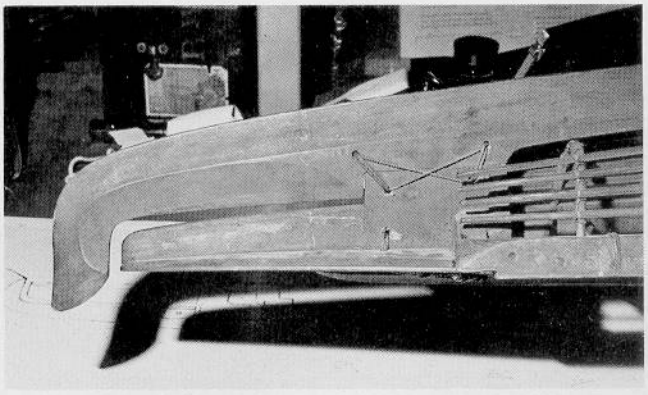
Building the One-Hole Aleut Bidarka

Part I

1



These two photographs show the structure of the author's reconstruction (left) and that of the Aleut Bidarka in the Lowie Museum collection. Once covered by canvas, the external shape will be the same; only the wood that comes in contact with the skin determines shape.

by David W. Zimmerly
photographs by the author

The Aleut Bidarka is so perfect in its way that a mathematician himself could hardly add anything to its sea going qualities", wrote the ethnographer and Russian Orthodox priest I.E.P. Veniaminov in 1840. But for all its perfection, the Aleut kayak has gone the way of the Dodo and Great Auk. Modern kayaks, when modeled after aboriginal designs at all, are slightly related to those used by the Greenland Eskimos — an accident of history caused by Greenland's greater proximity to the early sport kayaking centers of England and Europe. The Aleut kayak deserves a better fate.

History

Living on islands surrounded by treacherous water that's ice-free most of the year, the Aleut people needed some form of water transport. An absence of trees on the Aleutian Islands forced the inhabitants to rely on scarce driftwood for a framework that was covered with the easily-obtained skins of sea mammals.

Two types of boats emerged: a decked-over kayak for hunting and an open boat capable of carrying goods and people. At least one of the islands, the easternmost of the Fox group of the Aleutian chain, was occupied as long ago as 3000 B.C., according to archaeological evidence. One or both of these skin boats were probably developed in some form by then.

In the 1700s, Russian traders came to the Aleutian Islands to pursue the sea otter for its fur. Traded in China, these pelts built many a fortune for the Russian middlemen. The Aleut, however, were cruelly subjugated, their numbers decimated, and their culture unalterably changed.

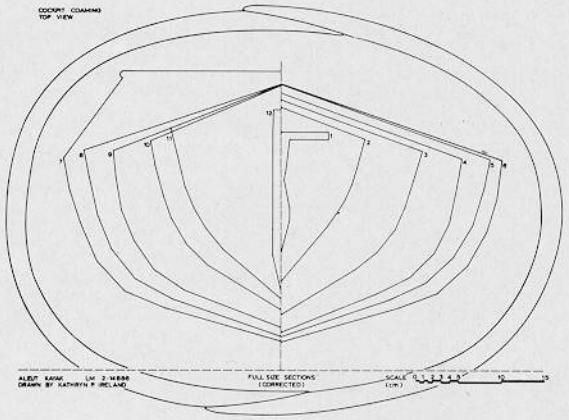
Before the Russians, one-hole bidarkas (kayaks) were found in abundance, along with some two-hole boats. The Russians apparently introduced the concept of the three-hole bidarka, the middle hole reserved for their traders, missionaries, and explorers. They also fostered the building of two-hole bidarkas for use in the otter hunt. Led by a hunt boss in a three-hole, scores of two-hole bidarkas took station around the hapless sea otter. The stern man paddled and guided the craft while the bow man readied his throwing board. With a throwing board, the Aleuts could reputedly throw a dart with an accuracy of one inch at forty yards.

Veniaminov wrote a very good description of an Aleut kayak from Atka Island in 1840:

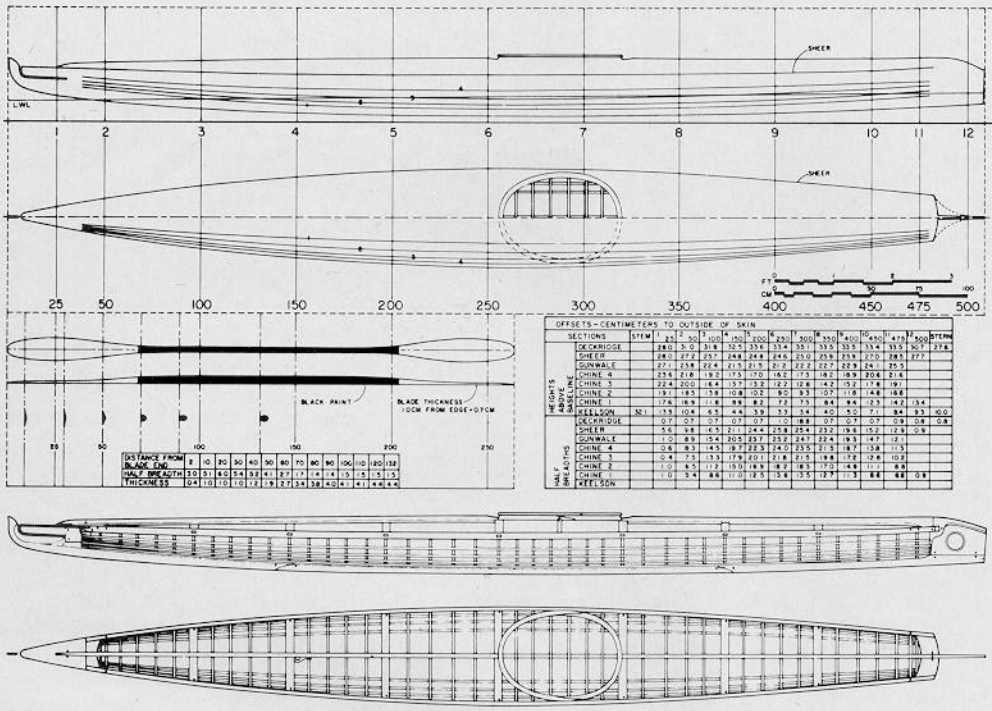
> "...The *baidarki* of the present-day Aleuts are no longer as perfect as those of the former Aleut riders. At that time, in the hands of excellent riders, they were so speedy that birds could not outrun them. They were so narrow and sharp-keeled that they could not stand upright in the water without a rider, and so light that a seven-year-old child could easily carry them."

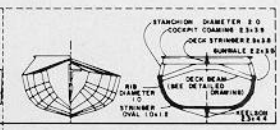
He went on to describe the gunwales, deck beams, ribs, and keelson. The last of these parts, he pointed out, was "always in three pieces in order that the *baidarka* may 'bend' over the wave."

Stability in this crank craft was achieved through masterful training, balance, and the use of double-bladed paddles. In the event of a capsize, an Aleut paddler could not roll the kayak back upright, but depended instead on



Looking for a good sea kayak with speed and character? Try lashing this beauty together.





THIS SPECIMEN CONSISTS OF AN UNCOVERED FRAME, A DOUBLE PADDLE AND A SAIL. ALL PARTS ARE OF SUPERIOR WORKMANSHIP, ALTHOUGH LATER REPAIRS SUCH AS THE COCKPIT COAMING STANCHIONS ARE OF INDIFFERENT QUALITY. THESE STANCHIONS ARE TOO LONG, FORCING THE COAMING OUT OF ITS OTHERWISE LEVEL PLANE. THE STERN HOLE SERVES ONLY TO LIGHTEN THE FRAME AND IN USE WAS COVERED OVER WITH SKIN. ALEUT KAYAK RIBS ARE LOCATED ON DECKBEAM CENTERS INSTEAD OF BEING STAGGERED TO MISS THEM AS ON ESKIMO KAYAKS FOLLOWING STANDARD ALEUT PRACTICE. THE KEELSON IS IN THREE SECTIONS WITH CURVED NOTCHED SCARF JOINTS. THE ORIGINAL PART OF THE FRAMEWORK WAS PAINTED RED.

OFFSETS – CENTIMETERS TO OUTSIDE OF SKIN

	SECTIONS	STEM	1	2	3	4	5	6	7	8	9	10	11	12	STERN
			25	50	100	150	200	250	300	350	400	450	475	500	
HEIGHTS ABOVE BASELINE	DECKRIDGE		28.0	31.0	31.8	32.5	33.6	33.4	33.1	33.5	33.5	33.4	33.5	30.7	27.6
	SHEER		28.0	27.2	25.7	24.8	24.8	24.6	25.0	25.9	25.9	27.0	28.5	27.7	
	GUNWALE		27.1	23.8	22.4	21.5	21.5	21.2	22.2	22.7	22.9	24.1	25.5		
	CHINE 4		23.6	21.8	19.2	17.5	17.0	16.2	17.3	18.2	18.9	20.6	21.6		
	CHINE 3		22.4	20.0	18.4	15.7	15.2	14.2	12.8	14.2	15.2	17.6	19.1		
	CHINE 2		19.1	18.5	15.8	10.8	10.2	9.0	9.3	10.7	11.8	14.8	16.6		
	CHINE 1		17.6	16.9	11.8	8.9	8.2	7.2	7.3	8.4	9.4	12.3	14.2	3.4	
	KEELSON	52.1	11.5	10.4	6.5	4.4	3.9	3.3	3.4	4.0	5.0	7.1	8.4	9.3	10.0
HALF BREADTHS	DECKRIDGE		0.7	0.7	0.7	0.7	0.7	1.0	0.8	0.7	0.7	0.7	0.9	0.8	0.8
	SHEER		5.6	9.8	14.5	20.1	24.4	25.8	25.4	23.2	19.6	15.2	12.9	0.9	
	GUNWALE		1.0	8.9	15.4	20.5	23.7	25.2	24.7	22.4	19.3	14.7	12.1		
	CHINE 4		0.6	8.3	14.5	19.7	22.3	24.0	23.5	21.5	18.7	13.8	11.3		
	CHINE 3		0.4	7.5	13.3	17.9	20.1	21.8	21.5	19.8	17.0	12.6	10.3		
	CHINE 2		0.3	6.5	11.2	15.0	16.9	18.2	18.3	17.0	14.8	11.1	8.8		
	CHINE 1		1.0	5.4	8.6	11.0	12.5	13.6	13.5	12.9	11.3	8.6	6.8	0.9	
	KEELSON														

