Fine WoodWorking

JANUARY/FEBRUARY 1981, NO. 26, $3.00

Patternmaking

FINE HOMEBUILDING

The New Magazine About Building and Rebuilding Houses.

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Dear Fine Woodworking reader:

Just as a void existed for the serious woodworker when we started Fine Woodworking magazine five years ago, so does a void exist for the serious homebuilder and renovator today.

There is no magazine that covers the whole broad and vital field of homebuilding with quality, style and depth. So we at The Taunton Press are starting a magazine that will do just that, and we're calling it *Fine Homebuilding*, because that's what it will be about.

Fine Homebuilding will deal with both new and old construction techniques, and also with design. The emphasis will be on "fine"—well done, but not necessarily expensive—and the magazine will be written by people in the field who know their subject well. It will cover everything from site preparation to interior-wall finishing, with equal emphasis on additions, renovations, restorations and new construction.

A lot is happening today in this age-old field (solar is just one small facet) and we intend to tell you all about it, not only because it's interesting, but also because we think this information will help you with your own homebuilding needs.

Fine Homebuilding magazine will be published bimonthly and have the same size and feel (but not the same look) as Fine Woodworking, and of course the same commitment to technical and visual excellence.

The first issue of *Fine Homebuilding* will be coming off the presses January 15th, and we're excited about it. If you are too, you can become a Charter Subscriber.

A one-year subscription is $14, a real bargain for the amount of useful information you will receive, and a saving of $4 over the newsstand price. Besides, newsstand sales will be limited, so you should subscribe to be sure you see it. Just send your payment in the convenient order form enclosed in the magazine, or use the address below. Of course, if you're not pleased with the first issue, we'll be happy to refund in full.

—Paul Roman, Publisher

The Taunton Press 52 Church Hill Road, Box 355, Newtown, CT 06470

Cover: A patternmaker finishes the interior of a large core box. Above, a young patternmaker prepares to glue up segments to form a stacked cylinder. A hybrid breed of woodworker, the patternmaker is part cabinetmaker, part machinist and part wood sculptor, whose job it is to make the patterns for the molds that produce cast metal objects. Your iron jack plane, your jointer beds and your table-saw castings all began as wooden patterns in a shop much like this one. For more on patternmaking and how wooden shapes are integral to metal casting, see the article beginning on p. 82. Photos: Mike Wampler, courtesy of the Gleason Works, Rochester, N.Y.

Fine WoodWorking®

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I have noted the increasing frequency with which articles in *Fine Woodworking* have to do with precision. The debate concerning tolerances in drill presses is a case in point.

Let me make it clear at the outset that I am not prejudiced against machines. Some of my best friends are machines. However, I must concede that machines are not overly bright.

It took man quite a while to learn this simple fact about machines, and we are still not totally convinced of it. This knowledge was one of the great discoveries of the Industrial Revolution, the other being that machines ate cheap power rather than expensive food, and hardly ever got tired or went out on strike.

The first application of this discovery was in mass production. After a machine had been trained to turn out a certain piece of work, it would continue to do so as long as it was fed power and raw materials. Machines worked best at turning out identical pieces of work, pieces that were so much alike that one could be easily substituted for another. Cars, furniture, casegoods, ball-point pens and all sorts of other things could be mass-produced. But because the machine enables us to enjoy a higher standard of living, we've also permitted it to set standards of perfection according to machine abilities rather than according to our own abilities.

"Pretty close" is not good enough for machines because they don't know how to be anything but exact. With "pretty close," machines become confused and their bearings heat up. But man has always known what to do with "pretty close." He hits it with a hammer, or puts in some shims, or changes the design, or adds some molding. Man's ability to respond to "pretty close" is precisely what makes him human and vastly superior to machines. The ability to adapt to "pretty close" makes human work so much more pleasing and sought after than that of the machine.

So please do not print any more articles about drill presses—or whatever—with an "accuracy on the order of 0.001-in. runout." That's a machine measurement. About ⅛ in., more or less, is a human measurement. If we want our craft to be the end result of human endeavor, let's focus more on the creativity of the average worker who throughout history has produced most of what all of us think of as beautiful and pleasing. After all, if God had wanted man to be perfect, he would not have created wood filler.

—Thomas P. Sullivan, Mt. Angel, Ore.

With regard to R. Bruce Hoadley's article on the use of the dial indicator (*FWW* #25, Sept. '80, p. 89), concentricity or runout in a drill chuck is not determined by taking a dial-indicator reading against the chuck body. The proper method is to use a ground and polished test bar, equivalent in diameter to the maximum capacity of the chuck in question. This bar is clamped in the chuck jaws and a dial-indicator reading is taken against the bar about 1½ in. below the chuck nose. This reading will represent the total runout in the spindle and the chuck. Most small to medium-sized shop drill presses, equipped with ½-in. capacity, three-jaw geared chucks, are fitted with a drive spindle having a No. 33 Jacobs taper on the spindle nose. On a new drill press, the total runout on the ground spindle nose will range from 0.0005 in. to 0.001 in. The average plain bearing, light-duty chuck, such as the Jacobs 6A33, will be concentric within a tolerance of 0.004 in. The author also mentions that the dial indicator can be used to measure the trueness of quill rotation. A drill-

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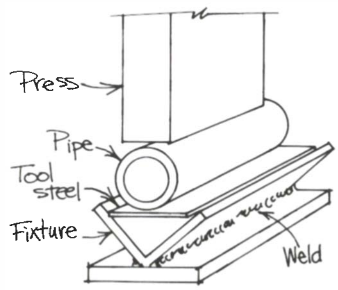
press quill does not rotate but serves as a means of supporting and feeding the drill spindle and chuck.

—A.R. Larkin, service manager, Rockwell International

Regarding Fred Johnson's nicely done article on making chisels and gouges (*FWW* #24, Sept. '80, p. 73): I put the sweep in my tool steel by making a simple fixture out of angle and flat stock, the sturdier, the better. Lay the tool steel parallel in the angle and put a piece of round stock or pipe on top to give you the correct radius. Now you need a press, but a little arbor press won't work; you need something with some poke behind it. I have a homemade 20-ton press from my car days. Squeeze it down until you get the radius you want. I haven't tried it with anything thicker than 1/8-in. stock, but I did try making some 90° veining tools out of 1/16-in. stock. It cracked. The auto-parts store probably has a press, if you don't have access to one. I agree that copper sweat caps are the handiest ferrules you could want—if plumbers didn't have them we would have to invent them. I've tried everything I can for gouge handles. Micarta is my favorite—mine came from some insulators at a redone electrical plant.



—R.W. Harrison, N. Olmsted, Ohio

Kenneth Rower's critique of Simon Watts' and Edward Barnsley's desks and of James Krenov's showcase (*FWW* #24, Sept. '80, p. 4) is stimulating and convincing. Detailed aesthetic criticism, although routinely applied to literature, music and "the fine arts," seldom deals with furniture design. Rower's letter persuades me that it should do so more often. And where better than in *Fine Woodworking*?

The articles about notable cabinetmakers seldom say anything trenchant about the design of the masters' furniture. The to-me obvious rightness of Barnsley's 1969 sideboard (*FWW* #16, May '79, p. 41) and the equally obvious wrongness of his 1970 elliptical dining table (p. 42)—here Barnsley seems to have strayed into an idiom he does not understand—scream for comment. All we get is a pleasantly anecdotal article about a nice old fellow.

Read in conjunction with Rower's letter, Watts' response seems to be making the curious claim that straightforward, simple designs are necessarily ill-proportioned and inharmonious. I hope that he is not right about that. And I wonder how ordinary the "ordinary people" who Watts says buy his work really are. Eighty years ago Thorstein Veblen suggested that the ownership of handcrafted goods was a form of conspicuous consumption and, before that, socialistic William Morris and his fellow workers in the Arts and Crafts Movement had felt frustrated at finding themselves, willy-nilly, working for the rich. Has the situation really changed?

—Urbane Chapman, Northfield, Mass.

I so appreciated your article on Sam Maloof (*FWW* #25, Nov. '80). It is refreshing to read of a person who says, "Keep up the faith and hard work, and it's possible."

We all have to start somewhere, and it is comforting and affirming to read how "one of the best there is" made his start not unlike some of us still struggling with lots of ambition

and a few good tools, wondering about next month's rent. It is a shot in the arm.

—*Warren Cadwallader-Staub, Princeton, N.J.*

The back cover of *FWW* #24 should simply have been entitled "Desecration." Trying to achieve "self-expression" in wood using nails and crayons, both craftsmen have fallen seriously short of any ideals or concepts of fine woodworking and have demonstrated a complete lack of any spiritual relationship with the wood.

Wendy Maruyama and Garry Bennett have fallen prey to the pressure to create an "original" design, as have many of today's craftsmen. Unfortunately the wood and all it would say are smothered and lost because the makers tried too hard to establish their own individuality and to make their own mark on the work. Clearly they turned a deaf ear to the wood as they labored over it and failed to show it any respect. In an act of desperation, they "made their mark."

The wood itself has individuality and is unique from one color and grain pattern to the next, contrary to the author of the article who stated "...just like everyone else's sanded wood." The author who wrote that is more at fault than Maruyama or Bennett in that such irresponsible statements are partly the cause of the destructive pressure that both craftsmen gave in to.

Somehow I have always been content to sign my work in an inconspicuous place. I don't recall Goddard, Townsend, Chippendale, Krenov or Emmett signing their work with nails or crayons, and it would seem they got their ideals and concepts, as well as their names, across very well. They realized the need to listen to the wood and let it express itself and not try to overpower it with their own self-expression.

Perhaps a friend of mine, also a cabinetmaker, summed it up best: "If you bore a child out of love and brought it into this world and this child was beautiful, even perfect in your own eyes, would you then scar its face just so everyone would know that it is your child?"

—*Michael Perrin, Knoxville, Tenn.*

I was glad to see Tage Frid's observation *(FWW* #24, Sept. '80, p. 48) that ripping short pieces on a radial arm saw can be dangerous. Having just lost part of a finger doing that operation, I would recommend extreme caution. Better yet, I would recommend not doing it. Adequate control of a short piece with push-sticks is virtually impossible.

—*Robert S. Maxwell, Washington, D.C.*

I have been concerned with comments, not only in *Fine Woodworking* but from many persons in the safety profession and elsewhere, regarding the safety, or lack thereof, of the radial arm saw. My work for many years has been in the safety field...and has included the safety of all woodworking operations at Eastman-Kodak Co.

I used a table saw for a number of years and then shifted to the radial saw. I feel much more comfortable with the radial saw, principally because the saw is in plain sight at all times.

