This Old Canoe
How to Restore Your Wood-Canvas Canoe

by Mike Elliott
Photographs by Mike Elliott, James Elliott, Brittany Merry
Illustrations by Mike Elliott
## Contents

Preface ix  
Acknowledgements xi  
Introduction xiii  
1 Getting Ready 3  
2 Assess and Plan 23  
3 Disassembly 33  
4 Gunwales, Stems and Decks 39  
5 Ribs and Planks 61  
6 Seats and Thwarts 73  
7 Canvas 93  
8 Keel and Stem-bands 113  
9 Paint and Varnish 123  
10 Final Assembly 127  
11 Care and Maintenance 137  
12 Restorers’ Guide 147  
Resources 171
Preface

When I was a kid, my father worked for the Canadian government as a forest entomologist (He would always refer to himself as “a real bugger”). Our whole family spent a few summers at forest research stations in north-western Ontario. That is where my father infused us with a love of canoes and canoeing. Over the course of those summers, he and I would hop into a wood-canvas canoe. He took me out on the lake and taught me how to paddle. He had grown up in Peterborough, Ontario and raced cedar strip canoes in the 1930’s. My memories of those summers in northern Ontario include waking up to the sound of warblers singing in the black spruce trees, swimming in the freezing water of those lakes until my lips turned blue and watching the sunset over the lake from my position in the middle of a canvas-covered canoe.

About 36 years later, I had my head positioned inside an old 14’ “Huron” canoe -- my first restoration project -- as I cleaned and scraped the old wood. It was given to me by Richard Reid, a professional artist living in the southern interior of British Columbia. I happened to look up and had a view of the canoe from the centre looking towards the bow. Memories came flooding back to me. This was what I saw when I was six years old -- the same ribs, the same seats, the same canoe. I checked with my father. He was a skilled carpenter and knew those old canoes inside-out. Sure enough, the canoes we used at the research stations were 14’ “Huron” canoes.

In my late teens, I became involved in elite-level sport and immersed myself in that -- for me at least -- neurotic, self-absorbed world. For the next twenty years I competed as both an athlete and a coach on national and international stages. In this environment, I gave little thought to life outside of the gymnasium. Then, I met Christy Luke in 1993 and soon decided to build a new life with her in Grand Forks, British Columbia. Yes, I had to look it up too. It was there that I decided to “get a life” and return to some of the things that brought me joy when I was a kid.

The next summer, as we looked out at the spectacular view from Chateau Lake Louise near Banff, Alberta, I turned to Christy and announced, “I am going to build a canoe and paddle it on this lake.” A few weeks later, Christy bought me a copy of Ted Moore’s *Canoecraft: An Illustrated Guide to Fine Woodstrip Construction*.

At this point, I should mention that I have dyslexia. It can take me up to an hour to read a page in a book. I find the prospect of reading anything to be daunting, unless I am reading something that interests me. I also require some previous background in the topic. Without a context, the words on the page are incomprehensible to me. Fortunately, as I started into *Canoecraft*, I found that Ted Moores included lots of pictures as well as some background information about the original cedar strip canoes. This harkened back to the stories my father told me about racing those canoes in Peterborough.

I poured over the book and soon approached my co-worker Barry Pratt with an idea. We were working with a group of boys who were having a rough time making sense of themselves and their place in the world. One thing I learned during my life in sport was that our worst personal demons can be conquered when there is a something worthwhile at the end of the road.

Barry and I asked the boys if they would like to go on a canoe trip. They were thrilled, but their enthusiasm waned when we told them they were going to build the canoes first. They were sure that the project would never happen and, if it did, the canoes would be
ugly and sink to the bottom of the lake. They asked us if we had ever built canoes before. We held up our copy of Canoecraft and said, “No, but we have a book.” The boys were convinced that the project was doomed.

Five months later, as the boys paddled the finished canoes toward a campsite on Christina Lake in British Columbia, a big power boat cruised up. The men in the boat complimented us on the beautiful canoes. The boys straightened up a little. Was that a sense of pride I saw? Was there even the glimmer of self-esteem shining through? The boys replied, “Thanks, we built them.”

The boys donated the canoes to a local summer camp and became minor celebrities for a time. People around town started to refer to me as “The Canoe Guy”. It was then that Richard Reid gave me his old canoe. When Christy asked me if I had ever restored a canoe before, I said, “No, but I have a book.”

This time, it was a copy of The Wood & Canvas Canoe: A Complete Guide to its History, Construction and Maintenance by Jerry Stelmok and Rollin Thurlow. They devoted one chapter to canoe restoration. It was enough to get me started and once friends-of-friends found out that I knew how to do it, I restored half-a-dozen canoes in as many years.

When I am learning something, it helps me to write about it. Fortunately, the type of dyslexia I am dealing with does not present too many problems when I am writing. In fact, I find it easier to read something when I am the one who wrote it. It also helps if I teach others while I am learning.

I helped write coaching manuals as I studied to become a professional coach. So, as I learned to restore old canoes, I kept detailed notes with a view to writing a canoe restoration manual some day. Although Stelmok and Thurlow’s book was helpful, many of the situations I encountered were not addressed. By the time I started Kettle River Canoes in 2003, I had a notebook full of information that was not available in any book. The first thing I did to market my business was to post articles about canoe restoration on my website. I gave detailed instructions on some of the key aspects of the restoration process. Barry, my former co-worker, who had many years of experience in business and advertising, was appalled by my generosity. For him, I was giving away my business. He asked me why I wasn’t giving away my tools too. For me, I was learning my craft and if I could help others learn at the same time, it was an added bonus. Once a coach, always a coach.

