DURING THE PAST SEVERAL DECADES, more and more people have learned how to skillfully use both hand and power tools for household chores and improvements, making furniture, outbuildings, and the like, and they often turn out very creditable jobs. Such people are good candidates for boatbuilding. Yet many are intimidated by the thought of making something that is not all square corners; bending wood or other flat material to form curved shapes discourages them. And when they look into boatbuilding and see that it usually starts with a lines plan and the attendant table of offsets that dimensions the curves—well, that's that. But these people are unnecessarily depriving themselves of a very fascinating and satisfying pastime. It is true that many types of craft do require coping with the basics of traditional boatbuilding, but this can be learned to the necessary degree, and studying this book is a good start.

On the other hand, many people are happy with the kinds of boats that can be built using waterproof marine plywood. Some of these are virtually frameless. But more about this when you dig into the following chapters.

Constructing the first boat, however small, is an unforgettable experience. Watching a hull grow from flat paper drawings and flat material into a shapely form provides hours of fun and is excellent therapy after a stressful day. When the job is done carefully, the finished vessel is a source of great pride to the builder. And unlike a piece of furniture, which is often
put in a corner and soon forgotten, a boat is used over and over for pleasure through the years.

A number of lucky people with the desire to learn boatbuilding have been able to take courses in various parts of the United States and the world. Currently, there are a number of good schools for boatbuilding in almost every country. But there will always be legions of aspiring boatbuilders who lack the money, the scheduling flexibility, or the proximity to attend one of these schools, which means there will always be ample reason for books like this one.

The purpose of this book is to introduce boat construction by explaining the elementary problems involved from starting the hull until water first laps at the keel. I don't purport to teach all the skills of an expert boatbuilder.

It is impossible to cover briefly all the information needed to build every type of boat, especially in view of new methods being developed. If you are fortunate enough to live in a boatbuilding area, you can learn a great deal from observation. When it comes down to building the kind of boat you want, you should bear in mind that a good set of plans is not only insurance against disappointment, but is also a source of construction details. In this book, I assume that you have acquired the ability to use ordinary carpentry tools—not much more is needed to build some boats—and, of equal importance, that you know how to keep your tools sharp. Nothing is worse or more discouraging than trying to make progress by hacking away with dull tools; there is no excuse for doing so. If you are a victim of dull edges, better take a week off in order to learn how to sharpen tools. A great reference is *Sharpening Basics*, written by Patrick Spielman. Another is *Fine Woodworking on Planes and Chisels*. You'll find complete publishing information on these and other books in the Appendix.

Along with the many modern products imported from Japan has come an increasing number of hand tools that are anything but modern, and made with steel that really sharpens well. In one mail-order catalog there is a story, told by an American tool buyer, of a Japanese woodworking shop in which the apprentices do nothing but sharpen tools for six months. So don't fret when you have to spend a few minutes bringing the edge of a chisel up to grade. Incidentally, I can attest to the effectiveness of Japanese water stones for honing, but to each his own.

The main thrust of this book is toward wooden construction, but the basics also apply to the layout and building of molds and templates for non-wooden hulls and to the finishing off of boats with non-wooden hulls.

If the project is to build a boat of a material other than wood or fiberglass, then another field has always been open, namely the cutting, shaping, and
welding of metal. Builders of metal boats utilize many of the basic wood boatbuilding techniques, but for book-learning about metal hull construction, refer to the Appendix.

A person considering the building of a boat very likely has been exposed to boats and boating, either for pleasure or for commercial purposes, and may have a pretty good idea of what he/she wants—sail, sail and power, oars or paddles, or pure power. Yet I have received mail about boatbuilding over the years from people with no boating experience and nothing more to go on than a hope of being waterborne in the future. Somewhere along the line they must choose a certain type of hull after deciding what their requirements are.

There are three basic hull types: flat-bottomed, v-bottomed, and round-bottomed. Sawn in two at mid-length, sections through these hulls appear as shown in Figure 1-1.

The flat-bottomed hull in cross section consists of straight lines running across from side to side. The bottom may also be a straight line when
viewed from the side (such as in a scow or barge), or the profile of the bottom may be curved, or “rockered.” In any event, the flat-bottomed hull is the easiest to build, has a minimum of beveled or twisted parts, and, if properly designed, can be a useful craft. Flat-bottomed skiffs are found the world over; flat-bottomed dories have a long heritage. Then there are pram dinghies, garveys, etc., which all have their places. In general, though, boats with flat bottoms are best used on sheltered waters. A lines drawing for a flat-bottomed skiff is shown in Figure 7-4 (page 145).