One thing I use is a front fence. I have never seen anyone else use one and I have always wondered why it has not been standard equipment. Mine is simply a hardwood fence across the front of the table which can be quickly raised to any height and clamped by nuts on two bolts that project from the front edge of the table through two vertical slots. By using

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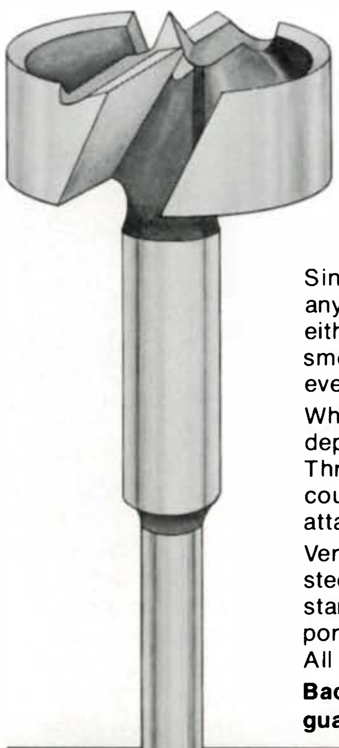

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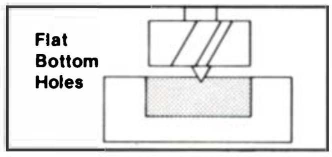

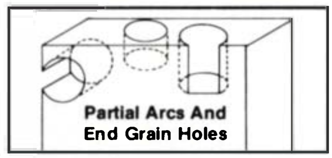

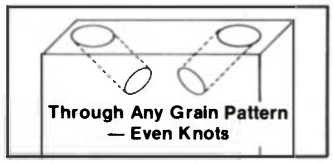

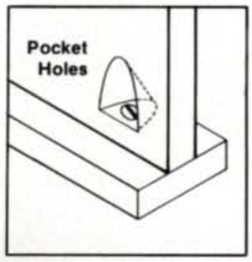

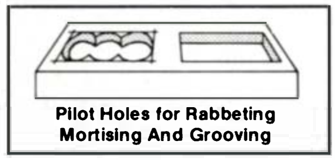

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this fence for ripping operations, the work is right at the front of the table. Your fingers are held away from the saw by keeping your thumbs on the ouside of the fence. Quite narrow stock can be passed by the saw without any chance of your fingers slipping toward the blade. I feel that this setup is much safer than reaching across the saw to reach work pressing against the standard rear fence....

—*Allen L. Cobb, Rochester, N.Y.*

Your piece on exhaustless dust-collection systems (*FWW* #25, Nov. '80, p. 58) is both interesting and factual. One small point gained from the design of many industrial systems may be in order. You correctly note that a cyclone separator will remove dust from the transport air. I would like to add that if a really clean shop is desired, the cyclone discharge opening should be equipped with a fine-particle dry filter. The filter could be a fabric or paper bag or possibly a pleated paper panel filter. The efficiency should be about 25% to 30% NBS standard. —*E.S. Mead, Burlington, Vt.*

...Regarding the problem of displacing unwanted air in cans of paint or varnish. I use a child's penny balloon. Blow it up to the approximate size of the air space in the can.

—*Kenneth Java, Frederic, Wis.*

...Photographers use an inert, nonflammable gas, heavier than air, to protect darkroom chemicals in partially filled containers. Beseler markets the gas as XDL Spray, and it can be found in any good photo store. This inert gas protects finishes from oxidation as well as it does the far more reactive photographic solutions. —*S.J. Crawshaw, Denver, Colo.*

Mac Campbell's article on 3-phase conversion (*FWW* #24, Sept. '80, p. 57) contains some misconceptions which, while they won't prevent his converter from operating properly, should be corrected....First is an apparent confusion between power, voltage and current....The instantaneous 3-phase power is constant rather than sinusoidal like single-phase power. This is why 3-phase motors run smoother—there are *no* power surges. Second, the reason that single-phase power is sufficient to keep the conversion motor running is because its total load (electrical plus mechanical) is less than two-thirds of the motor's power rating....

—*Tony Armendariz, La Honda, Calif.*

...3-phase power is more economical for the industrial user as it comes from the power company but Campbell's system introduces inefficiencies that will make his overall system use more, not less, energy.

The smartest thing one can do with a 3-phase motor and only single-phase power is sell the 3-phase motor and use the money to buy a single-phase motor. Or, in a real bind, a 3-phase motor can be run single-phase up to about two-thirds of its rated capacity if started by some external means....The solid-state converters available are expensive and have poor efficiency and usually poor starting torque. A motor-generating set—single-phase motor driving 3-phase generator—would give the best power and performance, but is also expensive and has efficiency losses. You just can't get something for nothing. —*Mike Graetz, Lakeland, Minn.*

...There are numerous types of single-phase motors; there are also a lot of types of 3-phase motors. These motors differ

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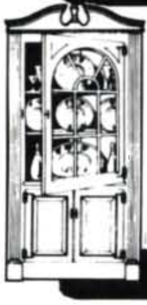

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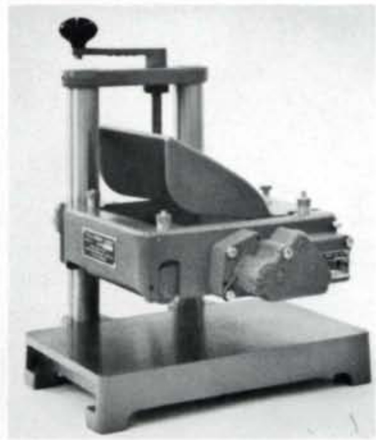

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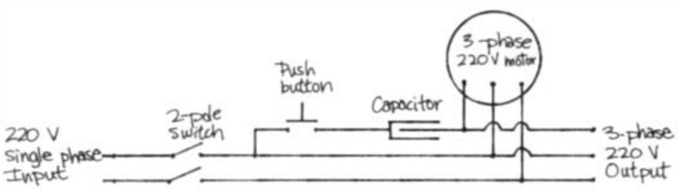
in many ways such as full-load efficiency, speed regulation etc., and 3-phase motors don't necessarily have higher starting torque. For example a single-phase repulsion-induction motor would start a much heavier load than a normal 3-phase motor. Furthermore, starting torque is quite pointless in woodworking machinery; I know of no examples where the machine must start under working load. . . . Rather than allow the converter to run with no mechanical load, Campbell might really be able to save some power by using it to drive some permanent load like the fan of his central dust-collection system. . . . He could get rid of the motor that drives his fan, eliminating one motor—and its losses, which now must be supplied by the converter. . . .

—*E. W. Jones, Wilkes-Barre, Pa.*

. . . When using a 3-phase motor as a converter as described, a second motor is not needed to start it. Simply place a motor-starting capacitor (readily available for about $10 from electrical suppliers and sources such as W.W. Grainger, Woburn, Mass.) in series with a push button as shown in the diagram below. After turning the power on, pushing the button will



cause one winding of the converter to act as a starting winding. A 3-phase motor can also be used directly on 220-volt single-phase in this manner, with an output of roughly two-thirds its rated output. Capacitor size ranges from about 150 μfd for a 1-HP motor to 650 μfd for a 5-HP motor.

—*Bruce Fortier, Essex, Mass.*

. . . To illustrate the efficiency advantages of 3-phase motors over single-phase motors, the article used a chart of motor currents. The electrical to mechanical power conversion efficiency of a motor is a function of current, voltage and power factor, and it is not valid to compare currents alone and expect a meaningful result. For example, an average 1-HP 110-volt single-phase motor draws as much as 16 amps at full load, versus 3.8 amps for a 1-HP, 230-volt 3-phase motor. In terms of power consumption however, the single-phase motor will use about 1,040 watts versus 960 watts for the 3-phase motor. Thus the single-phase motor draws about 400% more current but only 8% more power. If the motors were on a small saw, run at full load for one hour per day, and electricity cost 5¢ per kilowatt hour, the single-phase motor would use about a dime more energy per month than the 3-phase motor. Even the dime would disappear if the user had to convert single-phase to 3-phase because of the energy consumed by the converting equipment. . . . —*T.J. Cotter, Mauldin, S.C.*

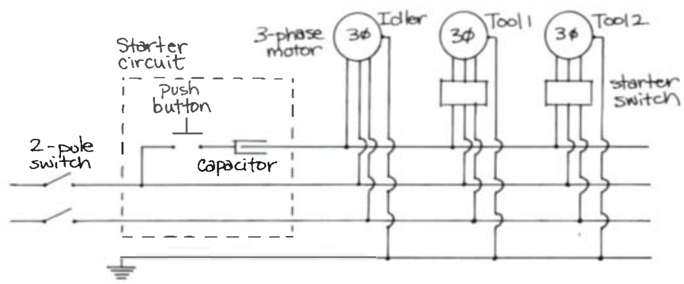
EDITOR'S NOTE: We received a dozen letters discussing the conversion to 3-phase power, several of them from electrical engineers who took the time to explain the intricacies in exhaustive detail. The excerpts printed above are the points on which the engineers agree. To validate their advice, we asked our New England correspondent, Richard Starr, to explore the question with Eric LaWhite of South Royalton, Vt. LaWhite is a mechanical-engineering consultant who has well-

equipped metal and woodworking shops and for 20 years has run about half of his machines on 3-phase current supplied by a small idler motor. Starr's report:

"LaWhite's idler, a 3-HP, 3-phase motor, sits inconspicuously in a corner of his woodworking shop. To get it running he spins its shaft with the rubber sole of his shoe (up to about half its rated 1,200 RPM), then switches on its 220-volt single-phase power supply. The biggest 3-phase motor in the shop, which drives a pedestal belt sander with 5 HP, caused the idler to buzz slightly as it generated the third leg of the sander's starting current. His 3-phase-powered equipment includes the sander, a table saw, a wood lathe, several machinist's lathes, a surface grinder and a dust collector. LaWhite can run all these tools simultaneously, without overloading the idler.

"LaWhite explained that the function of an idler is to generate the third leg of 3-phase current. Any motor in the circuit can do it. If your idler seems to overload while starting or running a large motor, you can augment its capacity by running a second or third motor in the curcuit—for example, run your idler and disc sander to start your table saw. In fact, as long as any two motors are running, they are both operating on 3-phase current. But take care using this method; there is risk in running power tools unattended. The advantage is that you don't need to waste current operating an oversized idler. LaWhite suggests using a conversion motor whose horsepower rating equals the average shop motor. The diagram at right shows the circuitry LaWhite recommends, with Fortier's capacitor starter included. Note that each leg of the 220-volt input requires its own circuit breaker, that the starter circuit for the idler motor should be enclosed in a metal box (capacitors can explode if something goes wrong), and that each additional motor should have its own starter switch with heaters for overload protection.

"Considering the conversion losses and the nuisance of setting up a second wiring system, why bother with 3-phase power? A major advantage to machinists, says LaWhite, is the instant reversability of 3-phase motors. Single-phase equipment can be run backwards by reversing the wires in the starting circuit but the motor must first be



stopped. When you switch a 3-phase motor into reverse at full speed, it is like hitting a brake. This is very handy on lathes and milling machines, and could be useful on woodworking tools. Reversing drum switches are available at electrical supply houses for about $15.

"New 3-phase motors sell for 10% to 30% less than the price of comparable single-phase motors, require less maintenance because they are simpler, and can be had in much larger sizes. They are slightly more efficient than single-phase motors.

"But for the small shop, the main advantage is in the purchase of used 3-phase equipment, and the advantage is twofold. First, the motors and the tools they power are built to industrial standards and are far more durable than 'home-craftsman' models. Second, since these tools are not in demand they can be had for bargain prices. LaWhite prowls the classified ads, used-tool shops and auctions.

"Consider these points when shopping for used 3-phase motors:

—Recent motors are usually more efficient than old ones; they have better magnetic properties. Ball bearings usually indicate a newer motor. Ball-bearing motors will run freely when spun by hand; they have grease fittings or permanent lubrication, while sleeve bearings have oil cups. When shopping for an idler, get a modern motor.

—For use as an idler, choose a lower RPM motor. It is easier to start, will run quieter and have fewer internal losses. There's no need to match

speeds among motors and idlers. But whatever starting method you use, be sure that your motor is running at rated speed once started. Always start in the same direction; a reversed idler will run the other motors backward.