I started writing a blog about wood-canvas canoe restoration in 2009. My niece, Kristen Luke, was launching her business as a marketing consultant specializing in social media. She needed someone to practise on, so I was it. What astonished Kristen was the fact that I did everything she told me to do. The result is here in the following pages. This Old Canoe: How To Restore Your Wood-Canvas Canoe contains a lot of the information I shared in the blog as well as other descriptions, illustrations and photographs not published anywhere else. When Barry asks me if I am going to share all of my canoe restoration secrets, I will say, “Yes, I have a book.”

Mike Elliott
Grand Forks, British Columbia
There is something special about wood-canvas canoes. Indeed, if you are reading this book, you are doing so because you probably grew up in canvas-covered canoes. You paddled them at summer camps; your grandfather taught you how to fish in them; your family shared wilderness adventures made possible by your faithful, old canoe. It is part of the family. The connection is hard to put into words but is as strong as any other family relationship.

These canoes have an elegance born in nature and are shaped by the elements that surround them. They are as beautiful as they are functional. They seem to move and breathe as part of the environment – part of you. However, in the latter part of the 20th century, aluminum and fiberglass canoes flooded the market along with their low-cost production methods. They pushed their labour-intensive canvas-covered cousins into obscurity. But family ties are strong. When a wood-canvas canoe becomes old and battered, it is carefully tucked away in the back of a shed or in the rafters of a barn. For whatever reason, most people who own wood-canvas canoes are loathe to part with them. What strikes me is that they were designed, from the outset, to be repaired and restored to their former glory.
Unfortunately, the methods and skills required for canoe restoration are from a by-gone age. In the pages that follow, my goal is not only to help you restore your canoe, but to help preserve the skills that make it possible.

This book provides the specific knowledge and techniques required to transform your old, rotten, forgotten canoe into a treasured family heirloom that can bring delight to you and others for decades to come.

**Built to be Rebuilt**

Your wood-canvas canoe is held together (almost exclusively) with tacks, screws and bolts. In fact, many have no glue in them at all. Consequently, any component that rots or breaks can be repaired or replaced. Once you understand the basic principles governing the behavior of wood and canvas, you will be able to rebuild your canoe.

Many years ago, my friend Richard Reid and I crawled under the back deck of his home in Christina Lake, BC to retrieve his canoe. He had not looked at it for almost 20 years and had no plans to use it again. My wife, Christy, looked at it doubtfully once we had it out on the lawn. Moss had grown a couple of inches thick and was hanging off the gunwales. Mice had chewed away the rawhide lacing in the seats as well as the better part of a couple of ribs. “Do you know how to fix it?” she asked. I smiled at her. We both knew that my woodworking skills were limited to say the least. In this, my first canoe restoration, I followed the adage: “When there is a will, there is a way”. At the time, the only power tools I owned were a variable speed drill and a random-orbital sander. As it turns out, the main advantage I had was the fact that I didn’t know what I was doing. All I knew for certain was that I wanted to bring this canoe back to life.

As my experience grew from weekend hobby to full-time business, I have collected more power tools and a wide assortment of specialized jigs and forms. Even so, there is one thing that is required above all else. It ensures the success of a restoration. Without it, you are doomed before you begin. A little Zen story will illustrate my point.

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**Zen in the Art of Canoe Restoration**

A Zen master and his student were walking together across a bridge when the student asked, “Master, what is Zen?” Before the student had a chance to react, the Zen master picked him up and threw him off the bridge into the river below.

Zen is the moment – right here, right now. Zen masters have written thousands of books in an attempt to explain the unexplainable. As the student hurtled through the air towards the water in the river, he was totally consumed in the moment. No past – no future – just now.

So, what does this have to do with wood-canvas canoes? I have found that a successful canoe restoration demands a mind and body that work together in the present moment. As soon as I rush things, I make mistakes and have to start all over again. As soon as I think of myself as the expert, I find something I’ve never come across before. As soon as I think the task is simple, I get bogged down in complex problems. As soon as I obsess over technical aspects and try to think my way through them, everything grinds to a halt in a mass of frustration. And the more I try to get out of my head and get back to “the moment”, the worse the frustrations become.

For me, a canoe restoration is an opportunity to immerse myself in the moment – now and now and now and now. When I succeed, the hammer drives the tacks straight into the wood – almost by itself. The hot, steamed wood bends to hug the canoe in a warm embrace. The work flows and I lose track of time.

However, as soon as I try to take credit for the accomplishment or repeat the masterful actions of the past, everything goes wrong. I bend a new rib over the canoe only to find that it is upside-down and has to be thrown away. The air of the shop is filled with my not-so-quiet curses.

In those moments, I endeavor to see the cloud of frustration as a gift. Sometimes at least, I am able to catch myself and laugh.
at the situation and – with any luck – laugh at my approach to it. I take a deep breath and shake my head. Instead of trying to change the situation, I revel in the fact that I am feeling frustrated. I practice learning how to accept the experience for what it is. When I succeed in truly embracing it – and myself – just the way it is right now, things tend to turn around. Paradoxically, as soon as I try to hold onto my feelings of frustration, they vanish and the rest of the day tends to flow a little more smoothly.

**Perfection is Impossible**

When it comes right down to it, you are not working *on* your old wood-canvas canoe, you are working *with* it. You and your canoe are active partners in search of a successful conclusion. You must listen to your canoe and accept its strengths and limitations. The minute you try to force the issue, your canoe will remind you who is in charge. Let your mind wander and your canoe will shake you back to reality. Think for a moment that you know what you are doing and your canoe will show you otherwise.

There will be times when you want one thing and your canoe simply has something else in mind. You must be prepared for situations where things don’t go as planned. The fact is, when things work out the first time, it will be the exception rather than the rule.