The arc-bottomed boat is a variation of the flat bottom and a close cousin to the v-bottom. Probably the best known arc-bottomed design is the Star class sloop. These 22-footers are still sailed worldwide, though they were designed in 1911. Both the flat and the arc-bottomed hulls require the minimum of layout work prior to building, as will be seen later.

The frames for a v-bottomed boat are made from a full-size drawing of the hull sections and then set up and left in the hull as permanent members of the structure. While this involves less work and less money for materials than framing a round-bottomed hull, it still calls for careful fitting. The chine pieces (corners in the sections of a v-bottomed hull) must be carefully worked to achieve bevels that continually change from bow to stern. The frames, too, are all beveled, and each is made up of as many as seven carefully fitted and securely fastened parts.

A round-bottomed hull has curved transverse frames that are sometimes called ribs. These are shaped by steaming or soaking them in boiling water until they are supple enough to be bent either directly on the hull framework or over forms in the shop, and then located in the hull after they have cooled and set. Most boats of the size a beginner would build have frames bent right in the hull; the bevel necessary to have them conform to the hull shape is twisted in during the bending process. Do not let this scare you. When working with relatively light material, the bending is not unduly difficult and can be mastered after a few attempts. In fact it can be a great deal of fun. The process will be described in more detail further along, during a discussion of framing.

An alternative to bending frames of one piece is laminating them of glued strips thin enough to take the necessary bend without treatment.

Bending wood by steaming or boiling is not restricted to round-bottomed construction alone, as it is entirely possible that certain parts of v-bottomed boats, such as the forward ends of bottom planks, will not bend on the boat cold and must be made limber for them to fit the shape of the hull.

Figure 1-2 is a lines drawing for a small round-bottomed hull. Lines drawings are discussed in detail in the chapter on lofting, which is the making of full-size hull drawings and templates for the various parts.
A 17'7" round-bottomed wooden launch that has been built by numerous backyard and professional builders. This how-to-build design drawn by the author for The Rudder magazine in 1953 is the predecessor to the Barbara Anne launch design shown in Chapter 2.
The relative merits of the hull types are argued far and wide, but just about everyone will admit that there will never be a v-bottomed hull as handsome as a well-designed round-bottomed boat, especially for a sailing craft. I am probably prejudiced, so argue away!

Figures 1-3 and 1-4 show the essential differences between the framing of flat-, v-, arc-, and round-bottomed hulls. Although the lower ends of the frames in the round-bottomed boat are shown butted against the keel, it is sometimes possible, depending on the hull shape, to install them in one piece, extending from the deck on one side to the deck on the other side. In contrast, note the number of pieces that make up a frame for a v-bottomed boat. On the other hand, frames are spaced farther apart than in a round-bottomed boat, so the frames are fewer in number.

Figure 1-5 is a section through a rather normal sailboat of the cruising or classic ocean racing type. The construction is typical of either the so-called deep-keel or combination keel-and-centerboard type boats, the latter being

**FIGURE 1-3.**
Typical construction sections through v- and flat-bottomed boats.
of moderately shallow draft, greater than an unballasted centerboarder but less than the deep-keel type. This type of boat is not recommended for the amateur’s first attempt at boatbuilding unless he/she has helped on a similar job or has watched enough of this kind of construction that he will not become discouraged when on his own. The framing is more difficult due to

**FIGURE 1-4.**
Sections through typical arc- and round-bottomed hulls.

**FIGURE 1-5.**
The midship section of an auxiliary sailboat showing bent frame with reverse curve.
reverse (S) curves in many of the frames, the planking is a tougher job than on a simpler hull, and there is a lot of heavy work getting out the backbone and deadwood.

The time needed to build a hull can be reduced if the hull shape is such that it can be covered with large pieces of flat material such as plywood. If a hull shape does not have compound curvature it is called “developable” and can be formed from flat sheets. There are ways of designing a hull with developable surfaces, either graphically on the drawing board or with a computer program. The surfaces are cylindrical, conical, or a combination of both, and the designer must be content with the limitations of these curves, but there are a good number of choices. More about this in Chapter 7.

Figure 1-6 shows the lines for a 52-foot hull that was designed with the aid of a computer. This boat was built of large fiberglass sheets: one for each side, one for each half of the bottom, one for the transom, and a number of joined strips for the wide chine surface on each side. To my knowledge, this was an unusual method of construction at the time (1969). On the other hand, the v-bottomed hull in Figure 1-7 cannot be built in this manner, for there are concave sections in both the sides and the bottom. Flat sheets cannot successfully be bent in two directions at the same time.