—You will seldom (if ever) find a 3-phase motor with a ground lead, so don't reject a motor if one is not present. Three-phase equipment is usually wired to metal conduit or *BX* cable, which provides grounding. If you wire with plastic-sheathed cable, be sure to ground the frame of each motor.

—Check the motor with an ohmmeter. Three-phase motors have either three or nine leads, and there's usually a wiring diagram on the housing or inside the cover of the wiring box. None of the leads should show a connection with the frame of the motor. A motor with a current leak is dangerous.

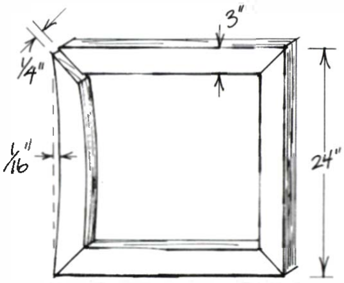
—Run the motor. It should sound right without excessive hum or grumble.

"Commercially built converters come in two types—static and rotary. The static variety generally consists of a box of capacitors tuned to a particular motor, which supply the starting current and then drop out of the circuit. It's designed for running a single motor under constant load. A rotary converter, which consists of a matched motor-generator set with capacitor start, is much more suitable for woodworking machinery. It works the same way as scavenged equipment, except it's designed for the job rather than cobbled together. One model, rated to handle a total of 9 HP and to start 3 HP under load, lists for $428. Suppliers of both static and rotary converters are Ronk Electrical Industries, 106 E. State St., Nokomis, Ill. 62075; Arco Electric Corp., P.O. Box 278, Shelbyville, Ind. 46176; and Cedarberg Industries, 5408 Chicago Ave. S., Minneapolis, Minn. 55413.

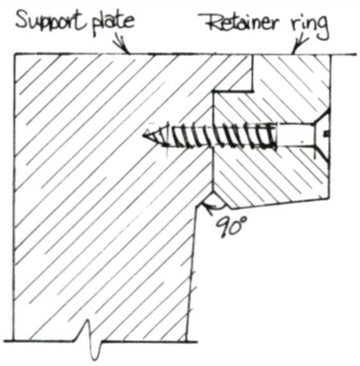
"In most conversion setups, two legs of current are supplied directly from the power lines at full-line voltage. LaWhite found that his idler was supplying only 160 volts on the third leg. Motors run on unbalanced 3-phase start slower and lose efficiency. Most 3-phase motors can be wired to run on either 220-volt or 440-volt. By wiring the output leg of his idler to 440-volt, LaWhite found that it would supply close to line voltage. But he warns that this reduces its current-carrying capacity, increasing the likelihood of overloading.

"Finally, LaWhite advises craftsmen to keep in mind that electricity is deadly, and wiring of this sort should not be attempted by inexperienced persons. In many jurisdictions, local codes make it illegal to wire without a licensed electrician. In any case, it pays to have a competent electrician check your system before you use it."

ERRATA: In Allan Boardman's article on precision in joinery (*FWW* #25, Nov. '80, p. 68) figure 4, showing how a miter opens if one frame member is slightly bowed, should have been drawn as at right. The photograph of Boardman's music box was not taken by the author, but by John Gambrell.



In "Turning without Screw Holes" (*FWW* #25, Nov. '80, p. 82), the retainer ring and support plate in fig. 4 should be rabbeted, as shown in the drawing at right. This ensures that after the jaw plate is inserted, the retainer ring will go back on the support plate in the same position it was when it was turned. Also, the socket in the support plate for the bead pivot, pictured in fig. 4 and fig. 1d as rounded, should have a 90° corner. This keeps the jaws from eventually running off-axis.



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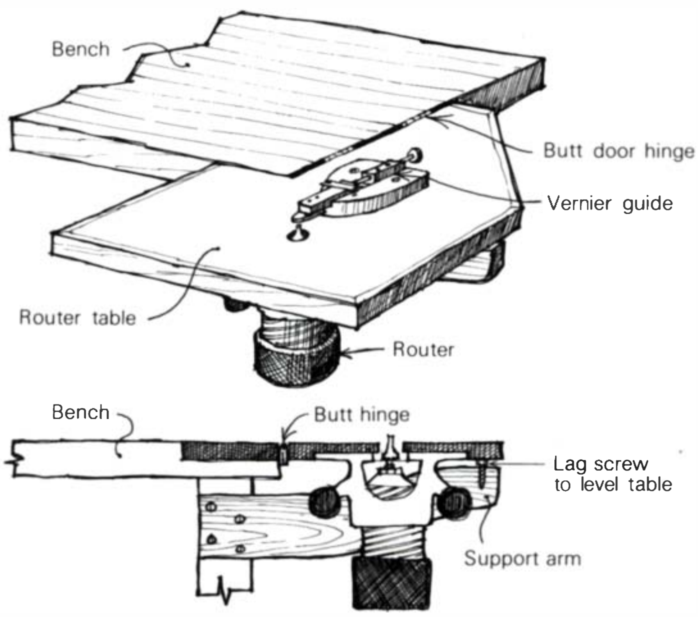
Hinged router table

I suspect that many of us use our routers upside-down, like a shaper, more than we do as a portable tool. I certainly do. But I don't like the flimsy metal stands sold for this use. They are too small and, used on top of the bench, are too high to be comfortable.

Here's a router table I built a couple of years ago that solves these problems. The table is solid and set at a comfortable height. Because the table top hinges over, I don't have to squat down to remove the router, change cutters or adjust cutter height.

I usually bolt, screw or clamp appropriate guides to the table for straight routing. For irregular contours I use a vernier-controlled guide as shown in the sketch. The vernier adjustment allows me to make two passes, removing most of the wood on the first pass and cleaning up the last 1/16 in. on a final cut. I make the rub block on the guide from hardboard. Any unusual problem can usually be solved simply by making a new specially shaped hardboard rub block.

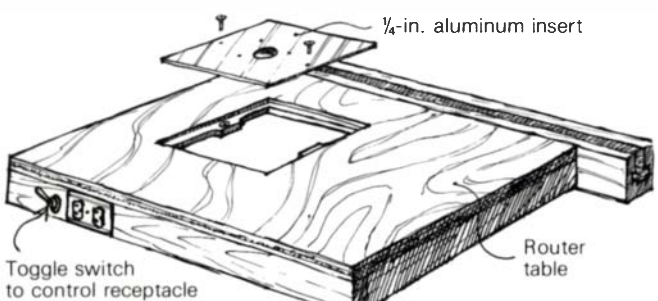
—*John W. Greenwood, Dublin, Calif.*



Other router-table improvements

I see the advantage of mounting an extra router base under the router table as suggested by Wallace Kunkel (*FWW* #15, March '79). But instead of groping around under the table to release the router or feel for switches and adjustment knobs, I've installed both an aluminum insert and a switch-controlled receptacle so I can perform all those operations up front with greater convenience and safety.

I made the 10-in. square table insert from 1/4-in. thick aluminum plate. I chose aluminum over mild steel because it's easier to drill out the mounting and spindle hole and, if polished, is almost friction-free. The insert is held firmly in place with two countersunk 1/4-in. flat-head machine screws into *T*-nuts in the table top. An accurately inlaid insert won't float or vibrate.



I mounted the switch and receptacle on the front of the router table. You can use any type of switch—just make sure it will carry the amperage. You will find plenty of other uses for the switch-controlled outlets (drills, sanders, etc). Just unplug the router when you don't want it to run.

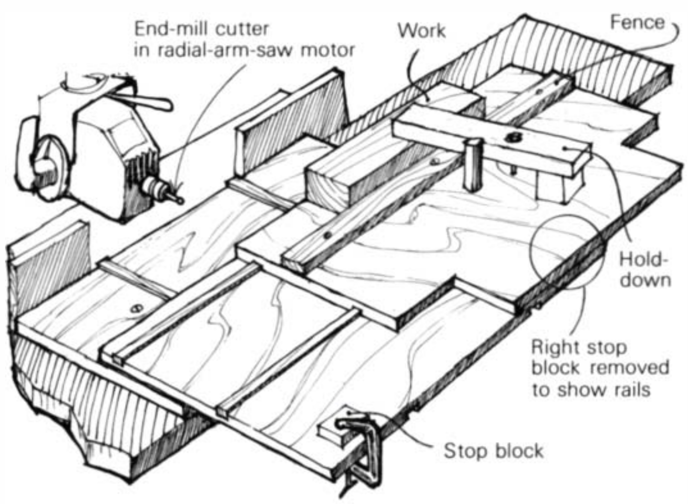
—*D. B. Neagley, Groveland, Calif.*

Slot-mortising table

I cut slot mortises on my radial arm saw using this two-way sliding table. The table consists of three separate 3/4-in. thick plywood or particle-board sections. Cut the middle and top sections wider than the bottom to leave room for clamping stop blocks. To get the two-way sliding action, cut tracks and set rails in the parts, as shown in the sketch. I used 3/4-in. square, waxed hardwood rails glued into grooves cut just less than 3/8 in. deep. The shallow grooves will separate the sections a little so the surfaces won't rub. Notch the back corners of the top section (so you have a place to clamp stop blocks) and add fences, handles and work hold-downs as needed.

To use the table, mount an end-mill cutter in a chuck on the saw's spindle and set the height and depth of cut with the saw's adjustments. Clamp the stop blocks in place to control side-to-side movement. Now you're ready to mortise. Secure the work in position, turn on the saw and move the table from side to side as you slowly push the work into the cutter.

—*Bill Horton, Chino, Calif.*



Grit-slurry sharpening

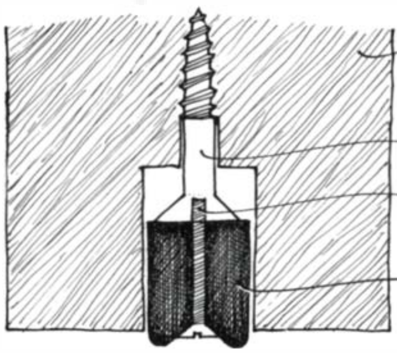
Here's yet another sharpening method to add a bit more lore to the subject many craftsmen approach with almost mystic reverence. The method uses a slurry of loose grit on a flat glass plate. It is the same method laboratories use to sharpen the microtome, an instrument that slices tissue into thin sections for microscopic examination. The method is effective for sharpening woodworking tools, particularly plane irons. Start by dumping a half-teaspoon of #400 grit on an 8x8 pane of glass, adding several drops of light machine oil to make a slurry. Hone the plane iron as though you were using a bench stone. When you obtain a good bevel, wipe the glass clean and repeat the process using #600 grit to obtain the final cutting edge. For optimum results, polish with a polishing compound or give the blade a few strokes on a leather strop.