ALEUT KAYAK

LOWIE MUSEUM, UNIVERSITY OF CALIFORNIA, BERKELEY

LM 2-14886

LENGTH	16' 8.6"	509.3
BEAM	20.4"	51.7
DEPTH TO SHEER	8.7"	22.0
WEIGHT	26.5 lbs	12.0 kg

COLLECTED BY MARGARET LANTIS, 1934, ATKA ISLAND, ALASKA

SCALE 1:8 (IN CENTIMETERS)

L.W.L. (LOAD WATERLINE) BASED ON 68 kg (150 lbs.) MAN SEATED 287.0cm FROM BOW

DISPLACEMENT TO SHEER 606.7 lbs 275.2 kg

C.P. (PRISMATIC COEFFICIENT) .50

THEORETICAL TOP SPEED 4.9 KNOTS

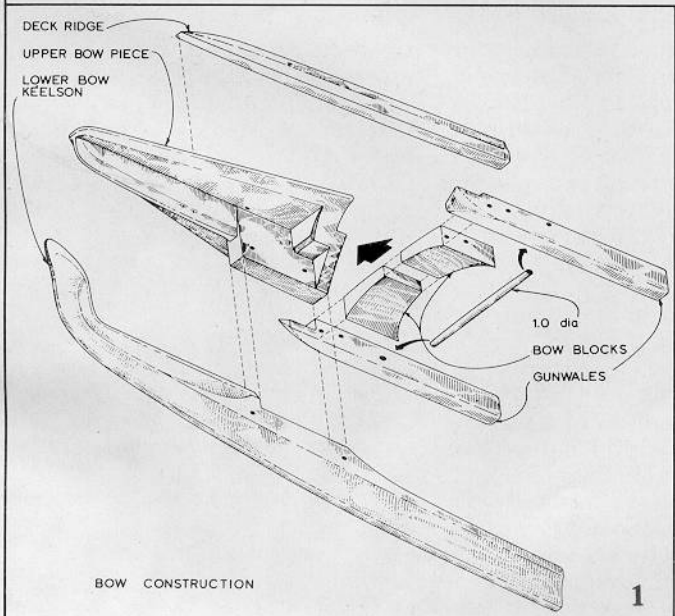
LOADED KAYAK UNSTABLE AT 22° HEEL

LINES AND CONSTRUCTION DETAILS

SHEET 1 OF 1

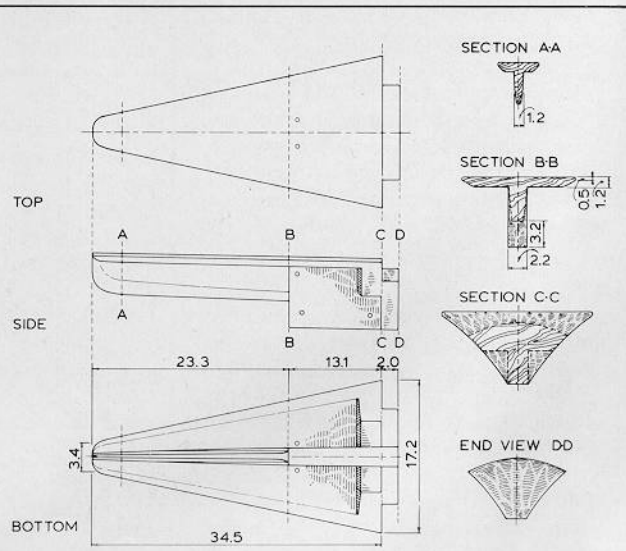
LINES TAKEN OFF BY DAVID W. ZIMMERLY, NOVEMBER 1978.

DRAFTED BY GAIL F. MCKNIGHT, 1980.



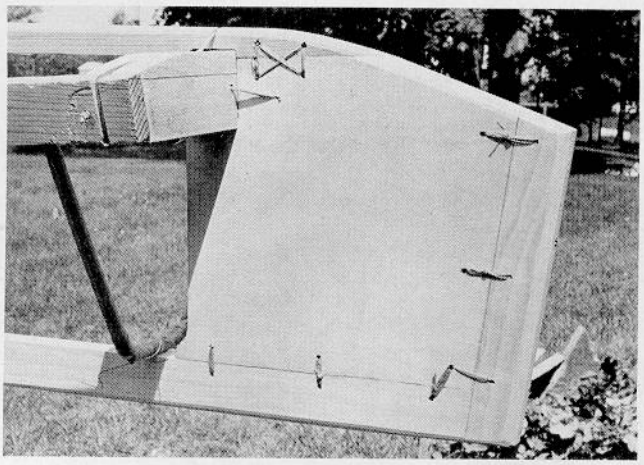
BOW CONSTRUCTION

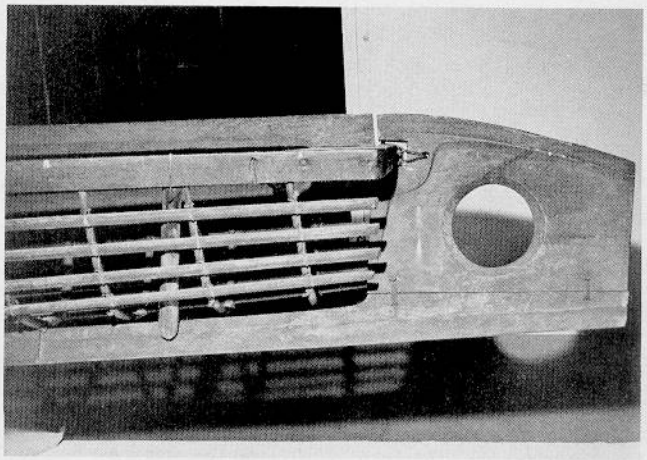
1



UPPER STEM PIECE

2





None of the internal structure needs to exactly copy that of the Aleut original. Note the differences between the author's stern section (left) with the Aleut structure below it. The hole served only to reduce weight.

getting out, righting his craft, bailing it, and reentering. He placed inflated seal or sea lion stomachs alongside the kayak for extra stability through all of this, but especially for entering. Pushed inside the bow and stern, these bladders also maintained positive buoyancy in case of holing.

Although the Greenland Eskimo kayaks and kayakers are well known for their several dozen capsize recovery techniques and their clever, beautifully-made kayak attachments and equipment, Alaskan Eskimos — the Aleut in particular — had the best woodworking techniques, bar none. Their fine joinerwork is nowhere more evident than in the one-hole bidarka at UCLA's Lowie Museum, brought back from Atka in 1934 by anthropologist Margaret Lantis. The red-painted frame was collected without its skin cover, allowing me to inspect its construction and make detailed measurements. It is the finest kayak I have seen.

Based on this examination, a study of the ethnographic literature, and my own reproduction of a two-hole Aleut bidarka from the Smithsonian's collections, this article, along with the one to follow in *SBJ* #30, describes the construction of a one-hole Aleut kayak, using modern tools and materials. The resulting craft will be a high-performance hunting machine — lean and fast, light and tippy — and a joy to look at. It is not meant for everyone.

Making the Pieces

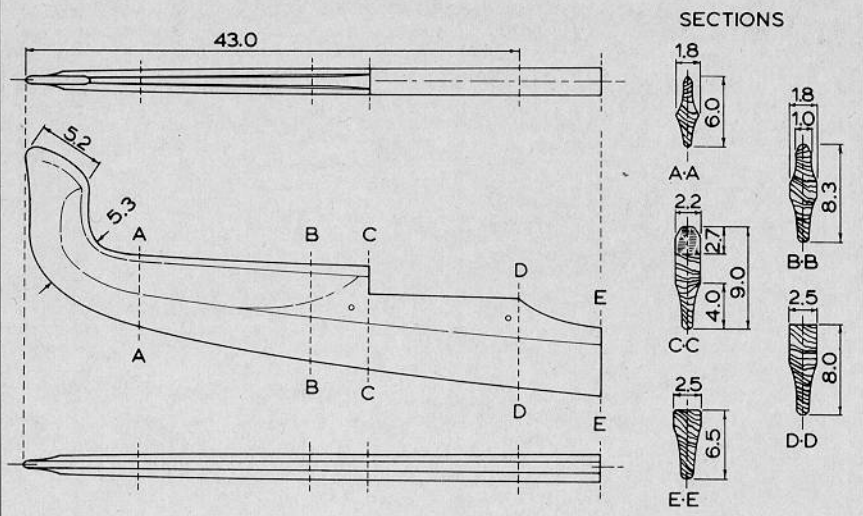
For woodworkers accustomed to glue and metal fastenings, the lashed-together construction of the Aleut kayak will seem strange indeed. I caution anyone against thinking that he will improve the boat by using screws and epoxy in the final joinerwork, however. This kayak is built very light and needs the movement of its parts to work with the waves.

In general, the parts of the kayak should be fabricated completely before actually joining them. All pieces can be gotten out of lumberyard stock, with care taken to find knot-free pieces for the gunwales and deck beams. Spruce, Sitka if available, is a good choice for all parts, but many other woods are suitable. Use whatever is available locally at a reasonable price.

All the measurements are given in centimeters. If this is your first time working with metric measurements, you may not have a feel for dimensions. But in time you'll find the actual use of a metric rule infinitely easier than the clumsy feet, inches, and eighths. Just remember: 2.54 centimeters is the same length as an inch, and 100 centimeters is just a bit longer than 39 inches (3 inches more than a yard).

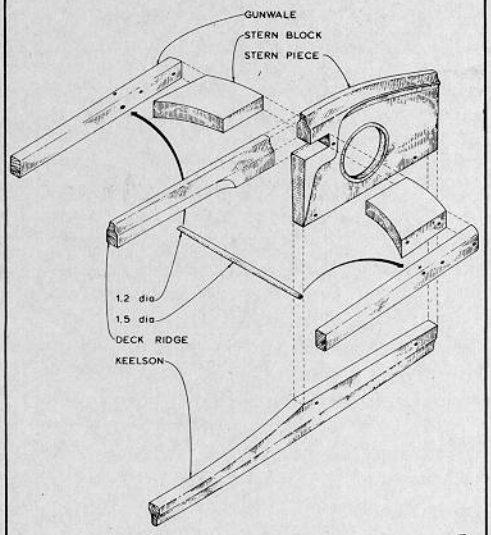
The only part of the construction that is at all difficult is the bow section shown by exploded diagram in figure 1. Figures 2 and 3 are measured drawings of the upper and lower bow pieces, which may be made of pine for easier working. The upper bow piece is more easily built up in two parts; that is, a horizontal top plate lashed to a vertical piece to achieve the approximate shape. The important thing to remember is that only the wood that eventually comes in contact with the canvas cover will affect the final shape of the kayak. The Aleut design of the pieces keeps the weight as low as is consistent with high strength, but none of the internal pieces of *your* kayak need mimic them. Photograph 1 shows the built-up bow of my two-hole Aleut kayak reconstruction, with the top plate mentioned above lashed to the upper bow piece.