Mistakes are the engine of learning and mastery. Indeed, in order to allow your body to learn anything, you must give it permission to screw up. However, you are starting down a particularly challenging path. A friend of mine, a master carpenter with 25 years experience, ran from the room a few hours into a canoe restoration and wished me luck on my crazy adventure.

Your canoe may have been made in a factory as one of thousands in the production line. However, after four or five decades, it is unique. The lines are no longer completely fair. The wood is no longer smooth and even. Abraham Lincoln said, “Every man over forty is responsible for his face.” So too, the life of your canoe is written in every crack and warp in its venerable hull.

I use a lot of photographs to illustrate the techniques I describe in this book. Bear in mind that I have the luxury of selection. If I were to illustrate the mistakes as well as the successes, this book would be a twenty volume set.

My hope is that by presenting some of my successes and alerting you to some of the pitfalls, your canoe restoration will be rewarding, enjoyable and successful.

**How To Use This Book**

Rebuilding an old canoe is a completely different enterprise from that of building a brand new one and requires an altogether different mindset. This book is set up in a step-wise manner to help you through the entire process. The chapters are arranged in the same order you would follow in the actual restoration. The key to success is to pull your old canoe out of the shed and get to work. This book is meant to be used in the shop as you work on your canoe. Feel free to write notes in the margins. Indeed, I have provided a few pages at the back of the book for your own notes about canoe restoration procedures.

This book presents one approach to the restoration of wood-canvas canoes. I’m sure you have other ideas that work better than those discussed here. My hope is that this book provides you with a good foundation for further refinements to the process.
Chapter 1 discusses the equipment and materials required to do your project as well as a basic understanding of the wood-canvas canoe. Chapter 2 takes you through the process of assessing your canoe and planning the restoration. The restoration begins in Chapter 3 by exploring how to take your canoe apart. Chapter 4 starts the process of rebuilding your canoe by making or repairing the inwales, outwales, stems and decks. This work often involves bending wood, so that process is described in this chapter as well. The hull is restored in Chapter 5 by making or repairing ribs and planks. Seats and thwarts are discussed in Chapter 6. Chapter 7 explains how to replace the old canvas with a new one. Then, the canvas is filled, so I discuss some options for that. The chapter ends with a discussion of some alternatives to canvas. The process of making and installing a new keel and stem-bands is explored in Chapter 8. Paint and varnish are applied in Chapter 9 followed by the final assembly and finishing details in Chapter 10.

A canoe is not fully restored until you are able to transport it safely, store it correctly and deal with minor mishaps when they occur. All of this is presented in Chapter 11. Chapter 12 provides technical dimensions for a variety of specific canoes that are each representative of many other makes and models. The book concludes with a list of resources to help make your canoe restoration a success.

The Devil is in the Details
Wood-canvas canoes are constructed with time-honoured methods and materials. However, “the devil is in the details” and it is those details that I explore in this book. Enjoy.
Now that you have decided to restore your old canoe, there are a few things you must have in order to do the job. I will start by introducing some vocabulary. You will need to know basic canoe terminology so that you can understand the parts of your canoe and follow the directions in this book. Then, I’ll discuss some of the tools, supplies and materials required for each phase of the restoration. Right now, let’s look at the parts of the canoe and some basic design features.

Anatomy of Your Canoe
In general terms, a canoe is a vessel in which the paddlers are facing the same direction as they are traveling. This allows them to see what is ahead. This is critical when navigating fast-moving water flowing over and around a variety of obstacles (such as rocks, boulders and ledges). The canoe has to move just as easily backwards as forwards. Therefore, it is symmetrical – the front half is exactly the same shape as the back half.

For the canoe restorer, a symmetrical hull is extremely helpful when faced with the task of rebuilding a broken hull. As long as you have half the canoe (more or less), you can rebuild the entire thing.
It is useful to know some basic nautical terms.

**Bow**
The front end of the canoe is called the bow.

**Stern**
The back end of the canoe is called the stern.

**Amidships**
The centre of the canoe is referred to as both the centre and amidships.

**Starboard**
When in the canoe facing the bow, the right side is called the starboard side.

**Port**
When in the canoe facing the bow, the left side is the port side.

Other terms are used to describe the shape of the canoe. These will come into play as specific canoe designs are discussed (especially in Chapter 12). However, I will mention a few terms now that will come up a number of times in this book.

**Sheer-Line**
The top-edge of the canoe is called the sheer-line and is delineated by the inwales and outwales (known collectively as the gunwales).

**Chine**
The point at which the bottom of the canoe transitions into the sides is called the chine.

**Keel**
The piece of wood fastened to the bottom of the canoe along the centre-line is the keel.

**Rocker**
The degree to which the ends of the canoe lift up beyond the bottom amidships is known as rocker.

Looking down the length of the canoe from one end to the other, the shape of the hull can change. The sides can be shaped in one of three ways.

**Straight**
If the sides are aligned vertically, they are called straight sides.

**Flare**
If the sides are angled away from the centre-line as they travel from the bottom to the sheer-line, they are said to flare.

**Tumblehome**
If the sides of the canoe curve back towards the centreline as they travel from the bottom to the sheer-line, they are said to have tumblehome.
Work Space
It is not necessary to have a work shop in order to restore a canoe. All that is required is a space long enough for the canoe plus another 7’ (2 meters) or so. The width of the work space need only be enough to allow you access to at least one side at a time. I restored my first canoe in my basement. The space was 8 meters long and 2 meters wide (plus a work bench).

The carport is often the workshop of choice when a dedicated space is not available. While it would be nice to have a heated space to allow work on the canoe over the winter, it is not essential. It is important to bear in mind that most of the finishes used in a canoe restoration are linseed oil-based. As a result, they need at least 10°C (50°F) to dry. The same thing applies for the glues and fillers.