This method is superior in several ways to sharpening on a stone. The glass is flat and wears little even with much use, and the large surface area allows for a more comfortable

hand motion. The large surface is particularly suitable for the use of a roller device to hone the iron at a constant angle. Finally, you can buy a wide range of abrasive powders at hobby shops that deal in lapidary supplies (one source is Grieger's Inc., 900 S. Arroyo Parkway, Pasadena, Calif. 91109). A small investment in materials will allow you to perform work that would otherwise require several different grades of stones. —*George Mustoe, Bellingham, Wash.*

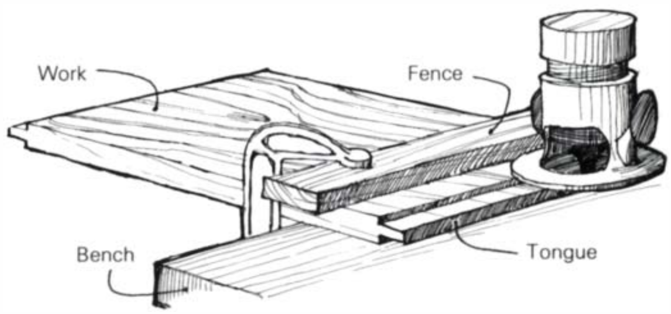
Adjustable table feet

If the floor is not even, a small table will rock despite your efforts to have cut all four legs to the same length. These adjustable feet solve the problem better than cardboard or wooden shims, the usual solution. To make the feet, tap the head of a #10 or #12 wood screw to accept a #4-40 machine screw. Drill ½-in. holes in each table leg, then assemble the dowel-plug feet as shown below. Loosen or tighten the screw to adjust the foot. —*J.A. Hiltebeitel, S. Burlington, Vt.*



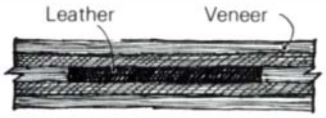
Routing tongues

I cut the tongues for tongue-and-groove joints with a router. There are faster methods, but the router's precision depth adjustment produces a fit that's unbeatable. First set the router depth by trimming the edge of a scrap board. Flip the board over, trim the other side and test the resulting tongue in the groove (which has been previously cut). Make fine depth adjustments and continue to rout test tongues until the fit is perfect. To cut the tongue, first measure the distance from the router base to the bit. Then clamp a fence to the work this distance from the tongue. Gently tap the fence into perfect position with a mallet, checking the measurement with a steel ruler. —*Jeffrey Cooper, Portsmouth, N.H.*



Laminated leather hinge

This hardware-free leather hinge is laminated into the wood to be revealed later by routing. Faced with designing some wooden book covers, I decided to use thin, home-laminated plywood for strength. To allow the covers to flex when the book opened, I embedded a 1-in. wide strip of thin leather in



1. Laminate leather in veneer stack

2. Rout out top and bottom to produce hinge

the center of the 5-ply veneer stack. After the plywood glue cured, I used a ⅛-in. straight router bit to rout away the two plies of wood on the top and on the bottom of the leather hinge. To achieve precise depth control I used paper shims between router base and book cover, removing one sheet at a time until the depth was exactly right. Although I chamfered the edges of the routed groove by hand, it is possible to chamfer with a *V*-groove bit. The width of the routed groove depends on the thickness of the plies and the required travel of the flexing pieces.

I would not use this hinge for a vertical cabinet door but it would work fine in many horizontal applications such as the top of a lap desk. There is no crack for dust to get through. The general principle might be useful in making tambours as well. Just keep in mind that the leather hinge must be routed out of the surrounding stock if it ever wears out.

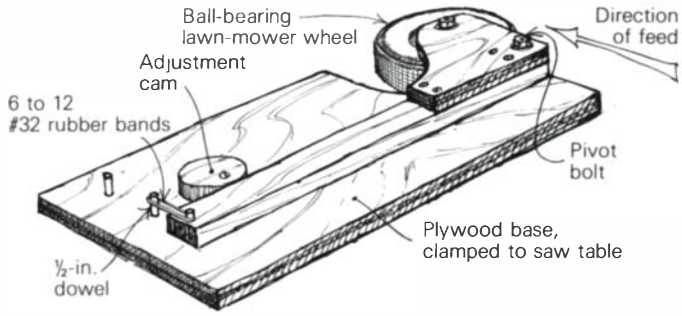
—James D. Thomson, Toronto, Ontario

Rubber tire hold-in

The simple lawnmower-wheel fixture sketched at right has made featherboard hold-ins obsolete in my shop. I have two: one as shown and the other a mirror image of the first. I use them on both the table saw and the router table for ripping, cutting grooves, shaping, and other operations.

The advantages of this fixture over featherboards are significant: Feed friction is greatly reduced, hold-down pressure is adjustable and consistent (even when the stock is uneven) and setup is quicker and easier. Since fore/aft friction is all but eliminated, there is little tendency for the fixture to squirm and turn under the clamp. Only one clamp will keep it in place, even on a waxed saw table. The disadvantage is that there is no kickback resistance as with featherboards. But kickback can be all but eliminated by using sharp, clean blades and carefully setting up for each cut.

The idea for rubber-tire pressure wheels is not mine—similar fixtures are used on large power-feed industrial woodworking machines. I suppose the wheel could be cut from plywood to save the extra few dollars for the ball-bearing lawnmower wheel and special axle bolt. But I find it comforting to see the rubber tire flatten a bit as it pushes the work against the saw fence. *—Bob DeFrances, Delray Beach, Fla.*



Inexpensive workbench

This simple workbench uses two pipe clamps for the vise. The size of the bench, quality of material and construction de-

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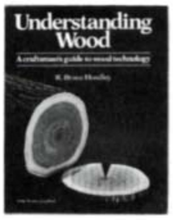

Bruce Hoadley has been studying and teaching wood science and technology for 28 years. He's been a woodworker and carver even longer, so he knows and understands well why wood behaves as it does and what a woodworker needs to know about it—from how trees grow to how best to cut, season, machine, join, bend, fasten and finish wood; even how to identify 54 common domestic and imported species. It's the definitive book about wood for woodworkers, clearly illustrated with spectacular photographs and informative drawings. We expect it to be a classic for many years to come. *Understanding Wood: A Craftsman's Guide to Wood Technology* by R. Bruce Hoadley, 272 pages, hardcover, $18 postpaid.

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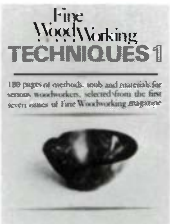
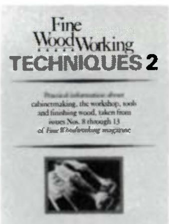
There's no better way to learn woodworking than to watch Tage Frid do it. He makes it look so easy. But then, if you know what you're doing, it can be easy. That's why we thought the best way of presenting Frid's vast experience was to photograph him at the bench, as he shows step by step how to use the tools and make the joints essential to good woodworking. Frid uses both hand and power tools and makes joints ranging from the simple tongue-and-groove to more complicated dovetails and multiple splines. He even shows how to construct the jigs he uses to make cutting and gluing easier. *Tage Frid Teaches Woodworking—Joinery: Tools and Techniques*, 224 pages, hardcover, $16 postpaid.

Rediscovering an almost forgotten lore.

Working green wood has always been a significant part of our woodworking tradition, but it has rarely been written about. John D. Alexander, Jr., has set things to right. In this clearly illustrated book, he guides you from the felling of a tree through splitting and fashioning the parts to constructing a handsome post-and-rung chair with interlocking mortise-and-tenon joints that tighten as the wood dries. He even shows how to strip and weave a bark seat. The book is full of intriguing lore you'll enjoy. *Make a Chair from a Tree: An Introduction to Working Green Wood* by John D. Alexander, Jr., 128 pages, softcover, $8 postpaid.

Two treasuries of woodworking information.





The technical articles in *Fine Woodworking* are not easy to come by. The vast array of information they contain is hard to find anywhere else. Now we're reprinting those articles in hardcover form just as they appeared in *Fine Woodworking*—no abridgments, no changes, only a few corrections of errors not caught the first time around. *Techniques 1* covers the first seven issues of *Fine Woodworking* and contains 50 articles by 34 craftsmen; *Techniques 2* covers issues eight through thirteen and contains 61 articles by 53 craftsmen. We've also included some Methods of Work. *Fine Woodworking Techniques 1*, 192 pages; *Fine Woodworking Techniques 2*, 208 pages, each $15 postpaid.

1,750 ideas for a winter's night.

When we were putting together the early issues of *Fine Woodworking*, so much good work had to be left out that we decided to do a separate book from pictures sent to us by the readers. We chose 600 for the *Biennial Design Book*, published in 1977. Two years later we followed it with *Design Book Two*, containing 1,150 photos. Both are more than spectacular picture books. They are strong statements of the incredible vitality of the woodworker's art in America today and a useful record for the future. *Fine Woodworking Biennial Design Book*, 176 pages, softcover, $10 postpaid. *Fine Woodworking Design Book Two*, 288 pages, hardcover $16, softcover $12 postpaid.

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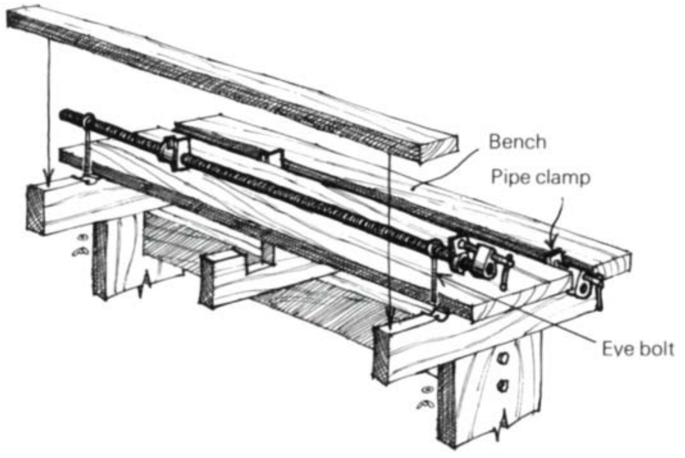


sign can all be varied to suit the needs of the builder. My choice is the trestle-leg design shown; others may want to use four corner legs to provide a mounting location for a leg vise. (For a pipe-clamp leg-vise design, see Methods of Work, *FWW* #11, Summer '78). The major drawback to this design is the non-adjustable dog height. To overcome this problem, preset the dog height at ¼ in. or ½ in. Then, to surface thin stock, shim it off the table with thin plywood.

—J. Butler, Hubbardston, Mass.

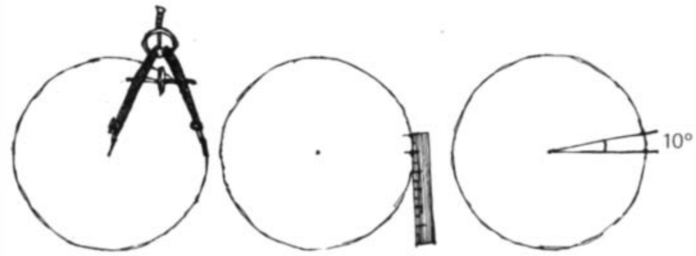
Faceplate scraping

A curved cabinet scraper works extremely well for the final shaping of bowls and other faceplate turning projects. The scraper easily smooths end-grain areas where turning tools tend to tear out splinters and chunks. It also eliminates the need for coarse grades of sandpaper that put in those hard-to-remove, concentric scratches.

—John Rocus, Ann Arbor, Mich.