Because I could not find naturally-curved wood for the lower bow piece (shown in figure 3) as the Aleut did, I glued it up from two blocks with the grain in different directions, then sawed and sanded it to the final shape shown in the photograph. The lower bow piece also forms the forward part of the keelson and should be left about 160 centimeters long to allow for later scarphing. Cut the middle length of



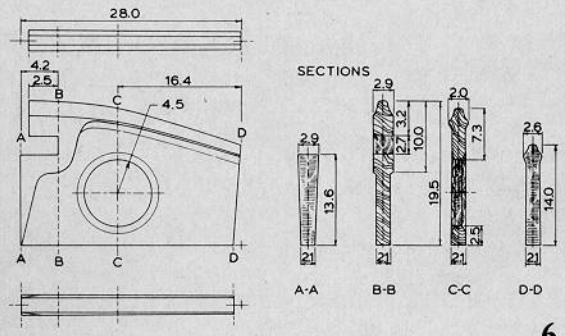
LOWER STEM PIECE

3



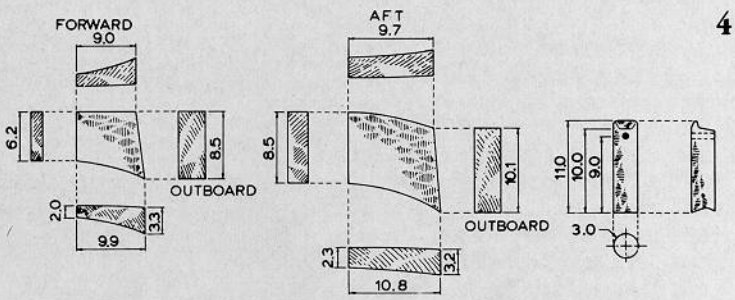
STERN CONSTRUCTION

5



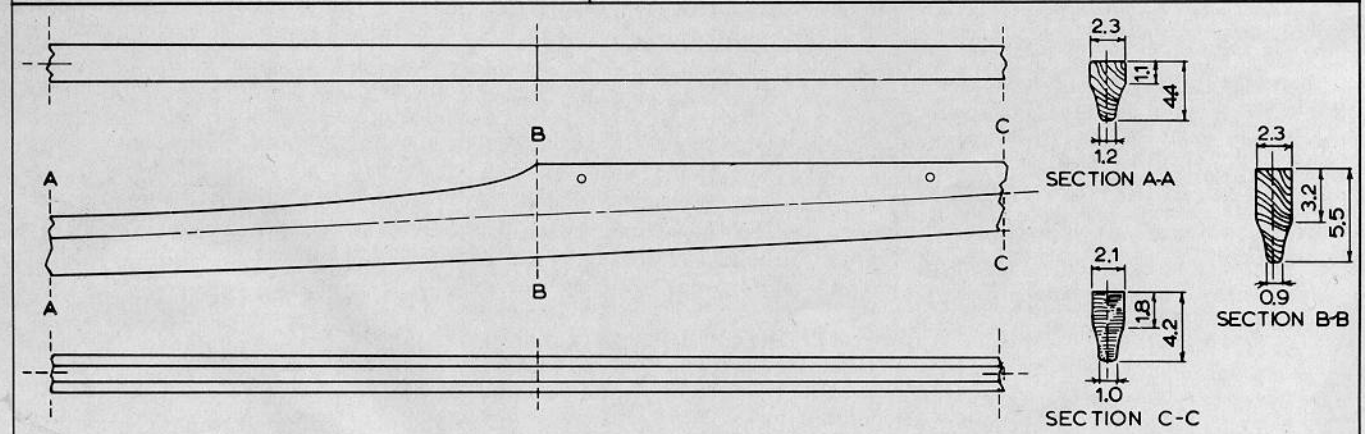
STERN PIECE

6



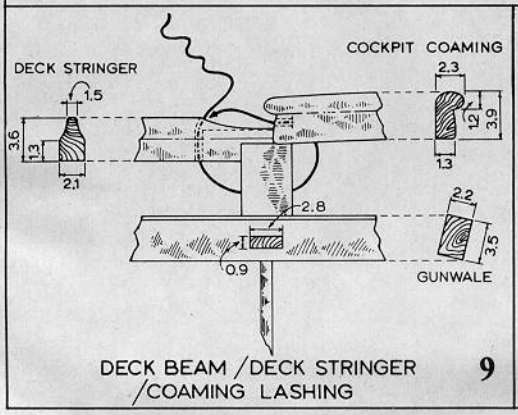
BOW BLOCK (2) STERN BLOCK (2) COCKPIT STANCHION (2)

4



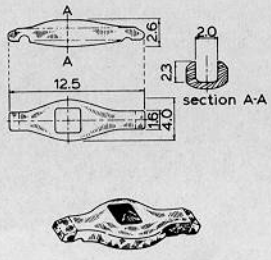
STERN KEELSON PIECE

7



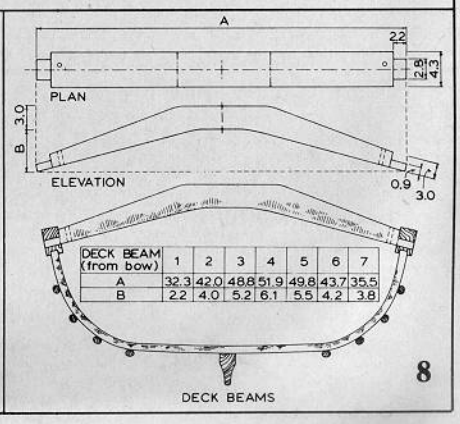
DECK BEAM / DECK STRINGER / COAMING LASHING

9



MAST STEP
located between ribs 11 and 12

10



DECK BEAM (from bow)	1	2	3	4	5	6	7
A	32.3	42.0	48.8	51.9	49.8	43.7	35.5
B	2.2	4.0	5.2	6.1	5.5	4.2	3.8

DECK BEAMS

8

keelson about 250 centimeters long (it will later be scarphed to forward and aft pieces) and shape it to section AA shown in figure 7.

For simplicity, the bow and stern blocks shown in figures 1, 4, and 5 can be made rectangular and one-piece. The large stern piece shown in figures 5 and 6 is straightforward in construction. The aft keelson is made as shown in figure 7, with an overall length of about 150 centimeters to allow for later trimming and scarphing. The photograph shows the simplified stern construction I used in my two-hole kayak. Again, this treatment could be used instead of the more complicated Aleut cross sections which, although aesthetically more pleasing and lighter weight, take more time and skill to make.

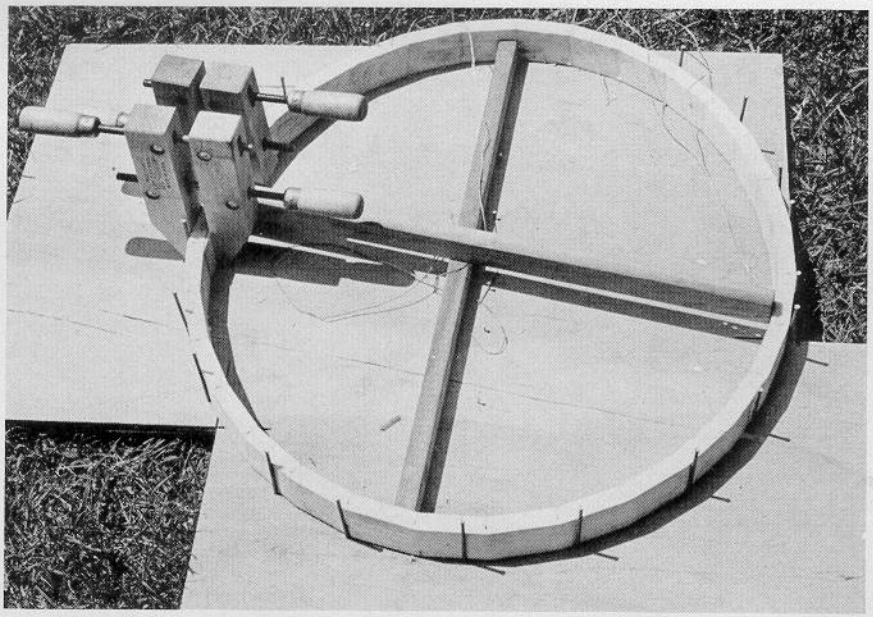
The gunwales, (cross sections shown in figure 9) are cut 3.5 centimeters high by 2.2 centimeters wide and 445 centimeters long. Mark out the locations of the deck beams and cut out mortises about 0.5 centimeter from the bottom of the gunwale. Also mark rib locations and drill the bottoms of the gunwales with round mortises 1.0 centimeter in diameter and about 1.5 centimeters deep to accept the ribs.

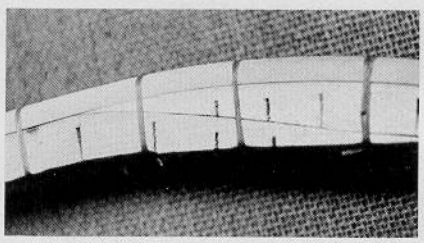
The deck beams are made to the dimensions found in figure 8. The length and midpoint depth are given in the table there. With straight-grained, knot-free stock, the deck beams can be cut out of a 2 by 8.

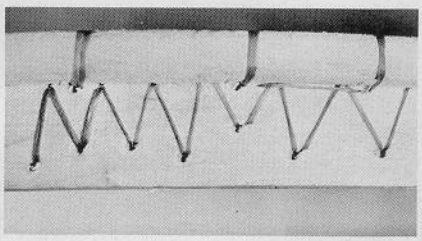
Rip the hull stringers out of a 16-foot, knot-free 1 by 6, and plane them down to an oval cross section 1.0 by 1.2 centimeters. Leave them full length for now.

The forward and aft deck stringers are initially 240 and 170 centimeters long, respectively, with the cross section shown in figure 9. Leave the ends untrimmed until final assembly.

The ribs are a very slight diameter of 1.0 centimeter. To avoid breakage, it is best to make all 43 of them from willow shoots of appropriate diameter. If this is not available, use the clearest, most straight-grained spruce you can find. Cut them about 70 centimeters long. This length will accommodate the longest ribs in the middle of the kayak, but save the shorter leftovers to be used near the ends. Although the finished kayak has a shallow vee bottom, the ribs will be bent with a flat section at the bottom as shown in figure 8. The addition of the keelson on edge creates the vee bottom. Set the ribs aside in a trough of water (a section of eaves trough capped on both ends will do nicely) until assembly time.