For canoe restoration, floor space is more important than bench space. When I started my canoe restoration business, I didn’t have a permanent work bench. Instead, I used a variety of surfaces that could fold up and be stored away when not required. I used a large, heavy folding table, a Black and Decker Workmate® and two ironing boards (all purchased at garage sales for $5 each). The ironing boards are old heavy-duty steel monsters that date back to the 1960’s. They are used to support long length boards being fed onto the table saw. They also serve as portable tables whenever I am using a number of tools and fasteners. I set up an ironing board and a supply of fasteners on each side of the canoe. The height of the ironing board can be adjusted to allow easy access to tools that are being constantly picked up and set down again. Having the tools within inches of the work makes everything quicker and less tiring.

More recently, I have acquired a steel audio visual cart for the shop. Not so long ago, institutions and schools moved television sets and VCRs from room to room on sturdy steel carts. The TV sets were massive, heavy brutes, so the carts were built to last. In the canoe shop, they make wonderful rolling tool carts. They have large, heavy-duty wheels and are also equipped with a built-in power bar and long extension cord. These carts are no longer required in schools and often collect dust in the back corner of a storage warehouse. If you can get your hands on one, these carts are very useful in the canoe restoration shop (and elsewhere). They take up a bit of room on the floor, but you will find that you use it almost every day.
Safety Equipment
You will need some basic safety equipment to protect your body from head to toe:

1. respirator mask
2. safety glasses or goggles
3. hearing protection
4. work gloves
5. neoprene gloves
6. vinyl gloves

Besides the items shown, you will require a pair of coveralls or a workshop apron. My fingerless work gloves have padded leather on the palms for vibration protection. Neoprene gloves protect when working with chemical strippers and boiling water or steam. Vinyl gloves protect when applying finishes.

In addition to the personal protective equipment, be sure to outfit your shop or work space with a first aid kit, fire extinguisher (ABC type), smoke alarm and proper ventilation/dust collection.
Canoe Cradles

I can still hear my dad telling us as kids, “The bottom of this canoe touches two things: air and water.” Once restored, it is important to keep your old canoe off the ground between uses. You will also need some way of supporting it while you work on it. One of the most convenient systems is a pair of canoe cradles.

They are quick and simple to build and can be stored easily when not in use. They are also essential tools when repairing or refurbishing your canoe. Each one consists of two vertical struts, two base struts, two horizontal brace struts, two sling clamps and a cradle sling.

The dimensions of the cradle can vary, but all you need to build a pair of cradles are:

- 4 – 8’ 2x4’s (spruce)
- 2½” deck screws
- 2 strips of material 3½” wide for the slings (I use pieces of carpet or scraps of canoe canvas.)

As far as dimensions are concerned, they depend on you and your needs. Since I am 6’3” (191 cm) tall, I use cradles that are 32” (80 cm) high. My shop apprentice is 5’ 3” (160 cm) tall, so she uses cradles 24” (60 cm) high. All of the horizontal brace struts are 28” (70 cm) wide. The base struts are 24” (60 cm) long. The sling material is about 50” (127 cm) long. The clamps are scrap pieces used to hold the sling material to the vertical struts. These can be about 6” long.

To build a cradle, start by creating the sides. They each consist of a 24” (60 cm) base strut attached to one end of a 28” (70 cm) vertical strut to form a T-shape. Next, the 28” (70 cm) bottom brace strut is attached between the two sides and the 28” (70 cm) upper brace strut positioned somewhere in the middle of the vertical strut.

I take a minute to round-off the inside corners of the vertical struts. Otherwise, the sling material wears out quickly and has to be replaced frequently. I use an angle grinder and 24-grit sandpaper to round the corners, but the same job can be done with a rasp and a little elbow-grease.

Construction of the cradle is completed by attaching the sling by means of the clamps. The whole process takes the better part of an hour for both cradles. If you want to pretty them up a bit, the struts can be rounded off and sanded smooth. Any cradles that are going to spend a lot of time outside are finished with an opaque oil-based stain to protect the wood.
A Homemade Mallet

A wooden mallet is used for a wide variety of tasks in a canoe restoration. I call mine “The Persuader” because it helps release seats from corroded carriage bolts with a little persuasion.

It is possible to buy a wooden mallet new or find one at a garage sale. However, making your own provides an opportunity to practice using tools and techniques that will be used throughout the restoration project.

I made mine from a piece of 5/4 birch (refer to page 13 for an explanation of this jargon). Actually, any dense hardwood approximately 1 1/4” (32 mm) thick and 3 1/2” (89 mm) wide will make a fine mallet. Start with a piece of hardwood about 12” (30 cm) long and mark out a handle that is about half the total length. Make the width of the handle roughly the same as the thickness.

Carve the handle by first shaving the corners to create an eight-sided handle. I find that the handle is most comfortable when the body of the handle has a smaller diameter than the end. Shave each of the eight corners to create a sixteen-sided handle. Smooth the remaining corners to create a round handle (more or less). All of this is a matter of personal preference. Once the handle feels comfortable in your hand, use some 60-grit sandpaper to smooth any ragged edges. Continue sanding in progressions from 80-grit to 220-grit to create a smooth handle. Wet the handle to raise the grain and let it dry. Hand sand in progressions from 320-grit to 600-grit. Protect the wood with a mixture of two parts double boiled linseed oil and one part turpentine. There is no need to apply varnish.
Sheer-Line Gauge

The outwales of most canoes fit flush with the top of the inwales. Consequently, the top edge of the sheer-line planks must be cut away. This is explained in more detail in Chapter 5.