Approximating angles

Here's a surprisingly accurate procedure to estimate angles using only a rule and a compass. First, draw a circle with a radius of 5¾ in. Now say you want a 10° angle. Mark off two points one inch apart (a 1-in. chord) on the circumference. Join the two points with the center of the circle, and the resulting angle is almost exactly 10°. If you want 20°, just lay out two 1-in. chords (not one 2-in. chord). Use fractions of an inch or just split the distance by eye for angles less than 10°. For large angles lay out multiples of 60° (using the compass set to the circle's radius) then add or subtract 1-in. (10°) slices to get the angle you want. *—Jules Paquin, Laval, Quebec*



Draw circle, radius: 5¾ in. | *Mark off 1-in. chord* | *Connect to center*

Methods of Work buys readers' tips, jigs and tricks. Send details, sketches (we'll redraw them) and photos to Methods, Fine Woodworking, *Box 355, Newtown, Conn. 06470.*

Currently I am making F-style mandolins, and am having a small problem with some of them. The sides, made of highly figured maple, are steam-bent. Occasionally I find splits on the surface of the wood after it has dried. These are not deep enough to present a structural problem, but they are too deep to be sanded out. Is there any type of glue that would fill these cracks, and still not repel a water-base or alcohol-base stain? Since I have to reject these, I'd very much like to solve this problem. I hate to see such beautiful wood go to waste.
—Glenn J. Behrle, Milford, Conn.

First, it makes sense to attack this problem at its source—the bending process. Here are some questions to consider: Is your material at optimum moisture content (12% to 20%)? Is it thin enough for the bend? Is the material backed by a bending strip? Are there any tiny defects on the surface prior to bending? The smallest tear-out paves the way for a serious split. Are you steaming too long and weakening the stock?

Assuming you have done your best to minimize the splits, there are several possibilities for dealing with them. First, I know of no glue that will fill cracks and stain like raw wood. Assuming you use a lacquer finish, you could stain the wood first, seal it and then fill the cracks carefully. You might use a lacquer stick matched to the stained wood or a mixture of epoxy resin and stained wood dust. Or you could fill the cracks first and then use the color in your lacquer instead of stain. This is done commercially and hides all sorts of problems, although it does obscure the figure of the wood.

My real feeling is that if you are making really fine and expensive instruments, you should continue to reject those with imperfect sides. This is one reason for making an inexpensive companion line which will allow you to use less than perfect materials. *—Richard Newman*

I have two plank-bottom rocking chairs, and their seats have split. One was previously repaired with crosspieces housed in routed slots. These failed. Would applying a strip of thin plywood about 4 in. wide to the bottom of the chair create problems or would I be better off with a solid-wood strip?
—Daniel R. Williams, Maryland Heights, Mo.

I have a plank-bottom chair that failed in exactly the same way yours have. I closed the gap with a clamp and then screwed two pieces of oak about ⅝ in thick, 1¾ in. wide and 6 in. long at right angles to the split and about 10 in. apart. I don't find such repairs objectionable if neatly done—they become part of the story of that particular chair.

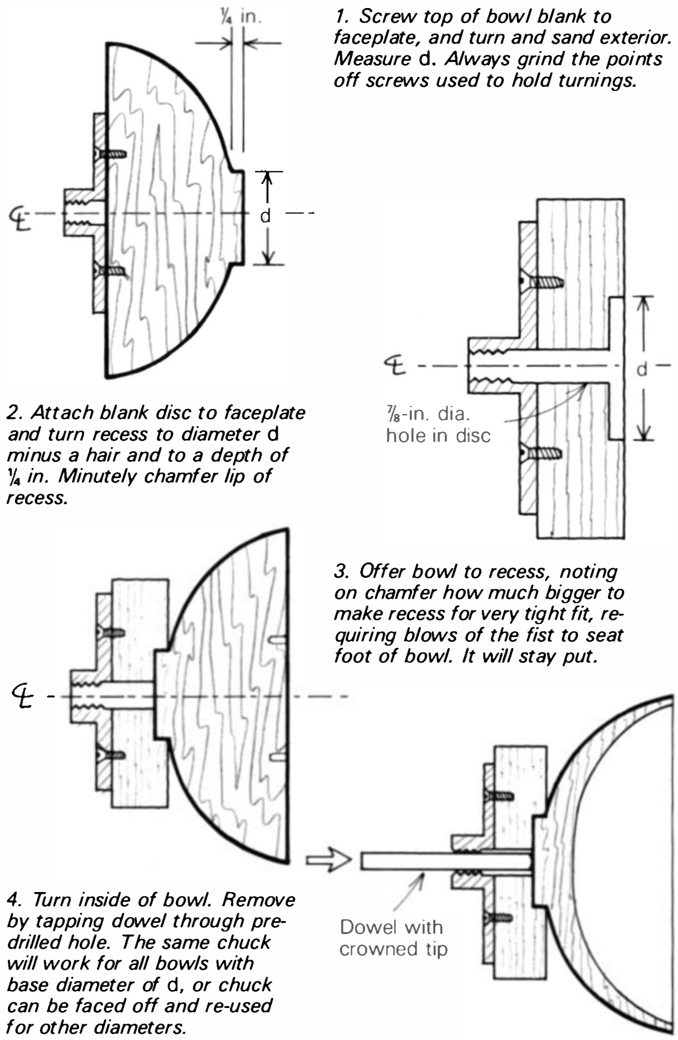
Attaching a piece of thin plywood would certainly hold the two halves together, but the seat would probably flex when you sat on it. I would find this annoying. *—Simon Watts*

I have occasion to reglue wooden chairs. Sometimes the spindles and legs are locked into place with nails. Most of the time I can cut around the heads and manage to pull them out. But sometimes the nails are driven too deep or the wood is too hard and the nails break off at the top when I pull them. Is there any way these nails can be removed?
—Maurice H. Revkin, Cranston, R.I.

If you can't pull the nail out, try driving it through with a small drift punch. If that is not possible, then drill a small hole alongside the nail about the same diameter. This will relieve the pressure on it and often make it possible to pull. If necessary, drill a hole on each side—but as close to the nail as you can get. *—Simon Watts*

For turning bowls and such, I screw a block to a faceplate and then glue the turning blank to the block with an interface of brown paper, using yellow glue. I can separate this assembly after turning, but I cannot clean up the bottom surface of the turning where the paper was glued, even after much sanding. I have to cheat and cover the bottom with felt. Do you have any suggestions? *—Henry J. Teller, Greenville, Ohio*

You can plane the paper and glue off the bowl bottom, or you can scrape them off if you burnish a heavy hook on your steel scraper blade. Then sand smooth. You can avoid the problem by starting with stock about ⅜ in. thicker than your project requires; glue and turn as you've been doing, then use the parting tool to cut right through the stock ahead of the glue joint. Or you can change to a wooden chucking system as described in the diagram below. There's a number of



1. Screw top of bowl blank to faceplate, and turn and sand exterior. Measure d. *Always grind the points off screws used to hold turnings.*

2. Attach blank disc to faceplate and turn recess to diameter d *minus a hair and to a depth of ¼ in. Minutely chamfer lip of recess.*

3. Offer bowl to recess, noting on chamfer how much bigger to make recess for very tight fit, requiring blows of the fist to seat foot of bowl. It will stay put.

4. Turn inside of bowl. Remove by tapping dowel through predrilled hole. The same chuck will work for all bowls with base diameter of d, *or chuck can be faced off and re-used for other diameters.*

chucks on the market designed for this work; the Child Coil-Grip chuck that Woodcraft sells is one example. Finally, you'll find information about other home-built chucks in *FWW* #19, p. 72, and #25, p. 82.

We have a carved wood bear poised in an upright position. It's roughly 22 in. tall and 10 in. in diameter. Over the years it has developed a vertical, ⅜-in. wide split. I have been asked to repair it, and since it's a company heirloom and mounted in a reception center, I'd like you to advise me on how to do it right. Should I bring the crack together by clamping and gluing or should I use a wood filler?
—Lou Brown, Louisiana, Mo.

If you use glue and force the split together with clamps, it will crack again. Don't use filler either. If the wood should pick up additional moisture, its swelling will push the filler out. The best thing to do is clean out the split and chisel the edges

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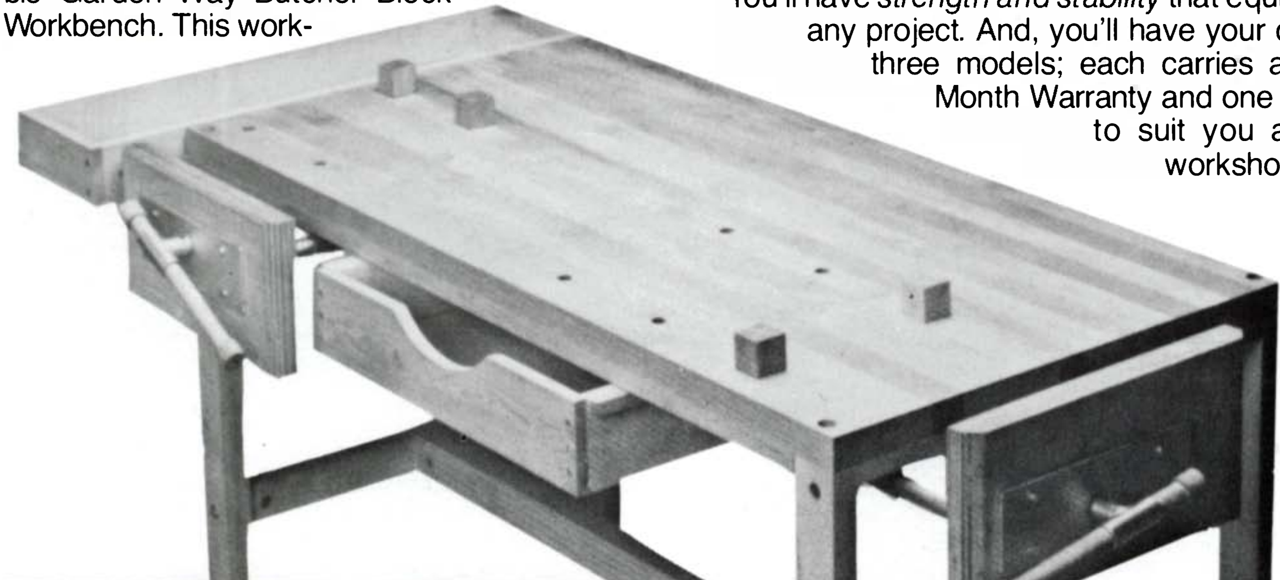

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City __________ State ________ Zip ______ straight. Cut a strip of wood that will barely fit into the crack; then compress it in a vise so it slips in easily. Then apply glue to the inside of the crack (not on the piece to be inserted) and tap the strip in place with a hammer. The moisture from the glue will make it swell for a tight fit. Use either Titebond or Cascamite. —*Tage Frid*

I want to make jigsaw puzzles and don't know how. What kind of plywood should I use? What kind of sawblade? What's the best way to proceed?
—*Nancy Mills Boyce, Minneapolis, Minn.*
Stick your picture, drawing or photo to the plywood with rubber cement, not glue, which will wrinkle the paper. Use a good-quality ¼-in. plywood with no gaps or voids in the interior plies. Five-ply Baltic birch is best for this. Use a medium-fine jigsaw blade, available from Woodcraft Supply, 313 Montvale Ave., Woburn, Mass. 01888. The teeth must point down so as not to tear up the paper on the surface. Use a thin piece of plywood scrap underneath so the bottom doesn't splinter out.