Constructing the cockpit coaming of one piece. Top: *the coaming is slightly egg-shaped, as is the coaming of a modern kayak. Lay out the pattern on scrap plywood with finish nails. After the coaming is sawn part-way through at intervals, it is boiled, set in the form, clamped, and allowed to dry.* Left: *once the scarph joint in the coaming is trimmed, it's drilled through and lashed together.* Right: *rather than carve the lip, the author lashed on a half-round.*

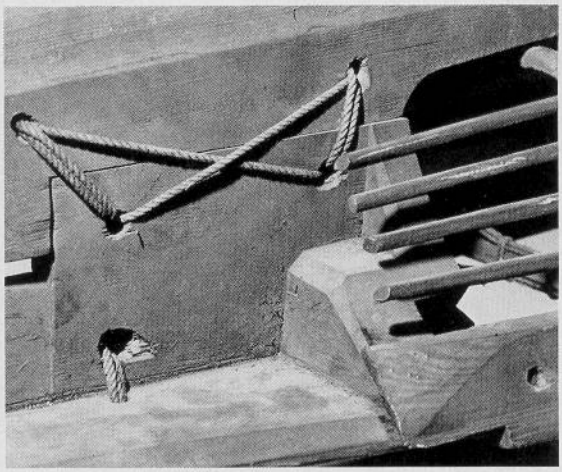
The cockpit coaming on the original kayak is made in two parts with straight scarph joints on both sides. The small lip shown in the cross section in figure 9 was carved into the coaming.

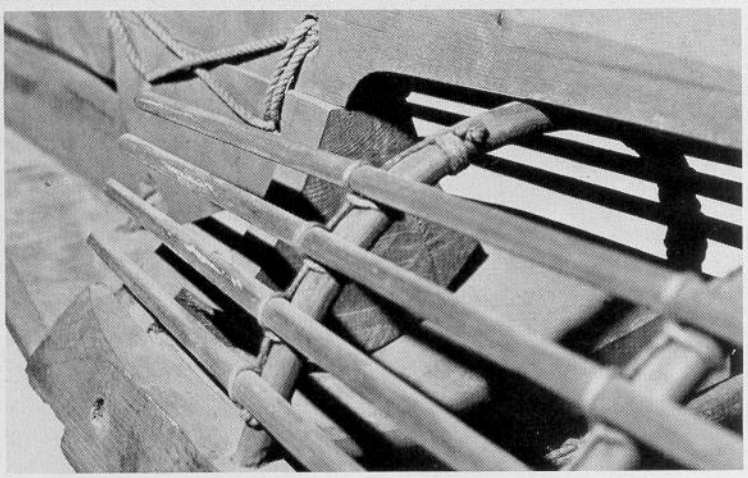
I suggest making the coaming from one long piece with only one scarph joint. Here's how: Take an 8-foot length of spruce 1 by 2 and plane it down 3.9 centimeters high by 1.3 centimeters wide. To facilitate bending, make saw cuts (⅛ inch is the kerf thickness of a normal circular saw) to within 0.16 centimeters (about 1/16 inch) of the far side. Space the kerfs every 5 centimeters. Plane one end of the coaming's flat side for 12 centimeters, as shown in the photograph. This is one side of the scarph joint.

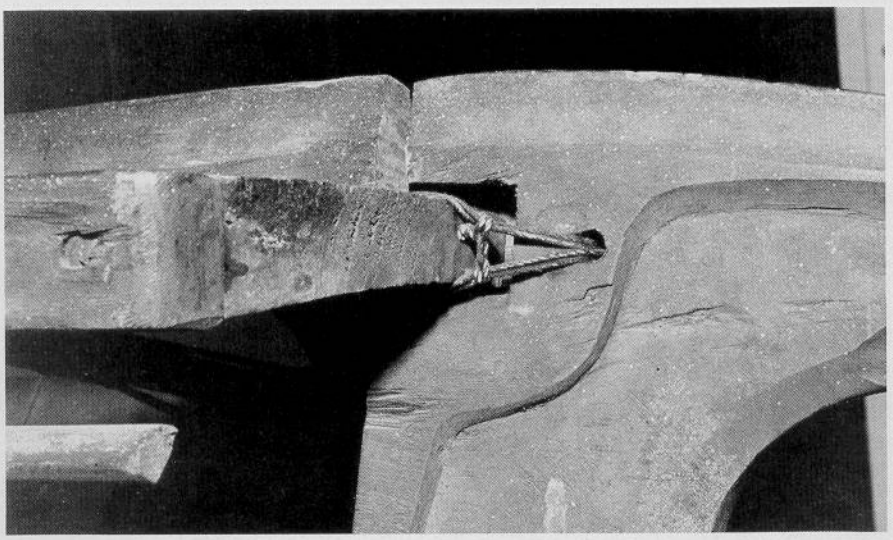
On a piece of scrap ¾-inch plywood of sufficient size, mark the outer edge of the cockpit coaming to be 65.2 centimeters long by 48.0 centimeters wide, and slightly egg shaped. Drive 3½-inch finishing nails into the plywood around this line to make a form for the coaming, as in the photograph. Put the coaming into an 8-foot length of eaves trough that is capped at both ends and set up on bricks to make room for a two-burner camp stove underneath. Boil water in a kettle and pour it over the coaming, then light the camp stove to keep the water hot. After 20 to 30 minutes, remove the coaming from the hot water and bend it into the circle of nails. Mark the overlap, trim the long end to match your original scarph joint and replace the coaming in the form. Hold the scarph together with wooden clamps. (You may have to reheat the coaming before putting it back in the form.)

Once dry, drill 1/16-inch holes through the scarph joint like the lower holes shown in the photograph. With a needle and a heavy waxed cord, sew the scarph joint together. You will be using a wood joining technique that is thousands of years old and quite good.

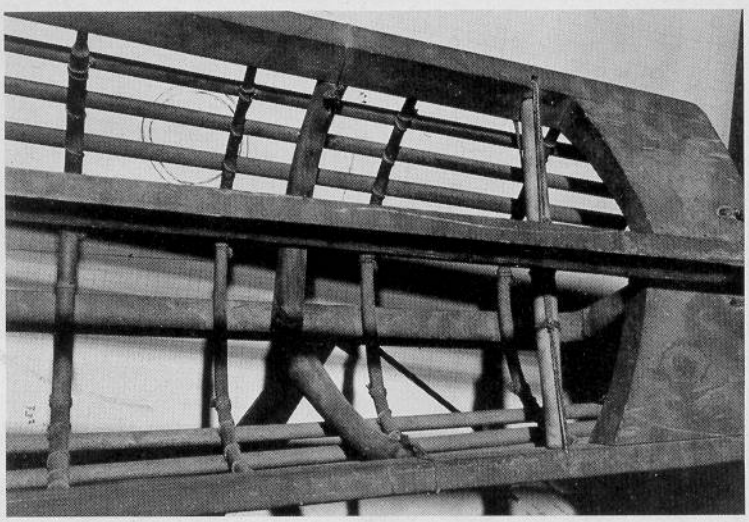
The lip around the coaming takes a spray skirt, and is simply made. Give an 8-foot length of ½-inch half-round molding the hot water treatment in the eaves trough. When it's pliable, wrap it around the top of the coaming and trim to fit with a simple butt joint. While the half-round is held in place by clamps, drill ⅛-inch holes, spaced

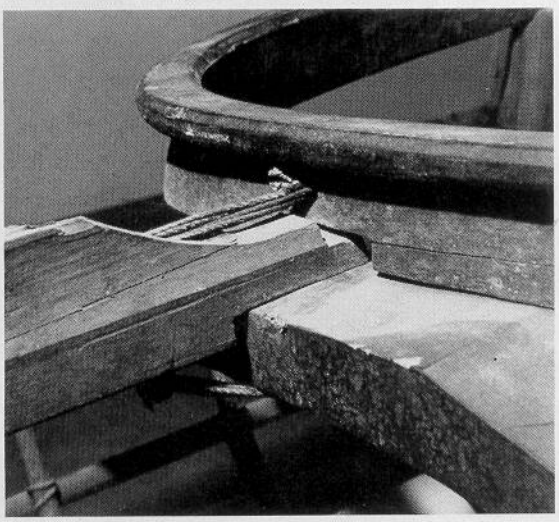






These details of the Lowie Museum's bidarka show the outstanding craftsmanship of Aleut woodworkers. The Aleut design of the pieces keeps the weight low, but the strength high. It is an elegant and remarkably beautiful work of engineering. Top left: *this side view of the bow (upside down) illustrates the joint between the upper bow piece and the keelson (see figure 1).* Top right: *here's the bow again, looking forward. Note the lashing of the stringers to the forward rib.* Left: *this side view of the stern structure shows the carving used to eliminate weight. Note how the lashings hold the stern blocks together and in place.* Below left: *the stern, seen from the top.* Below right: *deck stringer-deck beam-coaming joint and lashing.*





every 5 centimeters, just below it. Make sure none go through a saw kerf. Bring out the needle and waxed cord again, and sew or lash the lip in place. You can cut grooves across the top to countersink the lashings, but since this area will later be covered by canvas, it's not really necessary.

Of the 78 individual pieces that make up the original kayak, only 5 remain to be fabricated. A round, straight deck beam 1.0 centimeter in diameter and 20 centimeters long is located just behind the bow blocks, as in figure 1. A similar stern piece, shown in figure 5, is 1.5 centimeters in diameter and 26.5 centimeters long. Two stanchions, 6.2 centimeters long and 2.0 centimeters in diameter, fit between the gunwales and the coaming. These are shown in figure 4.

Finally, make the mast step to the dimensions shown in figure 10. In the final assembly, it will fit over and lash to ribs 11 and 12. Hardwood is best for this part.

Except for the rudder, mast, and sail which will be described later, all the parts of the kayak framework have been prefabricated. Sit back for a bit and admire your work so far. In *SBJ* #30, we'll put the puzzle together and turn it into a boat. □

Building the One-Hole Aleut Bidarka

Part II

Assembling the puzzle

by David W. Zimmerly
photographs by the author

Lean and fast, light and tippy, the Aleut bidarkas were high-performance hunting machines. Aleut hunters would venture as far as fifteen miles off shore in them for as long as eighteen hours at a time. Although not for everyone, these kayaks are too good to be relegated to museums.

Last issue (SBJ #29), ethnologist David Zimmerly described shaping each of the seventy-eight individual pieces that make up the bidarka's frame, using modern tools and materials. Here he tells us how to put them together, using traditional arctic joining techniques, and how to cover the boat. The articles are based on the author's reconstruction of a two-hole bidarka (from the Smithsonian's collection) and on his examination of the outstanding one-hole frame in UCLA's Lowie Museum. The Lowie frame is shown here in drawings and photographs.