They are cut to expose approximately \( \frac{1}{2} \)” (13 mm) of the rib-tops. This can certainly be done by eye, but a simple gauge makes the job much easier. It takes a few minutes to make this gauge. Most of the dimensions are not critical.

However, it is critical that the distance from the sheer-line edge of the gauge to the pencil point is \( \frac{1}{2} \)” (13 mm). Check and recheck before you drill the hole.

I drill a \( \frac{3}{8} \)” (9.5 mm) diameter hole for a standard pencil which has a \( \frac{1}{4} \)” (6.5 mm) diameter. I wrap some plastic electrician’s tape around the pencil until I have a snug fit in the gauge.

(Above) A simple gauge is made to mark the top-edge of planking along the sheer-line.

(Left) The sheer-line gauge marks a line about \( \frac{1}{2} \)” below the top of the ribs. The planks are cut along the line to expose the top \( \frac{1}{2} \)” of the ribs.

(Bottom) Dimensions for a sheer-line gauge.
Canoe Tack Hammer

It always helps to have the best tools for the job. Anyone restoring wooden canoes spends a lot of time hammering tacks into soft cedar. Therefore, the hammer needs to drive tacks quickly and easily without damaging the wood. I checked with the Canadian Canoe Museum as well as the Wooden Canoe Heritage Association and learned that the old-time canoe builders selected a hammer with a wide domed face. This allowed the builder to pound away on soft cedar all day without leaving any marks. Some of the old-time canoe builders forged their own hammer heads, but what they produced was essentially a cobbler’s hammer. So, I went on-line and bought one on eBay for about $20.

The face is huge — 1-3/8” (35 mm) compared to the 7/8” (22 mm) face of the previous tack hammer I bought at the hardware store. It is also heavier — 13 ounces (364 grams) compared to 10 ounces (280 grams) for the other hammer. The additional weight drives the brass canoe tacks quickly without creating fatigue after driving several hundred tacks.

The domed face creates a “sweet spot” for effective hammering. If the tack is struck near the edge of the hammer’s face, the tack bends over to one side. However, with several months of practice over the course of the restoration, you will be driving tacks cleanly with only three or four hammer strokes. Soft cedar planks are left with only the slightest of impressions on the wood. You can hardly tell you’ve been hitting them with a hammer.

(Right) A cobbler’s hammer (right) is quite different from a regular tack hammer (left).
**Clinching Irons**

A tack hammer may be essential, but it is useless without a clinching iron. As the old song goes, “You can’t have one without the other.”

The traditional clinching iron for canoe restoration has a variety of curved surfaces that conform to most of the curves on the inside of your canoe. It weighs about 3.5 pounds (1.6 kg) and is 2” (51 mm) wide. The iron will cover the full width of most ribs. It can get heavy over the course of a day of tacking. However, the hole in the centre turns an otherwise unwieldy chunk of metal into a handy tool.

The traditional clinching iron does an excellent job in most situations, but it is often too large to get into the narrow confines at the ends of the canoe. While tackling my first canoe restoration, I used a small axe head and have used it ever since.

While the traditional clinching iron is beautifully designed, it is not the easiest thing to find. I restored several dozen canoes before getting a *bona fide* canoe clinching iron from Northwoods Canoe Co. in Atkinson, Maine. Until then I managed very well with a set of auto-body “dollies” available at any automotive supply shop. They often come in a set along with a variety of auto-body hammers which can serve well enough for driving canoe tacks until you acquire a cobbler’s hammer.

The technique of clinching canoe tacks takes time to develop into smooth, efficient movements. The tack is pushed into the cedar plank on the outside of the canoe with your “hammering” (dominant) hand while the iron is positioned on the rib directly opposite with your “clinching” (non-dominant) hand.

Check to make sure the clinching iron is in full contact with the rib and properly positioned to meet the tack. Drive the tack with authority until the head of the tack is flush with the plank. Raise the iron and run a finger over the wood at the spot where the tack came through the rib. Check to make sure the tack is not “proud” – raised above the rib. If you can feel the tack above the wood, the iron was not in full contact with the rib at the point where the tack came through. Reposition the iron and give the head of the tack another hit with the hammer. Raise the iron again and do another check.

Positioning of the iron is crucial to getting a proper “clinch” in the tack. When driving tacks on the bottom of the canoe, it helps to have an assistant holding the iron while you tack. Communicate with each other to make sure you are both working at the same location on the same rib at the same time. It takes time to develop a comfortable rhythm. Usually by the time you have your technique down, the project is completed. Nonetheless, it is a satisfying activity when things are going well. On the other hand, be prepared for lots of frustrations and keep your tack remover close by to pull out bent tacks.
Planking Gauge

As mentioned earlier, the curve of the hull where it transitions from the bottom to the side is called the chine. The planks in this area are tapered to fit the space that is roughly in the shape of a football. Replacing them requires precise measurement.

One end of the planking gauge is bent to form a right-angled hook. Place this hook to grab the tapered side of the space where the new piece of planking will fit. Place the new plank into the space with one edge sitting flush along the non-tapered side of the hole. The other edge of the plank overlaps the space and needs to be cut to fit precisely into the hole. The gauge holds the excess plank in the “U-pocket” of the tool with the notched end on top.

Run a pencil line along the edge of the notch to mark the position of the tapered edge of the plank. Move along the tapered edge of the hole to mark at regular intervals until you have travelled the full-length.

Remove the new plank and use a straight edge to join the marks into a line that describes the tapered edge of the plank. Cut along the line with a utility knife to create the desired piece. It is a good idea to cut a little outside the line and shave it off as necessary until the new piece is an exact fit. It takes less time to mark and cut the new plank than it does to explain how to use the gauge.
**Wood**

Most people prefer to end up with their canoe looking exactly like it was when it was built many decades earlier. Usually, this involves using the same woods that were used in the original construction. In some cases this is not possible. For example, all-wood cedar strip canoes built in the early 1900’s have ribs made of rock elm which is now close to extinction. Other woods are hard to come by. An example of this, is cedar.