I make puzzles on the band saw using a ⅛-in. blade. You can also use solid wood instead of plywood, but the pieces will be much more fragile unless made rather chunky.
—*Simon Watts*

Can you suggest a method for ebonizing maple to give a high-gloss black surface that will wear well?
—*Daniel Symonds, Towson, Md.*
Ebony is a dark brown wood, irregularly striped with charcoal or nearly black markings. To ebonize means to copy such wood. This involves the use of a well-concentrated aniline dye, used repeatedly. When the desired shade is reached, it must be sealed with a wash coat of shellac. Then a nearly black oil-stain is spread over it evenly, and with a painter's graining comb, (a cross between a comb and a rubber squeegee) about half of it is to be taken off, creating an irregular pattern, so the remainder will imitate the markings of ebony (one should have samples). When dry, the oil stain also has to be sealed with another, slightly heavier, coating of shellac.

However, if you would ask the average woodfinisher to ebonize an object, chances are that he would say to build up a heavy coating of black, or nearly black, lacquer finish and for final rubbing he would use water and 4-F pumice stone, so that the finished surface would not be glossy, but rather would be satiny-smooth. —*George Frank*

What is a good lubricant for wood screws and moving wooden parts like drawer runners and wood threads? I've been told to stay away from soap because it's water soluble and bad for the wood. —*Nancy Sharper, Chattanooga, Tenn.*
Many woodworking books recommend tallow as a lubricant for wood screws. Because it is not water soluble, it is also a good lubricant for outdoor furniture and that back-yard swing set that has been driving you mad. But tallow isn't exactly a standard hardware item. One source of the stuff ready-made is the local music store—ask for clarinet cork grease. But the best way to get some is to render it yourself. Here are the ingredients: two lamb chops, one broiling pan (or drip pan), salt and pepper. Place the meat in the pan and broil until done, turning it at least once. Remove the pan from the oven and place it on a counter to cool. Don't pour out any of the grease. While the pan cools, eat the lamb chops (salt and

pepper to taste). But do not add salt and pepper, or anything else, until the chops are out of the pan and on your plate. This is essential to avoid contaminating the tallow. Now go back to the broiling pan and remove the rack. That hard, dingy white stuff you thought was hardened grease is actually your tallow. Scrape it into any container with a lid. Be sure to save only the hard grease and not the liquid or semi-liquid stuff it is floating upon.

If you do not like lamb chops, you may substitute a beef steak, although beef tallow isn't quite as hard as mutton. Also, you won't get as much tallow from a steak as you will from two lamb chops. Unless you are overly fastidious, the impurities (those little flecks of brown stuff) won't bother you. If they do, simply place the tallow scrapings into a saucepan, reheat slowly and gently until the tallow is runny, then strain it through some cotton linen (an old sheet or your worn-out undershirt). You will have refined tallow, sometimes called Russian tallow.

A little bit of tallow will go a long way; too much on brass screws tends to tarnish them. Many old-timers used to drill a hole partway through the workbench and fill it with tallow. Then they would have it handy for dipping screws during construction.

—*Sandy Cohen*

Our front doors had been stripped by immersing them in a lye bath. I was told by the dealer that I must apply straight vinegar to them to neutralize the lye. The doors were hung, the better side to the interior and the other side to be stained on the outside. The painters applied an Olympic barn red stain to the exterior before I applied the vinegar. Afterwards I noticed brown streaks on the unfinished interior sides, sticky and wet to touch. I applied liberal doses of vinegar to the interior side of both doors. After a time, the exterior of the doors began to bleed; the stain ran. The painter suggested varnishing on top of the stain, and we did. The doors are now a complete mess, especially on the exterior. Can you help?

—*Patricia M. Brooks, Manakin-Sabot, Va.*

Undoubtedly, the lye remaining in the wood after stripping is partially responsible for the mess on the exterior of your doors. It will degrade your stain over a period of time. It probably will also attack the varnish that you put over the stain. Your only recourse is to take off all of the varnish and stain you can, using any of the paint removers carried by your local hardware store. Then wash both sides of the doors with vinegar in order to neutralize the lye deposits in the wood. Then wash well with clear water, let dry and sand or steel-wool off any grain that may have raised. Now you can begin again with the stain and/or varnish.

But back to the sticky streaks. I suspect that you have pitchy wood, with the pitch or gum coming to the surface either under the influence of time and heat or the lye treatment, or both. Sometimes by washing the streaked areas several times with a solvent such as mineral spirits one or two times, you can eliminate the condition, especially if the gum or pine resins are mostly on the surface. But if it is deep down in the wood, it usually is a non-repairable condition. I've had pitchy wood streaks in pine "bleed" for years, in severe cases.

—*Don Newell*

Follow-up:

George Frank's answer on staining and filling veneers (in *FWW* #25, Nov. '80, p. 30) was incomplete. I'm sure readers

who work with inlay know that colored veneers are available. There are many reasons other than poor planning for staining a part or portion of a marquetry piece. Several coats of fresh, clear shellac mixed with an equal amount of denatured alcohol should be applied to the areas not to be stained. Then if any stain gets on these areas it can be sanded off. Lacquer or varnish can be applied over this for a final finish.

The best way I've found to fill open-pore veneers is to apply six to twelve coats of a clear finish (lacquer or varnish) with lots of sanding between coats until the pores are filled. I don't recommend regular colored wood fillers for working with marquetry. *—Pete Rose, Saddle Brook, N.J.*

I have a very quick and easy solution for Larry Green's problem with setting jointer knives *(FWW #23*, July '80, p. 19). The method given in that column is alright but it can take a lot of time to set up. My way is to set the outfeed tables as close as possible, get a short (18-in.) piece of jointed ¾-in. board and take a light cut on one edge for about 1 in. Now using a soft-lead pencil, shade this 1-in. jointed area. Then reverse the board and joint it down its entire length. If the pencil marks wipe off completely, the outfeed table is too low and you'll want to raise it a few thousandths of an inch. If the marks are not wiped off at all, the table is too high and will have to be lowered. When the jointer is correctly adjusted, most of the pencil marks should be wiped off by the knives, leaving just a trace behind. *—Floyd R. Verstl, Stockton, Calif.*

Readers want to know:

I own a wood lathe made by Duro Metal Products Co. before 1940. There are several parts missing and I'd like to have them replaced. Does anyone know where I can get any literature (owner's manual or parts list) about this lathe?
—Wally W. Trotter, Winnepeg, Manitoba

Readers can't find:

I'd like to learn of a source for cast brass (not stamped) card-holder drawer pulls, like those on library card-catalog files.
—William Huggins, Issaquah, Wash.

...a mail-order source for large barrel nuts for ⅜-in. bolts and larger. *—Edgar Gibson, South Floral Park, N.Y.*

...a supplier of walnut and maple burls for turning blanks.
—Vincent Henderson, Rapid City, S. Dak.

...plans or measured drawings for a platform rocking chair.
—Craig Steele, Asheville, N.C.

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—Duane Van Horn, Lexington, Ky.

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Send queries, comments and sources of supply to Q&A, Fine Woodworking, *Box 355, Newtown, Conn. 06470.*

The Wendell Castle Book of Wood Lamination by Wendell Castle and David Edman. *Van Nostrand Reinhold Co., 135 W. 50th St., New York, N.Y., 10020, 1980. $18.95, hardcover; 160 pp.*

Walking through Wendell Castle's studio and shop, you get a strong sense of order, decisiveness and clarity of purpose. Looking at his laminated and sculpted furniture in the upstairs gallery, you're struck right off by the bold assertion of line and form and by its subtle varieties of color and texture. In his shop below, you find industrial-grade machine tools, workbenches and handtools arranged to advantage in a working environment that would satisfy the most meticulous craftsman. The short of it is that Castle, of Scottsville, N.Y., is one of the country's most talented and innovative furniture designers. He's an ingenious technician as well, enjoying a rare and uncanny ability to realize his conceptions with an efficiency that improves rather than compromises their quality.

Now Castle has written a book (his first) to share his 20 years' experience designing and constructing laminated wood furniture. The book begins with a brief introduction to the craft of lamination, its history, its potential for design and its essential difference from conventional woodworking. Describing the construction of a jewel case, he demonstrates how asymmetrical, organic shapes can be made by gluing layers of wood together and carving the resulting mass. This is followed by a chapter about the array of hand and power tools you need to do Castle's kind of work. Although the list of tools is helpful, there's not much advice on how to use them, advice especially needed about such unfamiliar tools as the electric chain saw, the ball mill and the pneumatic chisel. More disappointing is this chapter's cursory treatment of adhesives. Because much of Castle's furniture lacks mechanical reinforcement and depends wholly on glue to hold it together, a thorough treatment of glues, their specific applications and their particular working properties, seems in order. Instead, Castle summarily dismisses the subject as "an exercise in tedium" and confesses that he usually uses ordinary yellow glue, plus Cascamite for oily woods like teak. Many readers would have benefitted from an account of the experiences that led him to rely on these two glues.

After a discussion of designing for lamination, six chapters present the three basic methods of laminating wood structures. Castle's strategy here is to describe a method more or less in the abstract, then to follow with a chapter illustrating a specific application. First he deals with bentwood laminations, telling briefly how to make a curved gluing form, how to rip boards into thin strips or laminae and how to bend these around the form and glue them together to make a single component. He exemplifies this method by showing how to make his well-known bentwood music stand.

Next comes Castle's basic method, stacked lamination, whereby sculpted shapes are made from a series of layers glued one atop another *(FWW #5*, Winter '76). Imagine a contour map of a hill, each line representing a slice through the hill at a given elevation. If you wanted to make this hill out of wood, each line would define a layer or lamina, and the plan-view contours of each would probably vary from one layer to the next. Large laminations are usually hollowed (the centers sawn out of each layer and the halves edge-joined together) to reduce weight and wood movement. Castle demonstrates by showing us how to build a typical stacked table. Beginning with a working model, he describes making the layers, gluing, clamping and finally carving the tree-like form of the pedestal.

The last technique Castle describes is bricklaying, a method of gluing together relatively short segments (at least three layers thick) to form long, snake-like pieces. Like a serpentine brick wall, your form can twist and writhe in almost any direction as long as each segment sufficiently overlaps the ones above and below it. This technique, along with several variants—scarf lamination, fan lamination and barrel lamination—has great potential for the craftsman who wants to create twisted, involuted forms in sculpture or furniture. A bricklay coffee table illustrates the method.

Castle's strategy of presenting the material this way succeeds by giving us tangible proof of the basic techniques, and each exemplary piece helps us to imagine further uses for the methods. But readers with little experience in making laminated structures could do with more detailed advice on how to use certain tools and how to avoid nagging problems like rising gluelines. The closing chapter is a portfolio of photographs meant to "display the versatility inherent in the lamination techniques." And it does just that, though it's heavily weighted in favor of the stacked pieces that are Castle's forte, and gives short shrift to bentwood furniture.

In light of Castle's stature as a designer and craftsman, you'd expect his book to be an unqualified success, with thoughtful writing on design and coherent, carefully detailed treatments of laminating and sculpting techniques. But this is not entirely the case. The book is flawed by several peremptory pronouncements on aesthetics and by overly general advice on tools and shop practices.

Early on, Castle says that traditional furniture forms are effete, basically cubelike structures and that working within them confines us to a "rectilinear aesthetic." But, he promises, by abandoning traditional joinery and adopting his lamination techniques, the craftsman can free himself from "the necessity to operate within the confines of line and plane," and can become able to construct around the design rather than the other way around. He further argues that any design based on "extant furniture forms" or "dependent on the techniques of contemporary or period furniture" is "doomed to failure." This seems a heavy judgment, leaving us little choice but to follow Castle's design prescriptions (investigating and interpreting organic shapes) if we want to avoid what he calls "witting or unwitting plagiarism."