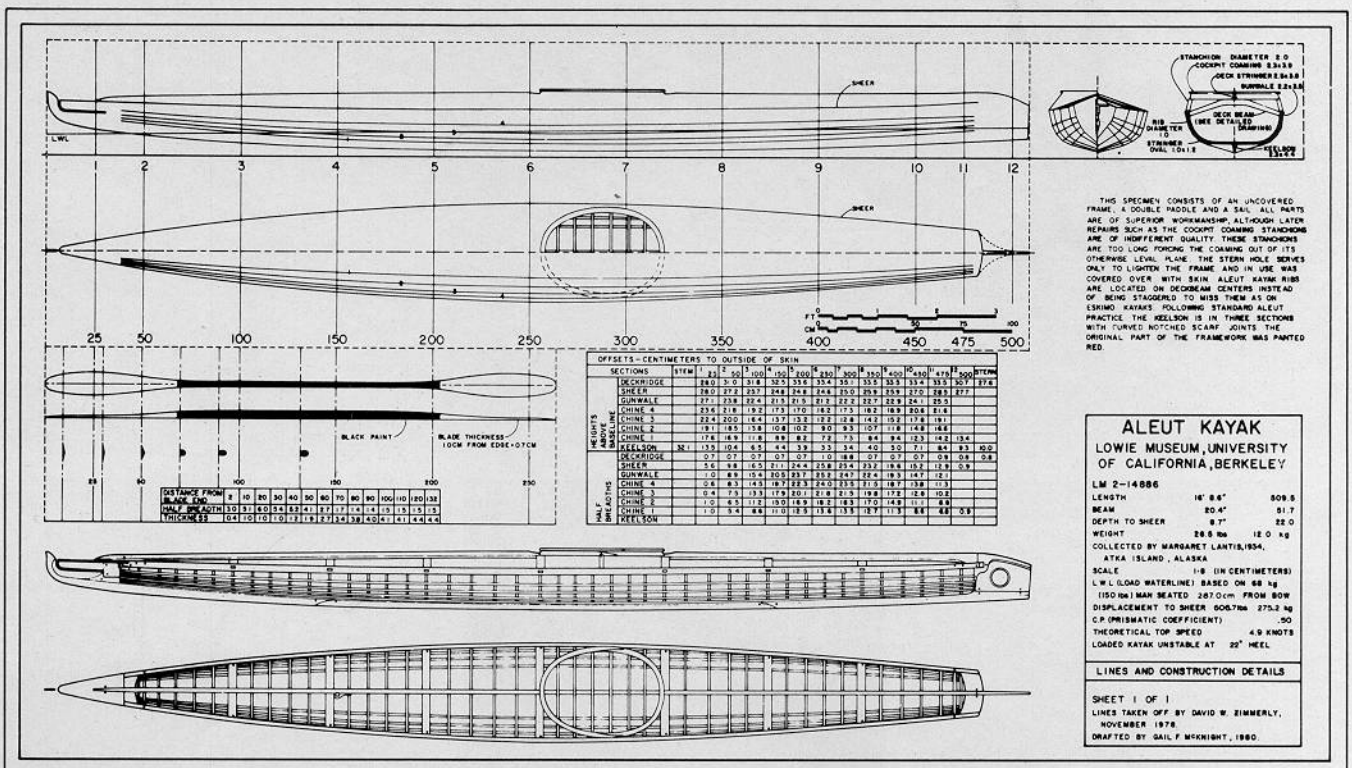
Remember, only the wood that eventually comes in contact with the canvas skin will effect the final shape of the kayak. The Aleut design of the pieces keeps weight low without sacrificing strength. As before, all dimensions are given in centimeters except where otherwise indicated.

— Editors

Few boats are as clean-lined or handsome as the Aleut bidarka. Yet they are not difficult to lash together.

Admired all those pieces long enough? Now it's time to lash them together. Two sawhorses make a fine assembly platform, but even an apartment floor will serve. The basic procedure is to join the gunwales to the deck beams and end blocks, and fit in the stern piece and the upper bow piece, followed by the deck stringers. Then, the deck framework is turned upside down and the lower bow piece/keelson is fitted along with the other two lengths of keelson. Next the ribs are bent, fit in place, and faired by "rack of eye." Finally the stringers are attached, then the cockpit coaming and stanchions, and lastly the mast step. That's the overview, now for the details.

Place the matched gunwales on the sawhorses and fit two middle (longest) deck beams. The gunwales will flare, as in figure 1. Tie them together with a temporary lashing as shown in photograph A. Then, working towards the ends, fit in the rest of the deck beams, except for the small round ones at the bow and stern. When you're satisfied that everything is symmetrical



THIS SPECIMEN CONSISTS OF AN UNCOVERED FRAME, A DOUBLE PADDLE AND A SAIL. ALL PARTS ARE OF SUPERIOR WORKMANSHIP, ALTHOUGH LATER REPAIRS SUCH AS THE COCKPIT COAMING STANCHIONS ARE OF INDIFFERENT QUALITY. THESE STANCHIONS ARE TOO LONG FORCING THE COAMING OUT OF ITS OTHERWISE LEVEL PLANE. THE STERN HOLE SERVES ONLY TO LIGHTEN THE FRAME AND IN USE WAS COVERED OVER WITH SKIN. ALEUT KAYAK RIBS ARE LOCATED ON DECKBEAM CENTERS INSTEAD OF BEING STAGGERED TO MISS THEM AS ON ESKIMO KAYAKS. FOLLOWING STANDARD ALEUT PRACTICE, THE KEELSON IS IN THREE SECTIONS WITH CURVED NOTCHED SCARF JOINTS. THE ORIGINAL PART OF THE FRAMEWORK WAS PAINTED RED.

OFFSETS – CENTIMETERS TO OUTSIDE OF SKIN

	SECTIONS	STEM	1	2	3	4	5	6	7	8	9	10	11	12	STERN
HEIGHTS ABOVE BASELINE	DECKRIDGE		28.0	31.0	31.8	32.5	33.6	33.4	33.1	33.5	33.5	33.4	33.5	30.7	27.6
	SHEER		28.0	27.2	25.7	24.8	24.8	24.6	25.0	25.9	25.9	27.0	28.3	27.7	
	GUNWALE		27.1	23.8	22.4	21.5	21.5	21.2	22.2	22.7	22.9	24.1	25.5		
	CHINE 4		23.6	21.8	19.2	17.3	17.0	16.2	17.5	18.2	18.9	20.6	21.6		
	CHINE 3		22.4	20.0	16.4	13.7	13.2	12.2	12.8	14.2	15.2	17.6	19.1		
	CHINE 2		19.1	18.5	13.8	10.8	10.2	9.0	9.3	10.7	11.8	14.8	16.6		
	CHINE 1		17.6	16.9	11.8	9.8	8.2	7.2	7.5	8.4	9.4	12.3	14.2	13.4	
	KEELSON	32.1	13.9	10.4	6.5	4.4	3.9	3.3	3.4	4.0	5.0	7.1	8.4	9.3	10.0
HALF BREADTHS	DECKRIDGE		0.7	0.7	0.7	0.7	0.7	1.0	1.8	0.7	0.7	0.7	0.9	0.8	0.8
	SHEER		5.6	9.8	16.5	21.1	24.4	25.8	25.4	23.2	18.6	15.2	12.9	0.9	
	GUNWALE		1.0	8.9	15.4	20.5	23.7	25.2	24.7	22.4	19.3	14.7	12.1		
	CHINE 4		0.6	8.3	14.5	19.7	22.3	24.0	23.5	21.5	18.7	13.8	11.3		
	CHINE 3		0.4	7.3	13.3	17.9	20.1	21.8	21.5	19.8	17.2	12.6	10.2		
	CHINE 2		1.0	6.5	11.2	15.0	16.9	18.2	18.3	17.0	14.9	11.1	8.8		
	CHINE 1		1.0	5.4	8.6	11.0	12.5	13.6	13.5	12.7	11.3	8.6	6.8	0.9	
	KEELSON														

ALEUT KAYAK

LOWIE MUSEUM, UNIVERSITY OF CALIFORNIA, BERKELEY

LM 2-14886

LENGTH	16' 8.6"	509.5
BEAM	20.4"	51.7
DEPTH TO SHEER	8.7"	22.0
WEIGHT	28.5 lbs	12.0 kg

COLLECTED BY MARGARET LANTIS, 1934, ATKA ISLAND, ALASKA

SCALE 1-8 (IN CENTIMETERS)

L.W.L (LOAD WATERLINE) BASED ON 68 kg (150 lbs.) MAN SEATED 287.0cm FROM BOW

DISPLACEMENT TO SHEER 606.7lbs 275.2 kg

C.P. (PRISMATIC COEFFICIENT) .50

THEORETICAL TOP SPEED 4.9 KNOTS

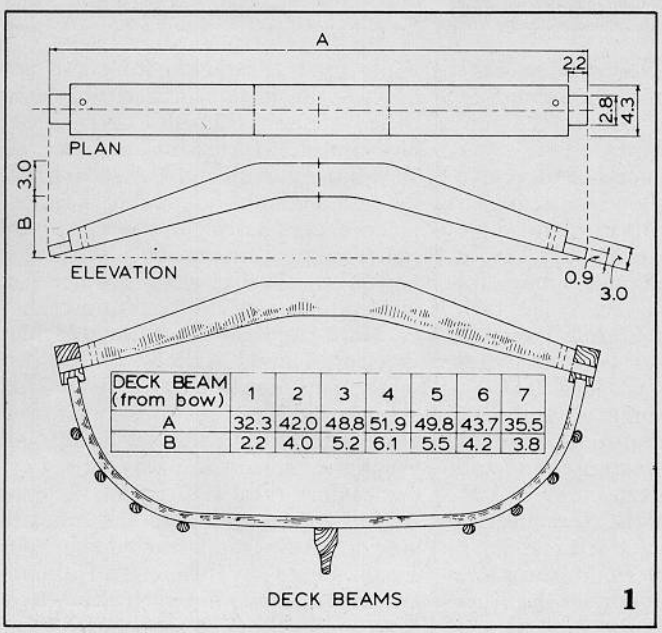
LOADED KAYAK UNSTABLE AT 22° HEEL

LINES AND CONSTRUCTION DETAILS

SHEET 1 OF 1

LINES TAKEN OFF BY DAVID W. ZIMMERLY, NOVEMBER 1978.

