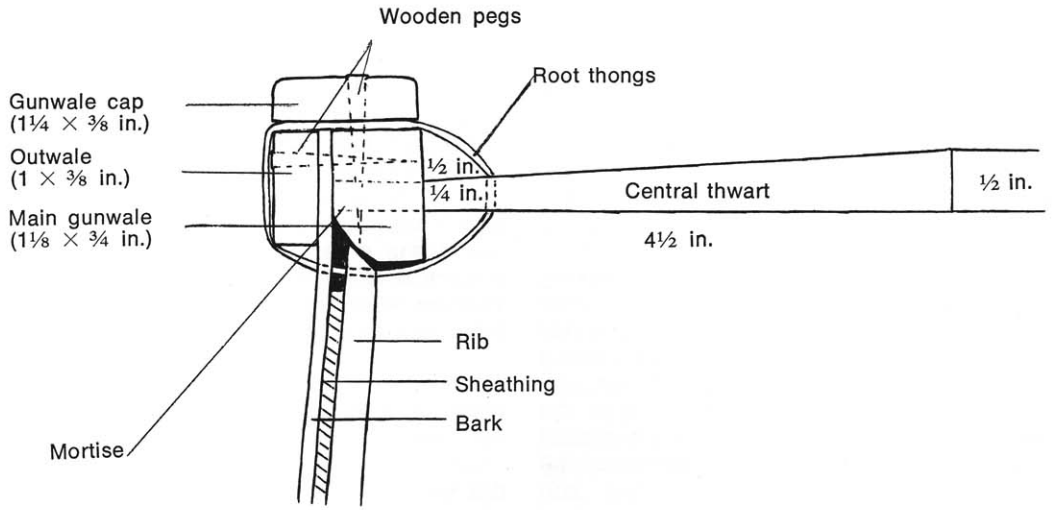

Figure 13
Cross-section of the gunwale at the central thwart

remaining length of the gunwale caps is attached with 2-in. wooden pegs driven into holes drilled at 9-in. intervals. This is the final step in finishing the tips of the canoe and reinforcing the gunwales.

Caulking the Inside

To ensure a watertight craft, the builder must caulk all the joints. The preparation of the caulking compound has already been described, but it should be recalled that the mixture used on the inside of the canoe contains pitch, which increases its adhesive properties. Albert's wife and his assistant applied this mixture with a cloth-covered spatula. Each joint was given a first coat of gum, which served to hold in place a 3-in.-wide strip of cloth; a second coat of gum was then smeared over the cloth, thus achieving a perfectly waterproof joint.

Inserting the Sheathing and the Ribs

With his crooked knife, the builder prepares about 50 strips of wood. This requires great skill and a sure hand, since the 4 ft by 3 in. planking has to be cut barely ⅛ in. thick, and the strips that will extend into the tips of the canoe must taper slightly, since this area is so much narrower.

The strips that serve as floorboards are installed in a special order in three rows, with the ones in the middle row slightly overlapping those on each end. In each row, the wood strip next to the gunwale overlaps its neighbour, which in turn overlaps its neighbour, and so on down to the centre of the canoe.

In the meantime, the ribs have dried; they have been taken out of their canoe "mould" and cut to varying lengths. The actual installation of ribs and sheathing now begins. Starting at the tips of the canoe, the builder inserts a row of sheathing strips between the headboard and the bark; while his assistant holds the strips in position, he installs the first rib, no. 14 (see p. 28), pushing the ends up between the main gunwale and the bark envelope. The rib is left for the moment at an angle; any attempt to move it into its final position would impose too concentrated a stress on the bark envelope, with the risk of splitting it. The builder installs all the ribs in this manner, pushing them just firmly enough to hold them in tilted position. Ribs that go in too easily must be corrected, for they would weaken the canoe. Sometimes, too, the ribs are too long, and then the crooked knife must once more be called into action.

When all the ribs have been installed at

an angle, the builder taps each one into its final position, with a birch mallet and a wooden drift, moving each one a bit at a time until they are all upright. Care must be taken at this point because such a great strain is imposed on the bark envelope by the driven ribs. Nevertheless, the ribs must exert enough pressure on the bark to keep it taut and also to hold themselves in position, since they are not attached to the bark or gunwales in any way. During installation, this pressure must be exerted evenly along the entire side, thus making the canoe capable of taking even greater strain. As he works, the builder sprinkles the bark liberally with hot water to make it as flexible as possible. Despite these precautions, two 10-in. splits appeared in the bark of Albert's canoe; these were closed and caulked in the same manner as the joints.

Caulking the Outside and the Tips

The final step consists of caulking the outside of the canoe. Here, too, a spatula is used, but moistened fingers must be used to force the hot, viscous gum into each joint and spread it evenly the full length of the joint. As it cools the caulking hardens. The joints at the tips of the canoe are more open, and they must first be filled with gum; then more is smeared over the edges, and, as with the inside joints, a strip of cloth is placed over the joint and coated with a second layer of gum.

The birchbark canoe is now finished. All that remains to be done is to test it in the water, to see if it is really waterproof.