Later, we learn that the designs "inherent in the lamination techniques" are no less subject to structural and technical imperatives than are pieces made the old way. Wood laminating, like conventional joinery, requires strict adherence to an entire body of mandatory principles, else the piece we build will fall apart. We must consider grain direction, wood density and moisture content, balance and weight. We must provide for perfectly jointed gluing surfaces, precisely parallel laminae, clamping ears and other "mundane demands of actual construction." The freedom from "lines and planes" that was promised earlier turns out to be just another kind of servitude. And so it should.

Despite its shortcomings the book is valuable for its presentation of the basic methods of laminating wood and the design possibilities these techniques bring to the craftsman. Though we might wish for more specific technical information, we are given enough to begin our own explorations into laminated furniture forms and a wealth of illustrative photos. The book is valuable in another way. It reveals how one designer/craftsman has gone about the business of selecting tools and equipment, setting up shop and, more importantly, how he has gone about creating his own distinctive and personal mode of expression in wood. *—John Lively*

John Lively is associate editor of Fine Woodworking.

FIGURING COSTS

BY DIANE SNOW CROCKER

One of the woodworker's most fundamental tools, profit is the primary source of working capital. Without profit it's difficult to keep your enterprise afloat, and it's impossible to expand your production potential. Increasing shop space, investing in additional equipment or replacing worn-out machines and tools and purchasing materials in economical quantities are all made possible by profit. How can you be certain to make this profit? The following is a system, consisting of three interrelated parts, that I developed after swallowing the bitter pill of experience more than once.

First is the working drawing from which price estimates are determined; second is the pricing sheet, which determines the production schedule; and third is the job cost ledger, a record of the actual materials and labor inputs, which determines whether the selling price is accurate. We submit the design drawing to the client; because it's drawn to scale, it can serve the dual function of sales and contract document, as well as the shop's working drawing. When the client signs the sales contract, the design has already been priced. Pricing is done on a standard form, on which we itemize the quantity and cost of materials, and the labor functions, including any specialty costs (subcontractors, consultants).

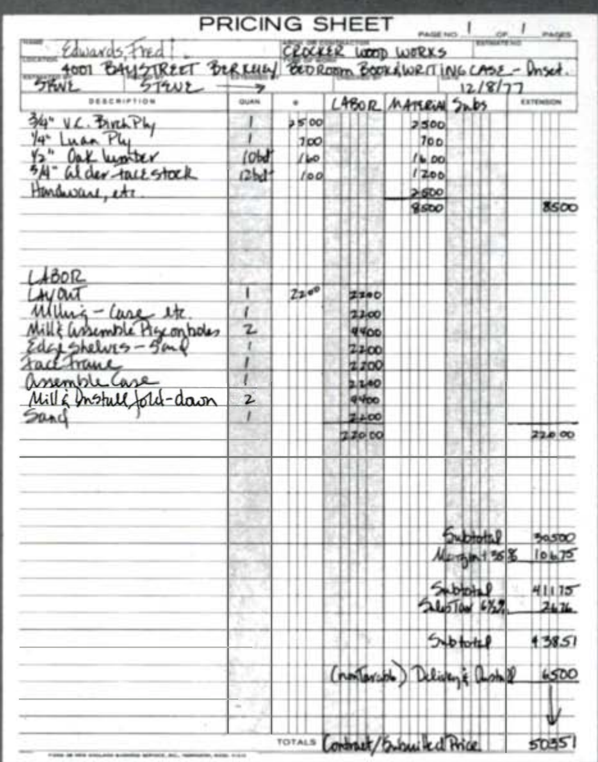
The degree of detail into which we break down labor procedures depends on the complexity of the process. If a piece requires any fancy mechanics, jigs to be made or special shaping to be done, then the accounting must be more detailed. Careful itemization of all the different operations is necessary later to reach a realistic assessment of how time is spent during the job. I estimate the time each operation will take and figure the total labor costs.

When all the production factors are projected and cross-checked for oversights, they are then subtotaled. The profit margin (anywhere from 35% to 100%, depending on the job) is computed and added for a second subtotal, then sales tax is added. Finally we compute the delivery and installation costs and add them, because this is non-taxable labor. Assuming the client signs the contract, we schedule the job into production. I prepare a production schedule for the shop from the price estimates' projected labor/process column. The workers in the shop use this as a guide to budget their working time in each phase of the job. If time runs over on one process and under on another, it all balances out. But if chronic overruns occur, you can look either to your skill in estimating or to your own time management, and then adjust these on your next estimate. Finishing ahead of schedule doesn't occur nearly as often—and it doesn't seem to sting when it does.

The real control in this method is the job cost ledger. We use a standard office form that has the advantage of being an envelope to catch stray receipts or bits of information relating to the job during production. Throughout the entire production process, the craftsman has the responsibility of recording each and every bit of "input" (both labor *and* materials) on the form at the time the operation takes place. This is the real trick because you get focused on the work at hand and don't always want to interrupt a train of thought to make the record. But if you leave recording it until the job is complete, it rarely gives a true picture of the production process. Because it's easy to fudge, you have to bring the ledger up to date at regular intervals during the working day.

After the job is done, dollar values are assigned to the entries of time and materials used. The facts of profit or loss clarify themselves, and what could easily become a habit of unrealistic estimating of your production capabilities can be remedied. You can learn from your mistakes instead of simply suffering with them, and in so doing, sharpen your judgment. Accurate job costing pays off in many ways. □

Diane Snow Crocker is a design consultant in Lafayette, Calif.



PRICING SHEET — Page no. 1 of 1 pages

Name: Edwards, Fred — Crocker Wood Works
Location: 4001 Bay Street Berkeley — Bedroom Book & Writing Case – Inset.
Steve — Steve → — 12/8/77

Description	Quan	$	Labor	Material	Subs	Extension
3/4" V.C. Birch Ply	1	25.00		25.00		
1/4" Luan Ply	1	7.00		7.00		
1/2" Oak lumber	10 bd'	1.60		16.00		
3/4" Alder face stock	12 bd'	1.00		12.00		
Hardware, etc.				25.00		
				85.00		85.00
LABOR						
Layout	1	22.00	22.00			
Milling – Case etc.	1		22.00			
Mill & Assemble Pigeonholes	2		44.00			
Edge shelves – Sand	1		22.00			
Face frame	1		22.00			
Assemble Case	1		22.00			
Mill & Install fold-down	2		44.00			
Sand	1		22.00			
			220.00			220.00
Subtotal						305.00
Margin 35%						106.75
Subtotal						411.75
Sales Tax 6.5%						26.76
Subtotal						438.51
(non-Taxable) Delivery & Install						65.00
TOTALS Contract/Scheduled Price						503.51

JOB COST ENVELOPE

Name: Edwards, Fred — Job No.
Location of job: 4001 Bay Street, Berkeley
Send Bill to: Same. Address
Date Commenced 12/10/78 — Date Finished 12/14/78 — Date Billed 12/15/78

Material	Amount	Labor (Process/hrs)	Amount
1 sh. 3/4 B. / 1/4" Birch	31.25	Layout – 1	22.00
11 bd' 1/2" oak	17.60	Milling – 2	44.00
1 sh. 1/4" Luan	5.69	Pigeonholes 4	88.00
8 bd' 3/4 Alder	8.00	Shelves 1/2	11.00
2 brass knobs	7.00	Face frame 3/4	16.50
2 catches	1.50	Case 1/2	11.00
24 shelf clips	1.92	Desk Table 3	66.00
for desk hinge	6.90	Sand 1	22.00
3 brass knobs	2.25		
Total	81.65	Total	280.50

SUMMARY OF COST

Material	81.65
Productive labor	280.50
Direct expense	
Overhead	
Sales Tax	26.76
Install/Del	55.00
Total actual cost	443.91
Estimated cost	503.51
Difference	
Selling price	
Net profit (12%)	59.60

Gentle Persuasion

by Maureen Kellogg Kayes

I remember vividly my feelings as Stan and I made plans to be married. Amid thoughts of silver and china patterns and dreaming of a family to be, I had visions of a houseful of beautiful handcrafted furniture, all "whipped up" by my handy husband. Admittedly, he had not built anything more difficult than a bookcase, we would be living in a small student apartment with no shop space, and the only tools he owned were some construction framing tools from a summer job, but none of that mattered. I just knew he could do anything. I just knew that all he needed was some gentle persuasion. What I didn't know was just how involved we would both become in this furniture-building endeavor.

The first piece I maneuvered my husband into making was a pine hutch. We had been married about a year and despite my persuasive efforts (he called it nagging), he insisted that he could not build furniture, giving the typical lame excuses of no space, no tools, no talent. I was ready to give up and planned to buy an unfinished hutch at a local hardware store, although I still secretly hoped that Stan would change his mind at the last minute. Somehow my plan worked. When he saw the poor workmanship (not to mention the price) of the piece I had selected, he decided he would give it a try after all. He started work, using space and tools at his parents' house. As he brought home the lumber, I began unpacking china and rearranging furniture to accommodate it, figuring that by the end of the week we could have a party to show off the finished piece.

Fortunately, I didn't send out any invitations. Weeks went by, and all I heard from my husband was how he had again revised our original design. First, silverware drawers were added, then glass front doors and finally, handcarved trim. I wondered what had happened to all of his self-doubts as I saw his pride and enthusiasm grow, and at the same time I wondered why I had ever wanted handcrafted furniture. I never saw my husband—he was always in the shop. The homemade hutch wasn't costing any less than the store-bought, unfinished version; it was taking forever to make; and for the last straw, I had to help finish it. I was appointed the tedious and boring job of chief sander, which I was convinced he'd given to me to end either this furniture-making idea of mine or our marriage, I wasn't sure which. The hutch was finally completed, but even though it looked good I had had enough. I decided that from then on we would buy our furniture at yard sales and antique auctions.

Time went by and I forgot the amount of work we had put into the hutch, and once again I began to yearn for furniture to fill our empty apartment. Then compliments started coming in and that clinched it. "Wow, you made that!" became the standard comment by our guests, and my ego being what it is, I figured I could get my husband going again so I could

share in the glory. This time he couldn't give me the excuse of no talent, so I made up a list of all the furniture I wanted—a canopy bed, a cherry dining table and matching Hepplewhite chairs, and so on.

I expected some protest, but by now Stan had gotten smart. He simply said he would be glad to build my furniture, but first he needed a few tools. We were both still students but we did manage to buy some hand and power tools. I hoped that these would be enough, but I soon found out that I had unleashed a monster. I kept my thoughts to myself as my obsessed husband looked through junk shops for old planes, through tool catalogs for more saws and chisels, through classified ads for used power tools. I became accustomed to the standard drooling trip through the tool department whenever we went shopping, and waited embarrassed in the car while he scavenged for materials in peoples' spring-cleaning throwaways or rummaged through the worst of junkyards. For all this effort, we had our hutch and two bookcases, a spare bedroom filled to the ceiling with tools and raw materials (trash to me), and an apartment full of sawdust. I could not see how I was ever going to get my furniture.