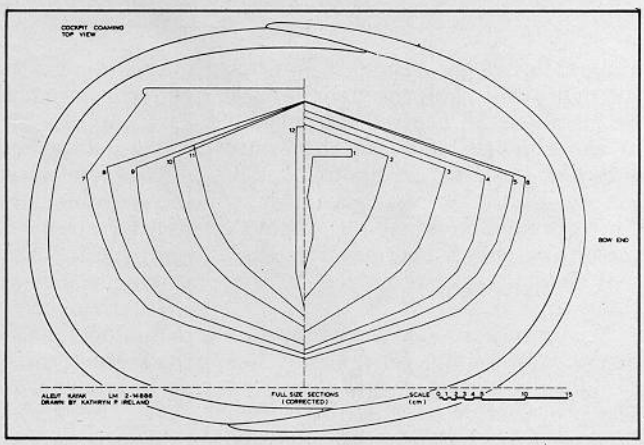
DRAFTED BY GAIL F. McKNIGHT, 1980.

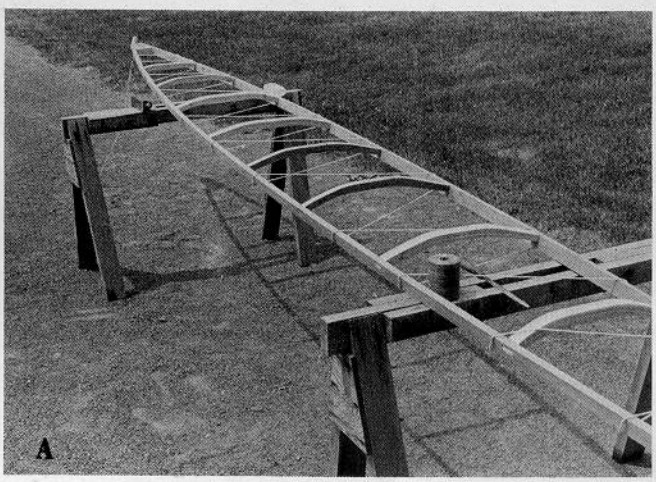


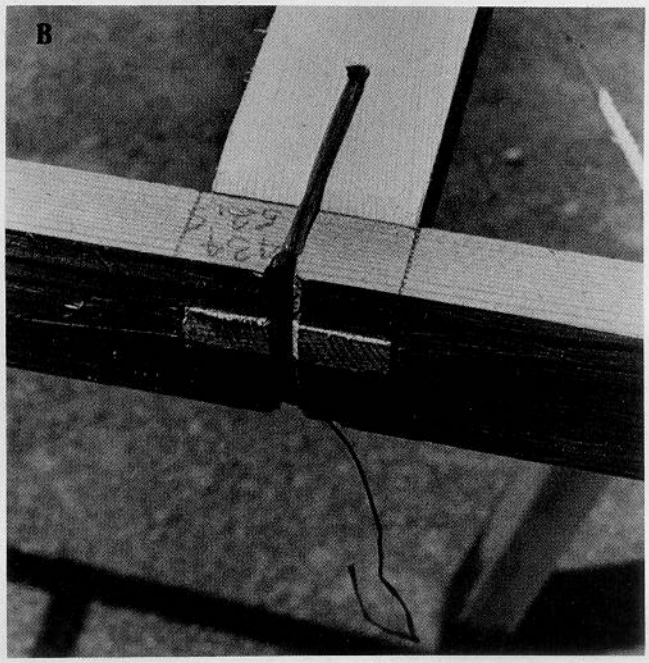
DECK BEAM (from bow)	1	2	3	4	5	6	7
A	32.3	42.0	48.8	51.9	49.8	43.7	35.5
B	2.2	4.0	5.2	6.1	5.5	4.2	3.8

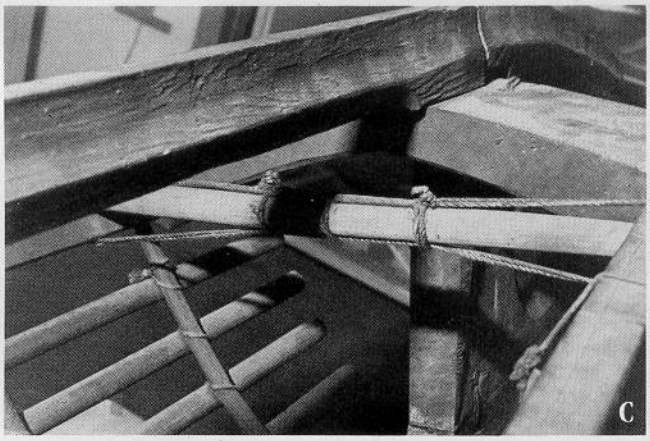
DECK BEAMS

1





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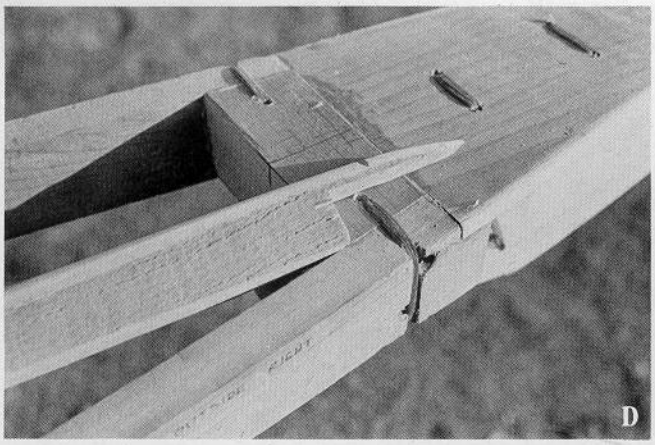
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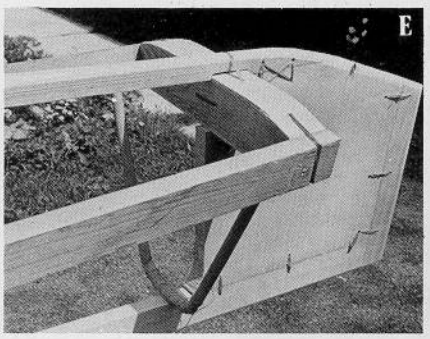
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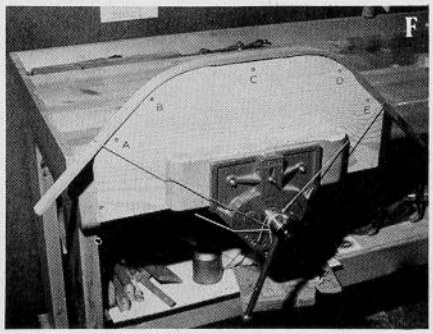
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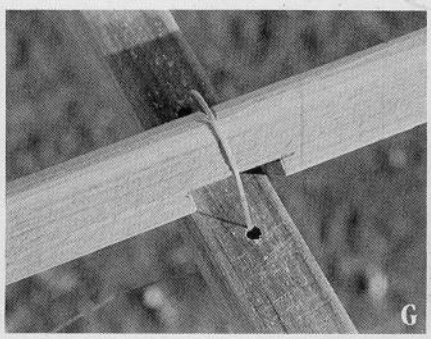

G

and exhibits a good snug fit (but not too tight), drill a hole through the deck beams about 2.5 centimeters inboard of the gunwale and lash the joints together as shown in photograph B. File notches to recess the lashings. Thin, braided nylon cord, such as mason's twine or fisherman's net twine, will do well. Take about four or five tight wraps at every joint.

The round beams at the ends need to be cut short enough for the gunwales to hold the (trimmed) bow and stern blocks by friction alone. Drill a ⅛-inch hole from top to bottom through the gunwales at the locations of these deck beams for the lashings. Take several turns from one gunwale to the other as shown in photograph C.

The bow and stern blocks are fitted next. They may have to be trimmed to fit both the angle and flare of the gunwales. Using screws and glue to pin the blocks in place would be acceptable, but lashings or wooden pegs are better. The Lowie frame had pegs that had sheared off. I used screws as temporary clamps and removed them after lashing. To lash the blocks in place, drill holes through them at an angle so that the drill emerges through the middle of the gunwales. Again, file notches to countersink the lashings. Two lashings on top of each side and two more through the bottom of the blocks and out the sides of the gunwales should be sufficient.

Now fit the upper bow piece to the bow blocks and gunwales. Hold it in place temporarily while you fair its outboard edges to follow the line of the gunwales as shown in photograph D. Lash the bow piece to both the gunwales and the bow block.

The stern piece is notched to receive the stern block as shown in figure 2. I used a variation of this in my two-hole reproduction because I didn't have a single piece of wood large enough for the stern piece; my assembly is shown in photograph E. The stern is lashed to the stern block and then to the after deck stringer which is added next.

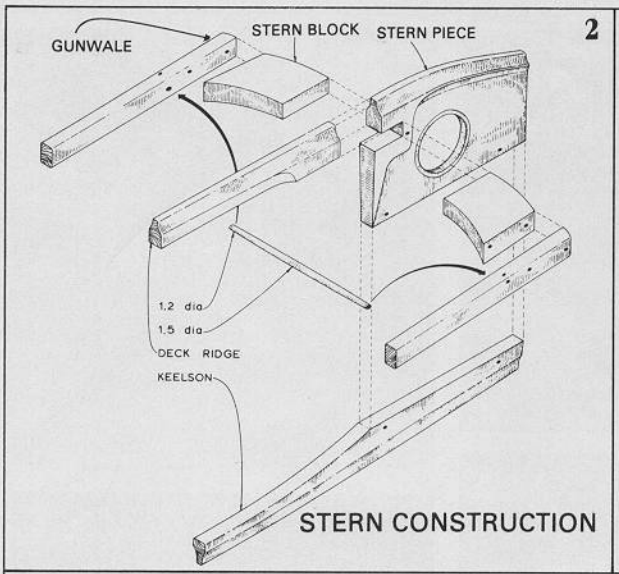
The after deck stringer is notched to fit on the after cockpit deck beam as shown in figure 3. The stern end should lie on top of the stern block and fit flush with the top of the stern piece as in figure 2. Once the stringer is in place, sight down it from astern and check its fit where it crosses the other deck beams. If it is too high at any point, notch the stringer over the deck beams in question. When it's fair, groove the top of the stringer in the way of the deck beams as shown in photograph F, and lash each joint with several turns. Lash the stringer to the stern piece also, but not to the cockpit deck beam until later.

The forward deck stringer is fitted and lashed in a similar fashion. The forward end may be notched as in photograph D to fit the bow block, or gradually tapered down and lashed as shown in figure 4.