Without a doubt, eastern white cedar (*Thuja occidentalis*) is the best wood for canoe construction. It is light, strong, resists rot and bends beautifully when soaked and steamed. In addition, it does not split when brass canoe tacks are driven into it to hold planking to ribs. When it comes time for the canoe restorer to remove tacks from 40-year-old white cedar, very little damage results.

By comparison, western red cedar (*Thuja plicata*) is more prone to splitting when canoe tacks are driven into it and older planking breaks more easily when tacks are removed from it. It resists rot and bends well – although not as well as eastern white cedar.

For many wood-canvas canoes, eastern white cedar was the only wood used to construct the hulls. However, as the supply of good quality white cedar became harder to come by in the late 1960’s and early 1970’s, many companies turned to the abundant supplies of western red cedar for the planking of their canoes. Bill Greenwood, who built canoes in Richmond, BC from 1934 to 1975, used western red cedar exclusively for the planking in his canoes.

As a canoe restorer in British Columbia, I use western red cedar for my repair work. It is abundant, reasonably priced and I can get it custom-milled locally. The difficulty is getting wood with perfectly straight grain. It is the main reason I get my wood custom-milled. It matches very well to the older wood in the rest of the hull. I always have to stain new wood to darken it to match the original wood. In the end, it is difficult to tell which ribs are the originals and which are the replacements.

It is interesting to note that Bill Greenwood used sitka spruce (*Picea sitchensis*) for the ribs of his canoes. At the time he was building, sitka spruce was widely available on the west coast of British Columbia. Now, it is very expensive and much harder to come by, so I use western red cedar to replace broken ribs in Greenwood canoes. I suppose the purist would have a hard time with this type of substitution. Essentially, it comes down to a choice on your part.

In some cases, authenticity gives way to practical considerations. You may decide that the original wood was not the best choice for a particular component in your canoe. I have replaced original decks made of western red cedar (in Richardson canoes) with hardwood (such as oak) to create a stronger, more durable canoe. I have also replaced original oak decks with birds-eye maple because I happened to have a scrap piece left over from another project and liked the idea of making the canoe a little prettier.

When you go to the lumberyard, there is a piece of wood jargon that comes in handy when making your order (in North America). The thickness of the boards is measured in quarters so that “four-quarters maple” refers to a maple board that is 1” (25 mm) thick (4 x 1/4”). This is written as 4/4 maple. So, 5/4 birch refers to a board of birch that is 1-1/4” thick. The actual thickness of the board depends on whether or not the board is rough or planed, so be sure to ask about that as well.
Adhesives

Adhesives and wood fillers play a limited role in the restoration of your wood-canvas canoe. I suppose the true purist would not use them at all. However, I find they come handy for some tasks.

In general, adhesives are used for repairing the rotted ends of inwales, outwales or stem-tops. New wood is joined to the original wood with a scarf joint. The joint is held with waterproof glue. This limits your choices.

When joining hardwood (such as inwales and outwales), polyurethane glues reign supreme. They hold very well, fill gaps and sand smooth. I use a polyurethane glue for most of my hardwood joints. Follow the directions on the container. It is, essentially, expandable foam. The moistened wood activates the glue which then foams up and sets in a few hours. Let it cure overnight before sanding.

Clean up is best done with a little lacquer thinner on a rag. I do not use this glue on cedar joints. To secure scarf joints in cedar (usually in rib-top repairs), I use resorcinol glues. They are water-based and yet are waterproof. They set up in about 24 hours. Resorcinol glues bond very well, clean up with a damp rag and sand beautifully once cured. I use either Dural Marine Glue (comes in powder form that you mix with water prior to use) or Elmer’s Waterproof Wood Glue (comes in a pre-mixed bottle). If you ask the people at the hardware store for resorcinol glue, they just stare at you blankly. Just look for a water-based waterproof glue.

Any holes or gouges in original planking (created in the process of rebuilding stem-ends or replacing ribs) can be filled with an exterior-grade wood filler. I use Lepage Wood Filler. It is economical, sets up in a few hours, sands easily and creates a smooth surface prior to re-canvassing.

Sometimes the original wood is left weakened by holes and gouges. These are repaired in a two-step process. First, the wood is painted with a wood hardener. It penetrates deep and sets up in about 24 hours at room temperature to stabilize the original wood. There are a number of products on the market and each is handled differently. Some are water-based while others are epoxy products. The second step is to fill the holes and gouges with a two-part epoxy putty. This product usually comes in the form of a cylinder with the resin at its core surrounded by an outer layer of hardener. Pinch off as much as you need, then knead the two parts together until they are mixed evenly. You have about an hour of working time before the putty begins to set and harden. The hardened putty sands easily and accepts stain. This process of wood stabilizing and filling also works well on the original stems to fill holes left by tacks used in the previous canvas job.
**Fasteners**

Wood-canvas canoes are held together, almost exclusively, with tacks, screws and bolts. Therefore, selecting the correct fasteners for the canoe is an essential part of a successful canoe restoration.

**Canoe Tacks**

It is impossible to talk about wood-canvas canoes without talking about canoe tacks. They are made of either copper or brass and are specifically designed for holding a canoe together – narrow, four-sided and tapered to a needle-sharp point. This shape allows them to be driven into cedar without splitting the wood.

The head of a canoe tack is small and often slightly domed. When it is driven into the wood, the bulk of the head is buried below the surface.