**FIGURE 1-6.**
A 52-foot fiberglass commercial fishing boat hull having developable surfaces.
A 32-foot wooden v-bottomed powerboat designed by the author and used as a specimen-collecting boat by the University of Florida.
Most of the figures in this chapter have been labeled with the names of some of the principal hull lines, and the beginner must become familiar with this nomenclature. For instance, the top edge of the hull viewed in profile is the sheerline, while the same line viewed in plan is the deck line, or deck at side. A chine is obviously the intersection between the side and bottom of a v-bottomed hull. Other lines in the surface of a hull will be explained later. Since both sides of a boat are usually the same, a designer draws the lines for only one side of a hull.

For hundreds of years, wood was the primary material used for building hulls, but matters are different now. As this is written, boats of fiber-reinforced plastic have been manufactured for more than 50 years; fiberglass boats dominate the standardized boat market, with hulls and other parts produced in volume from expensive molds and tooling.

But research never stops; resins have been improved, and there is a larger choice of reinforcements, some of them currently expensive but enormously strong. As of 2010, skilled amateurs as well as professional builders are building fast, strong racing boats from foam and carbon fiber, but this technology is not yet sufficiently well-established or user-friendly to be covered in this book. Look for that to change in the future.

Nor is wood dead. Both pleasure and commercial boats are still built of wood. Wood is being used in hulls in the conventional manner, some are built with plywood planking, and other hulls are made with multiple layers of relatively thin wood glued together and then often covered with a resin reinforced with a synthetic fabric.

The techniques of wooden boatbuilding are extensively employed in the construction of tooling for fiberglass boats and parts. Wood is used for the interior joinerwork in the better-quality fiberglass boats to avoid the cold, antiseptic appearance of the molded plastic and “mica” finishes that have become a logical extension of molded fiberglass hulls and cabins.

When demand is limited, such as for yachts 65 feet and longer, cold-molded composite (wood and epoxy) construction has become increasingly popular. True, welded aluminum alloy construction or a welded steel hull with superstructure built of the light alloy is still the choice of many of the larger builders. But here again, wood is usually chosen for the finish in the quarters because it provides a feeling of warmth that can never be achieved by the synthetics.

It is possible to gain an introduction to boatbuilding by purchasing and assembling a “kit” boat. There are a number of kits for v-bottomed motorboats, sailboats, canoes, and kayaks, usually with plywood planking. And there
FIGURE 1-8.

Susan, a flat-bottomed rowing skiff designed by the original author of this book in 1952. Over 100 had been built by 1970. It was a great beginner’s project at that time, and is still built in apprenticeships around the world. (Missy Hatch)

FIGURE 1-9.

The Chester Yawl, a 15' Whitehall-type boat. This one was built from a kit manufactured by Chesapeake Light Craft and might be a reasonable project for an ambitious 21st-century first-timer. (Chesapeake Light Craft)
has been a proliferation of kayaks and canoes from a number of vendors. Most of these kits are furnished with beveled parts that require only reasonable care to set up the frames accurately to form the hull. Then there are firms that supply a bare fiberglass hull as part of a kit. Here is where an amateur must be careful to be sure that guidance is provided or available to locate components such as engines and fuel and water tanks. The weights of such items can be quite large, and the amateur should not bite off more than he/she can chew.

Making a kit boat does not give the same sense of accomplishment as building a boat from scratch, but the scheme does make sense for those with limited spare time or for those who want a particular model of boat that is available in kit form. And building a kit is a great introduction for the first-time boatbuilder. Shown here are photos of some of the many types of boats that can be built from kits (see Appendix). Except as noted, all these boats were constructed entirely from kits by amateur builders.

**FIGURE 1-10.**
The 16’ Malahini is one of several outboard runabouts in the Glen-L catalog, which offers hundreds of kits of all types of boats. (*Glen-L*)

**FIGURE 1-11.**
The Swifty 11, a glued plywood lapstrake version of the Norwegian holmsbupram, is manufactured by Shell Boats. A sailing rig is available. (*Shell Boats*)
The frame of this 23’ cruiser was supplied as a kit by Clark Craft, another kit manufacturer with an extensive catalog. (Clark Craft)

An 18’ cedar strip–built King kayak from Redfish kayaks, which sells kits, like the one pictured, and finished kayaks. (Redfish Kayaks)
FIGURE 1-14.
The Penobscot 14 is a glued lapstrake kit from Arch Davis Design. (Arch Davis Design)

FIGURE 1-15.
Arrowhead Custom Boats and Canoes makes the kit for this 16’ glued lapstrake canoe they call The Flyfisher. (Arrowhead Custom Boats and Canoes)