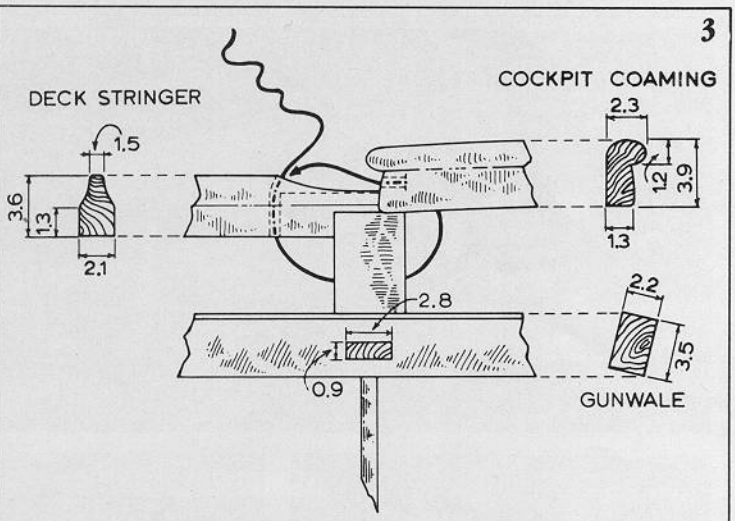
We are now ready to turn the frame upside down on the horses and fit the keelson pieces and ribs. The bow, stern, and middle keelson pieces should already have the rocker (fore and aft curve of the bottom) planed into them as shown on the line drawing. Lash the bow and stern keelsons in place as shown in figures 4 and 2. Also lash the forward end of the middle keelson piece, using a scarph joint as shown in figure 5. The stern keelson piece of the Lowie bidarka has pegs through the lashing holes to make the lashing tighter. Note from the line drawing that the scarph joints in the keelson occur underneath deck beams 2 and 7 and slant in opposite directions. Clamp the after end of the middle keelson against the stern keelson and adjust the two pieces until the distance from the bottom of the gunwales to the inboard side of the keelson at the mid-cockpit area is about 16 centimeters. Hold off cutting the scarf joint until after we've bent and fit the first rib, though.

Bending the ribs may be accomplished in either of two ways. An experienced builder can steam them, then bend and fit them by eye, one by one, so that they are symmetrical and just touch the keelson. Note that the ribs are flat across the bottom. By sighting down the length of the kayak, the ribs can be slowly decreased in size, starting with the center one and working out to the ends.

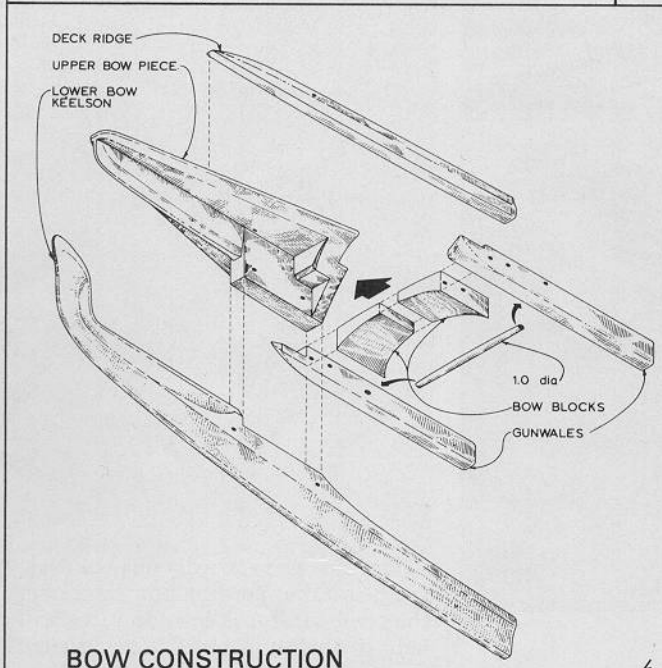
The beginner, however, should bend the ribs around plywood forms as in photograph G. A total of six forms should be made, one for each of stations 2, 6, 8, 9, 10, and 11. To make these, draw each numbered station full size from the table of offsets onto a



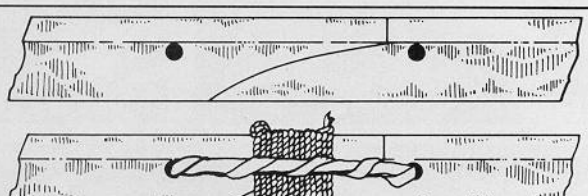
2 STERN CONSTRUCTION



3 DECK BEAM/DECK STRINGER/COAMING LASHING

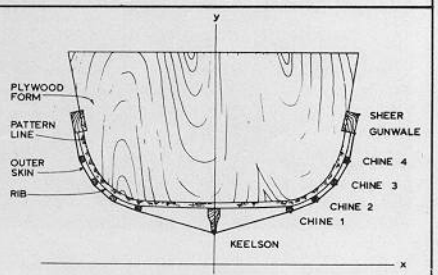


BOW CONSTRUCTION 4


KEELSON SCARF JOINT LASHING


STRINGER SCARF JOINT LASHING 5

STATION 6	X	Y
SHEER	25.8	24.6
GUNWALE	25.2	21.2
CHINE 4	24.0	16.2
CHINE 3	21.8	12.2
CHINE 2	18.2	9.0
CHINE 1	13.6	7.2
KEELSON	0.0	3.3



STATION 6 6

large sheet of cardboard or paper. Figure 6 illustrates the process for station 6. Using the heights above baseline (Y direction) and the half-breadths (X direction), plot the points on both sides of the Y axis and connect them. This corresponds to the shape of the outer skin of the kayak. Now draw in the keelson (2.3 by 4.4 centimeters), the stringers (1.0 by 1.2 centimeters) at the chine points, the gunwales (2.2 by 3.5 centimeters), and lastly, the 1-centimeter-diameter rib. (Be careful to keep the lattermost flat across the bottom.) The inside of this rib is the line to use for cutting out the plywood pattern. Numbering the 43 ribs to be bent from 1 at the bow, this form can be used to bend ribs 19 through 28. The other forms can be used to mold ribs as follows:

Form	Ribs
2	1-3
6	19-28
8	29-33 and 14-18
9	34-38 and 9-13
10	39-41 and 4-8
11	42 and 43

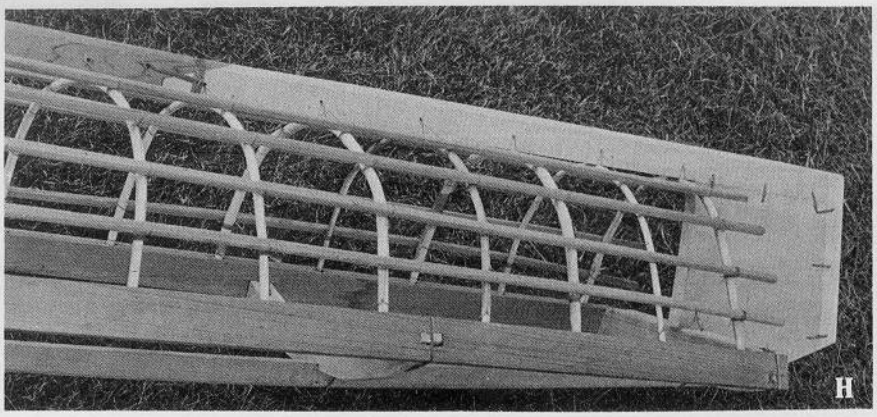
Holes drilled through the points marked photograph G as A, B, C, D, and E may be used to lash the hot ribs down to the form until they cool and dry.

With the kayak frame upside down and level, fit a well-shaped rib from the station-6 form into the gunwale mortises at rib location 24. The rib should just touch the keelson, and the flat part of the rib should be level. Put temporary ties diagonally from each gunwale to the opposite bend of the rib to prevent further movement. This rib is important: it will be used to sight in all the rest.

When all is in adjustment, mark, cut, and lash the last keelson joint under deck beam 7. To prevent further movement of the keelson, lash in some temporary stanchions between it and the deck beams.

Now fit the rest of the ribs, starting with number 23 and working down to number 1, then ribs 25 through 43. Continually sight down the framework as you fit the ribs to check for lumps or hollows. Some irregularities can be corrected with temporary ties, some will require that you fit new ribs.

Once the ribs are all fit and fair, lay four stringers on each side of the keelson. Place tight, temporary lashings in the way of each deck beam, running from gunwale to gunwale over the keelson. Slide the outermost stringer gently over the ribs into its final position. Do this again for each stringer in turn, then sight down the framework to make sure they are symmetrical and fair. Trim the ends of the stringers to the length shown on the line drawing, then check the ribs one more time and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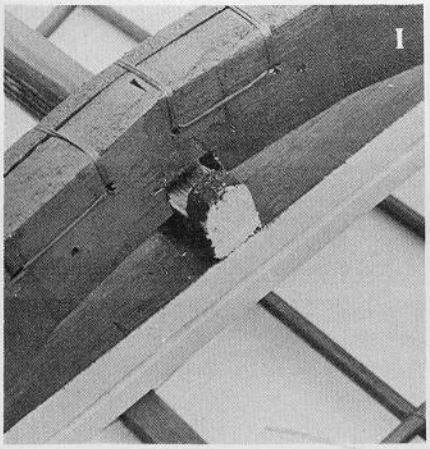
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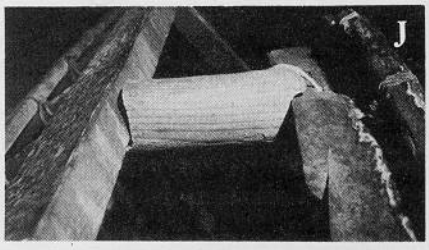
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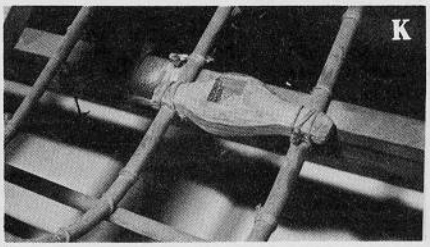
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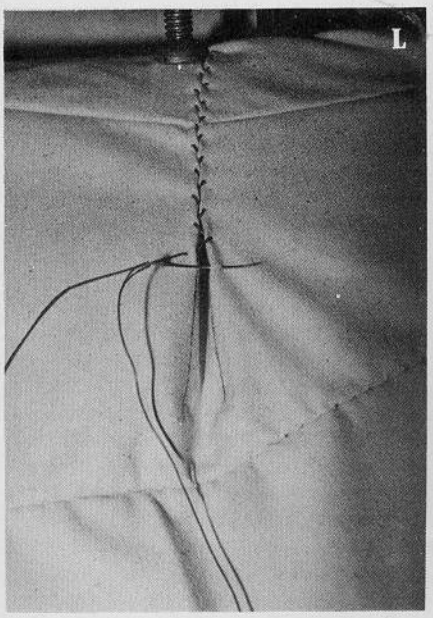
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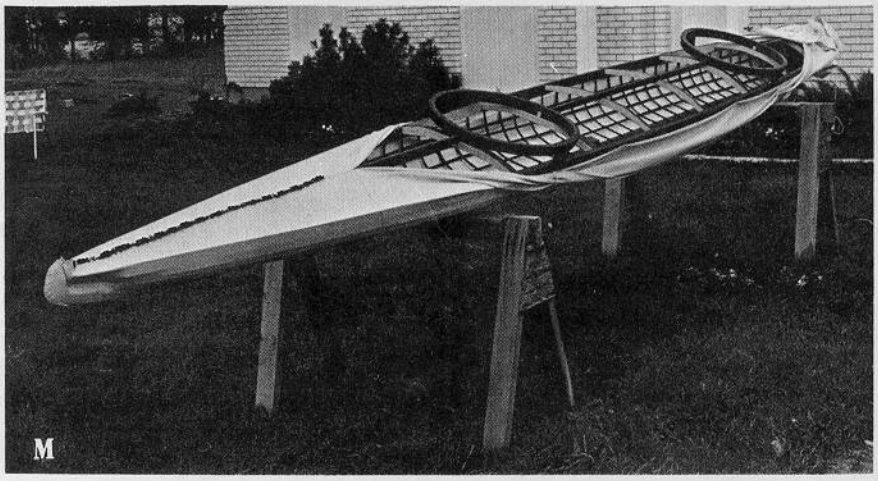

M

replace any that are out of line.