<table>
<thead>
<tr>
<th>Length (inches)</th>
<th>Length (mm)</th>
<th>Use of the tack in the canoe</th>
</tr>
</thead>
<tbody>
<tr>
<td>5/8</td>
<td>16</td>
<td>To secure stretched canvas at the stems.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>To attach planks to the stems.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>To clinch 5/32&quot; (4 mm) planks and 5/32&quot; (4 mm) ribs together.</td>
</tr>
<tr>
<td>3/4</td>
<td>19</td>
<td>To clinch 5/32&quot; (4 mm) planks and 5/16&quot; (8 mm) ribs together.</td>
</tr>
<tr>
<td>7/8</td>
<td>22</td>
<td>To clinch 5/32&quot; (4 mm) planks and 3/8&quot; (10 mm) ribs together.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>To attach rib-tops to inwales.</td>
</tr>
</tbody>
</table>

**Flat-head wood screws**

These screws are used to attach a variety of components in the canoe. In the United States, slotted screws are used almost exclusively while Canadian builders tended to prefer Robertson (square-drive) screws. In the old days, the screws were made of heavy naval brass (69% copper, 1% tin and 30% zinc). The addition of tin in the alloy helped prevent the loss of zinc when exposed to salt-water for extended periods. You can reuse the original screws from the canoe or buy screws made of silicon bronze.
### Use of the Screw in the Canoe

<table>
<thead>
<tr>
<th>Size</th>
<th>Length (inches)</th>
<th>Length (mm)</th>
<th>Use of the Screw in the Canoe</th>
</tr>
</thead>
<tbody>
<tr>
<td>#4</td>
<td>¾ &amp; 1</td>
<td>19 &amp; 25</td>
<td>Secures stem-bands (3/8” wide) to the stems.</td>
</tr>
<tr>
<td>#6</td>
<td>¾ &amp; 1</td>
<td>19 &amp; 25</td>
<td>Secures stem-bands (1/2” wide) to the stems.</td>
</tr>
<tr>
<td>#6</td>
<td>1</td>
<td>25</td>
<td>Secures the keel to the centre-line of the canoe (with #6 finish washers).</td>
</tr>
<tr>
<td>#8</td>
<td>1½</td>
<td>37</td>
<td>Secures the outwales to the sheer-line of the canoe.</td>
</tr>
<tr>
<td>#8</td>
<td>1¼</td>
<td>44</td>
<td>Secures the decks to the ends of the canoe.</td>
</tr>
</tbody>
</table>

### Carriage bolts

These bolts are used to attach thwarts and seats to the inwales of the canoe. Most of the original bolts I have come across were made of galvanized steel. These tend to corrode over time, so I opt for carriage bolts made of silicon bronze. The size of the bolts is unique to canoes. Therefore, 3/16” or #10-24 (4.8 mm) silicon bronze carriage bolts are commonly referred to as “canoe bolts”. It should be noted that the Old Town Canoe Company uses its own style of bolt. It is a 7/32” or #12-24 (5.5 mm) brass carriage bolt with a diamond-shaped head.

### Use of the Carriage Bolt in the Canoe

<table>
<thead>
<tr>
<th>Length (inches)</th>
<th>Length (cm)</th>
<th>Use of the Carriage Bolt in the Canoe</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>5</td>
<td>Secures the thwarts to the inwales.</td>
</tr>
<tr>
<td>4</td>
<td>10</td>
<td>Secures the seats to the inwales (with wood spacers) to hang about ¾” (22 mm) or 1¼” (44 mm) below the inwales.</td>
</tr>
<tr>
<td>6</td>
<td>15</td>
<td>Secures the seats to the inwales (with wood spacers) to hang about 2¾” (70 mm) or 3¼” (95 mm) below the inwales.</td>
</tr>
</tbody>
</table>
Nails
Non-corrosive fasteners (brass, bronze, copper) are essential in wood-canvas canoes. Years of exposure to water tend to corrode ferrous (steel) fasteners and result in the canoe falling apart. Alternatively, corroded ferrous fasteners become fixed in place over time. It is very difficult to remove these fasteners, so please be kind to the next person who restores your canoe and use non-ferrous fasteners.

You may notice that there are a number of options for attaching the rib-tops to the inwales. Copper common nails are the most authentic but are very soft and tend to bend even after pre-drilling. Bronze annular ring nails are very good but have to be pre-drilled. My own preference in original inwales is a 7/8” (22 mm) canoe tack. They drive easily and do not require pre-drilling. When driving nails into new ash inwales, I often have to pre-drill and use bronze annular ring nails.

<table>
<thead>
<tr>
<th>Gauge</th>
<th>Length (inches)</th>
<th>Length (mm)</th>
<th>Metal</th>
<th>Use of the Nail in the Canoe</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>7/8</td>
<td>22</td>
<td>brass</td>
<td>These finish nails secure the gunwale-caps to the inwales in “Huron” canoes.</td>
</tr>
<tr>
<td>14</td>
<td>7/8</td>
<td>22</td>
<td>bronze</td>
<td>These annular ring nails secure the rib-tops to the inwales (pre-drilled).</td>
</tr>
<tr>
<td>14</td>
<td>7/8</td>
<td>22</td>
<td>copper</td>
<td>These common nails secure the rib-tops to the inwales (pre-drilled).</td>
</tr>
</tbody>
</table>

(Below) Non-corrosive nails (from left to right: silicon bronze, brass and copper) are used to attach rib-tops to inwales.

(Left) Brass finish nails attach the gunwale-cap to the inwale in "Huron" canoes. They are a marked improvement over the original steel nails that corroded quickly.
Finishes
Bare wood has to be protected against water and rot with some kind of finish.
Let’s look at them in turn.