When all is ready, lash the ribs to the stringers and the ribs to the keelson as shown in figure 7. The lashing over the keelson may be either countersunk in a groove or go through a hole drilled in the keelson as in photograph H.

Next, fit the cockpit coaming over the deck stringers. The coaming may butt against the stringers, it may be notched as in photograph I (which is more usual), or both the coaming and the stringer may be notched. Shape the deck stringer to meet the notch in the coaming as shown in figure 3, and drill down through both the coaming and the stringer. The lashing goes under the deck beam; three or four tight turns should be enough.

Fit the coaming stanchions to the gunwales and the coaming as in photograph J. Be sure the coaming is level, then lash the stanchions in place. (The stanchions in this photograph were not original to the kayak and were fitted later by an indifferent craftsman.)

Finally, fit and lash the mast step between ribs 11 and 12 to port of the keelson as shown in photograph K. Congratulations! Your frame is complete.

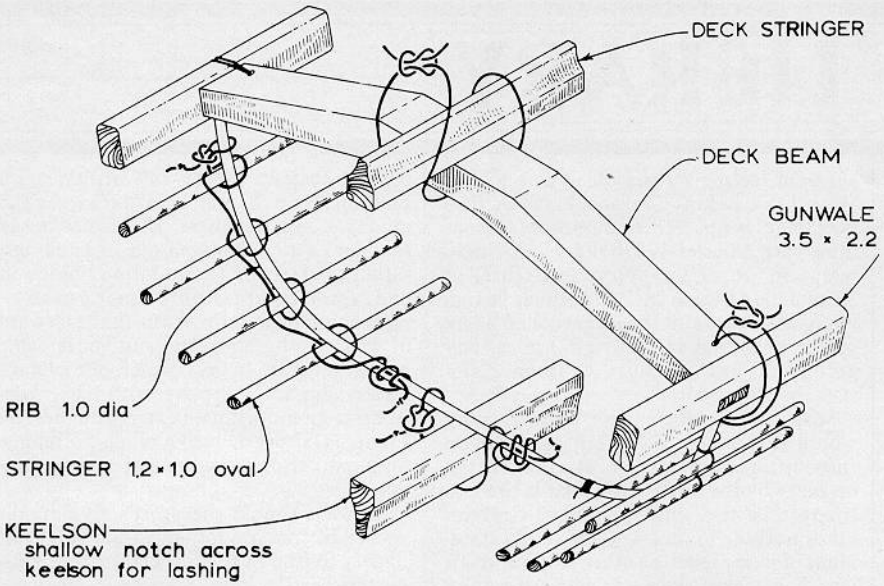
The original kayak was painted all over with a red ochre coloring that was probably made from crushed hematite mixed with water. A clear varnish or polyurethane is probably a better choice today. However, a red-ochre-colored metal primer could also be used.

Covering the frame

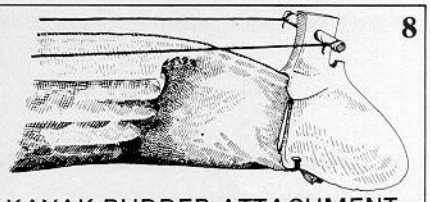
A well-made canvas cover that is properly treated and aired will last many years. One of my own kayaks didn't need a new cover until after eight years of hard use. For the Aleut kayak, you will need six yards of #10 duck canvas that is 60 inches wide. It currently sells for $11.95 (Canadian) per yard. It should be cheaper in the United States.

The canvas is sewn dry on the kayak. I've heard that pouring hot water over the cover after it is sewn in place will help to shrink it, but I've never tried this.

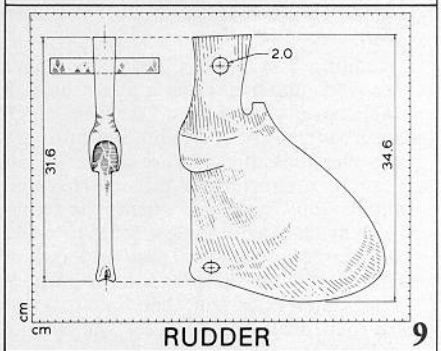
Stretch the canvas lengthwise over the bottom of the frame as much as you can. Bring the ends up over the bow and stern and secure them with lashings, thumb tacks, or both. Allowing for about a 1-inch hem that is turned under, mark for the vertical seam at the very end of the stern. Also allow for a small, round tube extension at the bottom of the stern as shown in figure 8. This is tied shut for use in the water, then untied to act as a drain when the kayak is beached. It also serves as an attachment point for the rudder. Remove the canvas from the stern and sew the stern seam, using a sail needle, palm, and waxed sailmakers thread. The two hemmed sides of the seam should just meet each other snugly. A plain round stitch, or the one shown in photograph L, may be used. This photograph also shows a dart being sewn without cutting the canvas — a good practice to follow whenever



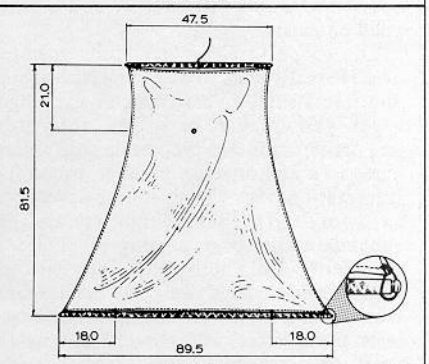
LASHINGS 7



KAYAK RUDDER ATTACHMENT 8



RUDDER 9



SAIL 10

possible as it decreases the possibility of leaks.

Next, mark, trim, and sew around the lower and then the upper bow pieces. Clamps or a temporary lashing may be used in the cockpit area of the kayak to hold the canvas together until it is trimmed and sewn. It's usually best to sew towards the middle from both ends. Keep the seam over the deck stringer, with no seam overlap. Fold the edges under and bring them together tightly. A dart will be necessary in the afterdeck running at a 45-degree angle from each outboard corner forward to the deck stringer. Be certain that the corners of the stern framework have been rounded enough to keep them from tearing through the canvas.

When sewing the forward deck seam, stop when you are just over the mast step. At this point, make a small tube of scrap canvas about 1 inch in diameter and 4 inches long. Sew the tube into the seam so that it is just to port of the deck stringer. This tube forms a sleeve for the mast to pass through to the step. Its design prevents water from going through the deck.

Continue sewing up to the top of the cockpit coaming, then put a tight lashing around the coaming to hold the canvas in place until you've completed the seams. Bring the hemmed canvas over the top of the coaming, but leave it just short of the holes that were drilled to lash on the half-round lip. Sew the canvas to those lashings to prevent stitching on the outside of the coaming, or through the holes themselves.

The cover is complete. A clear silicone sealer may be rubbed into any seams below the waterline.

Paint the outside of the bidarka with two coats of clear dope, the same as is used for covering fabric aircraft wings. It is available from International Paints as Aceto Butyrate Clear Dope/ZE-350003. Any good alkyd enamel paint may be used on top of the dope. The Aleut did not paint designs on the outside of their bidarkas, but they did often incorporate alternating pieces of ¼-inch-long red and black wool into the bow and foredeck seams as shown in photograph M.

Rudders and sails on Aleut bidarkas were not used before the advent of the Russian otter hunters, but afterwards they became quite common. Figure 9 illustrates the rudder that goes with this kayak. The 1-centimeter scale around the edges may be used to redraw the rudder full size. The rudder is attached to the kayak as shown in figure 8, with the two lines tied in an endless loop around the cockpit. The rudder was mostly used as a trim tab to counteract wind and current. Steering was usually done with the paddle.

The kayak in the Lowie Museum did not have a mast, but I estimate that the spar was about 2.0 centimeters in diameter at the base and about 120 centimeters long. A hole was drilled through it about 5 centimeters from the head of the spar to take a halyard. A sail was included with the Lowie bidarka and is shown in figure 10. It is made from light canvas and hemmed on all sides. The 0.7-centimeter eye sewn into the middle of the sail serves some unknown function. Perhaps it was part of a reefing system. The yard tapers from 2.2 centimeters in the middle to 1.4 centimeters at the ends. Another yard (perhaps this should be called a boom?) extends the foot of the sail. Both are painted black. Attach a sheet to each arm of the lower yard, and the sail is ready to go — but only on a reach or a run.

The double-bladed paddle shown on the lines drawing is all that's left to complete your Aleut bidarka outfit. You can make it from a two-by-four with some additional wood edge-glued on to make up the blade width, or you can cut the paddle from a knot-free two-by-six — if you can find one. Note that the blades are ridged on one side only, and are convex on the other.

A sturdy mat or seat made of wooden slats laced together should be used in the cockpit area. Transverse deck lines may be put on to hold an extra paddle or some light gear. Put one just forward of the cockpit, one near the bow, one just abaft the cockpit, and still one more near the stern. Drill holes through the sides of the gunwales about ¾ inch down from the deck where you want the deck lines and knot the line on the inside. Be careful that you don't drill too close to the ends for the bow and stern lines or you won't be able to get to them to tie the knots.

And that's it. Please send me a photograph of your bidarka care of *SBJ* once you've finished it and let me know how you like traditional arctic construction. Good paddling! □