Linseed oil - Revitalize
This oil is usually sold as ‘double-boiled’ linseed oil. It is not actually boiled. Drying agents are added to shorten the drying time to a matter of weeks (as opposed to raw linseed oil which takes decades to dry).

To revitalize wood, mix two parts oil with one part turpentine. This allows it to spread better and penetrate the wood. Some people heat the mixture prior to application. I don’t see a lot of difference as long as you are working at room temperature. Apply it liberally — there are no points for neatness. Then stand back and admire your handiwork. Personally, I usually just stand there with my mouth open — perhaps even giggling a little. Once you’re done, store the canoe for at least two weeks to dry at room temperature. The temperature has to be at least 10°C (50°F).

Stain - Match original colour
In a restoration, it helps to match the colour of the new wood with that of the original. When I’m staining woods with open grain (such as oak and ash), I stain the grain with a dark brown after applying a light brown. This replicates the weathered look in the original wood. Apply the stain and wipe off any excess. Any stain is fine although I prefer gel stains when I can get them.

Shellac - Base for varnish
Shellac is basic to all finishing. It is a resin secreted by the female lac bug on trees in the forests of India and Thailand. It is processed and sold as dry flakes which are dissolved in denatured alcohol to make liquid shellac.

Many people will caution against using shellac as a base for varnish or they will tell you that shellac goes cloudy when it comes in contact with water - not a good thing for a canoe. I researched the methods used by old canoe builders and found that most of them used shellac as a base for varnish. They had a trick for stopping it from turning cloudy that I will share in Chapter 9. Shellac is easy to use and buffs quickly with steel wool. Also, it dries in about an hour at room temperature as opposed to a couple of days for varnish. I apply two coats of shellac and a coat of varnish to new wood in one day.

Canvas Filler - Base for paint
In Chapter 7, I will describe two methods for “filling” the canvas. This process uses a compound to “size” or waterproof the canvas. When dry, the filler creates a base for the application of the oil-based paint. Without it, the paint soaks into the canvas and makes an ugly mess.

One filler is an oil-based concoction shared by the Wooden Canoe Heritage Association. I used it for years with great results. The
original builders used “secret” formulations usually involving white lead. The oil-based filler from the WCHA uses silica rather than white lead. This makes it less toxic but still requires a degree of caution.

The other filler is a waterborne latex compound that is specifically designed to waterproof canvas. It contains fungicides to help prevent rot and is used in commercial and industrial buildings to “lag” or seal canvas wrappings around large airduct systems. The main advantage of this compound is the fact that it takes about 30 hours to dry instead of about 30 days for the oil-based filler.

**Spar Varnish - Wood finish**
Traditionally, spar varnish was made by cooking an oil (usually tung oil, linseed oil, cotton seed oil or soybean oil) with one or more resins or gums (such as shellac flakes, mastic, rosin, amber, copal or damar). These days, commercially manufactured spar varnish adds alkyd resins (derived from petrochemicals) to linseed oil. If used straight from the can, the high proportion of solids (resin) in the varnish result in a finish full of brush-marks, bubbles and sags because it takes a long time to cure.

In order to get an even finish, the curing time must be reduced. This is done by thinning the varnish about 12% with mineral spirits – a.k.a. paint thinner. In some high quality spar varnishes, more thinner is required to get the desired curing time. Some manufacturers confuse the issue by selling products under a variety of names such as “Oil Finish”, “Wiping Varnish” or “Danish Oil”. In some cases, they are little more than thinned varnish.

**Alkyd Enamel - Canvas finish**
The filled canvas is painted with oil-based alkyd enamel paint. From a practical standpoint, you can think of alkyd enamel as pigmented varnish. Paint manufacturers would cringe at this description, but both enamel and varnish are handled in almost the same way.

These oil-based paints (often marketed as “rust paint”) replaced lead-based products. They are made with synthetic alkyd resins derived from petro-chemicals. They are strong, flexible and durable. Recent changes in the regulation of volatile organic compounds (VOC’s) in Canada have made oil-based paints a little more difficult to obtain. Most oil-based ‘rust’ paints in Canada now have a label stating “For Metal Use Only”. I heard one canoe restorer remark that it must have been a clerical error that left “Canoe Use” off the label.
Bedding Compound - Seal for decades

You will spend a lot of time and effort to create a waterproof canvas cover for your canoe. Therefore, it seems a little strange to poke a dozen or more holes through the bottom of the canoe in order to install a keel. If you do, it is essential to use a bedding compound that creates a waterproof seal and stays flexible for decades.

Having tried a variety of products, I have returned to the old school. Dolphinite 2005N Natural Bedding Compound is a linseed oil-based compound with the consistency of peanut butter. It is the same as the bedding compounds used a century ago. Other more modern compounds (such as 3M 5200 or Interlux 214) dry more quickly leading to cracks in the seal which allow water to seep into the canoe.

Wax - Protect

Don’t tell anyone, but one of my trade secrets is to apply a coat of carnauba (pronounced car-NOO-bah) wax to the newly painted canvas. It is a very hard wax that protects the finish. It also helps the canoe shoot through the water effortlessly. I guarantee you will be amazed with the difference it makes.

I use carnauba wax in a paste form. It is available at most automotive supply stores. Follow the directions for application and be sure to use lots of clean cloths. Using flannel and fleece rags, I move quickly over the entire canoe and keep turning the rags to a clean surface until I achieve a beautifully buffed finish.
A few months after starting my canoe restoration business, a man brought his canoe to the shop. He was not interested in having it restored but thought I could find someone who would like a nice little canoe. As he took the canoe off the roof rack of his car, he said, “It was fine until a tree fell on it.”

A client came to the shop a few months later and paid for the restoration of this lovely 14” “Huron” canoe. This project confirmed for me the fact that very few wood-canvas canoes are beyond hope.