We finally moved out of our cramped apartment and into a house with attic shop space. Even though all lumber (and finished furniture) had to be carried through a narrow disappearing stairway, it was wonderful to get the sawdust away from the rest of the house. Stan, fresh out of graduate school, was having trouble finding a job and actually found himself with time on his hands. Trying to keep busy, he began sorting through his materials for project ideas. I was ecstatic as his trash collection was converted into some real treasures. A thrown-out dresser, taken apart and stripped down to reveal some beautiful wormy chestnut, became a bachelor's chest. Springs torn out of a rotten chair and some wooden construction pallets combined to form the frame of an upholstered wing chair. Some discarded marble from a mine and some bargain walnut became a Sheraton half-round table, and a coffee table evolved from leftover oak flooring and some weathered oak barn scraps. One by one I began crossing items off my list.

Five years have passed since we built the pine hutch, and today we are a full-blown woodworking family. We live in a house built entirely by ourselves (my masterpiece of maneuver and persuasion), and Stan's basement shop is the envy of all his woodworking friends. We still seem to spend all our money on tools, but now I look at the catalogs too. I have advanced beyond chief sander to become more interested and skilled in furniture finishing, even to the point of offending my husband by suggesting improvements on his finishing techniques. We worked together to build a crib and cradle when our son, Jeremy, was born, and now that I am home with a little more time, I have taken on a few projects single-handedly—some toy shelves, a framed mirror—nothing big, but enough to be proud of. Our hutch still stands in the dining room, although we would like to find the time to make a new one. Somehow that beautiful piece of five years ago seems less impressive as our skills improve. We fight over our woodworking magazines, and Jeremy, now an imitative two-year-old, checks the joints and feels the finish on furniture wherever we go.

Looking back now, I laugh at how naive I used to be about the time and effort that woodcraft demands. On the other hand, though, you never can tell just where a little nagging might lead. □

Maureen Kayes, 27, of Richmond, Va., is a public-health nutritionist. Stan's current project is a canopy bed.

Events

Events listings are free but restricted to workshops, fairs, lectures and exhibitions of direct interest to woodworkers. The next deadline is January 1, for events beginning March 1 to May 15.

ALABAMA: Windtoys, Weathervanes and Whirligigs—juried exhibition of contemporary craft objects moved by wind, March 22 to May 9, Kentuck Center, 501 Main Ave., Northport. Deadline, Jan. 21. Details and entry forms from Kentuck Center, Box 127, Northport, Ala. 35476.

CALIFORNIA: Wood: A Contemporary View of a Traditional Material—conference, March 7-8, $55, includes lectures on tax benefits, grants, slides of Art Carpenter's work, carbide tools, design and environmental considerations, furniture design, woods of the world; demonstrations of figure carving, Japanese carpentry, boatbuilding, turning. 155 Dwinelle Hall, Telegraph & Bancroft Sts., U.C. Campus, Berkeley. Write Steve Collins, University of California Extension, 55 Laguna St., San Francisco, Calif. 94102.

DISTRICT OF COLUMBIA: Clockwork Universe—exhibit of 120 clocks, automata and mechanical globes (1550-1650), to Feb. 15, National Museum of History and Technology, 14th and Constitution Ave., Washington.

GEORGIA: Tables—seminars by Edgar Anderson, Feb. 20-22, March 20-22, Georgia Woodworker, Atlanta. $125 (one seminar); $225 (both). Contact Herb Teeple, Georgia Woodworker, 5015 Spalding Dr., Atlanta, Ga. 30360.

GEORGIA: Skills in Contemporary Woodworking—Saturday seminars, ongoing lecture and demonstration series, $60 per month. Contact George Berry Woodworking Studio, 745 Edgewood Ave. N.E., Atlanta, Ga. 30307.

NEW YORK: Crafts Students League—open shop/demonstration by Maurice Fraser: joinery with traditional and antique tools, 12 to 6 P.M.; edge-tool sharpening and introduction to woodworking, 6 P.M. to 8 P.M., Jan. 22 and Jan. 26. Spring woodworking classes start Jan. 21. Contact the Young Women's Christian Assn., YWCA Bldg., 610 Lexington Ave., New York, N.Y. 10022.

NEW YORK: Furniture Show—Andrew Willner's fantasy furniture in motifs from nature; Tom Lacagnina's abstract furniture designs inspired by geometry; Feb. 12 to March 19. Workbench Gallery, 470 Park Ave. South, New York.

MASSACHUSETTS: Sculptural Furniture—slide lecture by Jon Brooks, Jan. 28, 7:30 P.M., Morse Auditorium Lecture Hall B1, 602 Commonwealth Ave., Boston. Sponsored by the Boston University Program in Artisanry, 620 Commonwealth Ave., Boston, Mass. 02215.

OREGON: Juried Furniture-Maker's Show—February 20-22, Western Forestry Center, 4033 S.W. Canyon Road, Portland.

WEST VIRGINIA: Workshops—Traditional Furniture-Making with Ed Hillenbrand and Dave Kister, Feb. 23-27; Wood Bending with William Hammersley, March 2-6. Crafts Center Cedar Lakes, Ripley, W.Va. 25271.

ONTARIO: Ontario Industrial Arts Teachers Association Conference—May 14-16, McMaster University, Hamilton. Wood workshops include carving with G.W. Van Every, steam bending with Michael Fortune, green turning with Bob Hastings; lectures by Don McKinley, Bob Strini, Steven Hogbin, Wendell Castle; also metal, plastics, leather workshops. Details and registration forms from Les John, 436 Mount Albion Rd., Hamilton, Ont. L8K 5T3.

ONTARIO: Patterns of Growth—show of wood objects and photos of work by past and present students of Sheridan College, Feb. 4 to March 1. Ontario Crafts Council Gallery, 346 Dundas St. W., Toronto.

ONTARIO: Connections: A Canadian Retrospective (1967-1981)—furniture and accessories by Donald Lloyd McKinley, Feb. 16 to March 12, Koffler Gallery, 4588 Bathurst St., Toronto.

There's a wealth of information and ideas in the back issues of Fine Woodworking

Our readers tell us they regard *Fine Woodworking* more as a reference resource than as a magazine because of the timeless and hard-to-find nature of its contents. And because there is so much material to cover (new ideas and techniques pop up all the time) we don't intend to repeat ourselves editorially. All 25 back issues are now available and you can have a complete set for your shop.

1 Turning checkered bowls, making planes, French polishing, marquetry cutting. Plans for stamp box, wall shelf.

2 Eagle carvings, hand dovetailing, buying antique tools, oil/varnish finish, Gustav Stickley. Plans for spiral library steps, Shaker lap desk, rocking camel.

3 Close look at wood, making the mortise-and-tenon, desert cabinetry, turning green bowls. Plans for gate-leg table, stroke sander; survey of plans in print.

4 Krenov's notebook, wood and moisture, ornamental turning, exotic woods, heat-treating steel. Plans for Scandinavian workbench, hidden bed.

5 Stacking, carcase construction, using plywood, drying wood, guitar joinery, making shaper knives, deep bowl gouge. Plans for Gothic tracery, Duncan Phyfe chair, Adam side table.

6 Wooden threads, hand scraping, bent lamination, expanding tables, layout on two sticks, stacked plywood, pricing work. Plans for lumber-drying kiln, serving cart. Survey of woodworking schools.

7 Glues, lute roses, bowl turning, doweling, spalted wood, pine furniture, fan carving. Plans for 3-legged stool, solar dry-kiln, bent-laminated tray. Issues 1-6 index.

8 Steam bending, triangle layout, chain-saw lumber making, bowsaws, moisture meters. Plans for wooden clamps, Aztec drum, flageolet, double-ratchet gout stool, marking gauge.

9 Classical proportions, tall chests, entry doors, drawer bottoms, health hazards, blacksmithing, carving exercises. Plans for extension dining table, Shaker round stand, small turned boxes. Hardware sources.

10 Wooden clockworks, hammer veneering, ball & claw feet, laminated and staved turnings, chain-saw carving, circular saws. Plans for 2-way screen hinges, louvered doors, small workbench.

11 Dovetailed drawers, turning spalted wood, leather inlay, finishing notes, pencil gauges, hanging doors, dulcimer peg boxes. Plans for spinning wheels, scratch beader, Parson's tables, tool cabinets.

12 Greene & Greene, holding the work, tambours, stains and dyes, spindle turning, cleaving wood, sharpening, sanding, checks in veneer. Plans for corner-cupboard cockleshell, dust-collection system, shaving horse.

13 Relief carving, preparing stock, tung oil, roll-top desks, machine maintenance, lumber grading. Plans for turned microscope, endboring jig.

14 George Nakashima, tapered laminations, turning planes, chair critique, incised lettering, airpowered tools. Plans for box-joint jig, world globe, Austrian commode. Issues 1-13 index.

15 Making violins, stalking mesquite, mortise-and-tenon, milk paint, wooden aircraft, routed signs, staved containers, gilding. Plans for router table, treadle lathe, carved shells.

16 Edward Barnsley, wedged and pinned tenons, hollow turnings, preparing to finish, chair critique. Plans for vacuum press, circular stairs, workbench.

17 Sawmilling, timber joinery, bending compound curves, routing for inlays, tips for precision, finishing materials. Plans for solid wood doors, heavy-duty shaper, library steps. Planer survey.

18 Showcase cabinets, tapered sliding dovetails, haunched tenons, rule joint, turning chisels, rubbed finishes, cabriole legs, paneled doors and walls. Plans for drop-leaf and gate-leg tables.

19 Wharton Esherick, oyster veneering, PEG, oil/varnish mixes, chip carving, mortising machines, adjusting the jointer, wooden toys. Plans for baby rattles, toy dragonfly, toy trucks, turner's gauges. Band-saw survey.

20 Michael Thonet, one-piece plywood chair, split ash baskets, woven cane seating, Japanese planes, shaper cutters and fences, chair repair. Plans for fishing net, knock-down tables, adjustable plane, pigeonhole desk. Index to hardwood sources.

21 Hans Wegner, machine design, abrasives, woodturning explorations, ogee bracket feet, hewing, dowel joints, carcase dovetails. Japanese saws. Plans for three sanding machines. Issues 1-20 index.

22 Kerf-bent boxes, cowhide chair seats, solar wood-drying, saw sharpening, furniture conservation, shop math, backed veneers. Plans for easy chair and sofa.

23 Reproductions, blockfronts, turning thin bowls and spindles, carousel horses, hardwood plywood, carbide circular saws, frame-and-panel, pistol cases. Plans for blockfronts, post-and-panel chest, disc sander.

24 Setting up small shops, 3-phase power, making carver's gouges, production woodworking. Plans for vise, walking-beam saw, workbench, lumber rack, tool rack and box, sawhorses. Combination machine survey.

25 Sam Maloof, router rail, dust collection, bandsaw boxes, precision in joinery, butterfly joint, lathe tuning, two chucks, elm and chestnut, marquetry finishing, drawknife. Plans for pedestal table.

To order back issues of *Fine Woodworking*, send your name and address and the numbers of the back issues you want, along with your payment to the address listed below. Each back issue is $3.00 postpaid. ($3.25 foreign). Connecticut residents add 7½% sales tax.

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Two Oliver wood lathes, one table saw, cast-iron top, 38 in. by 54 in. with planer. After 3:30 PM please call (201) 694-6190.

Improved Primus 24-in. jointer, 9-in. smooth planes. English Stanley Multiplane with 24 cutters. $70 each, postpaid. Jim, (414) 468-0971.

Private accumulation for sale: Unisaw, Powermatic, shaper, planer, jointers, tenoner, stroke sander, clamps, mortiser, band saw, etc. (704) 369-9659 or 524-7589. Franklin, NC.

Large quantity of bird's-eye maple, kiln dried. 4/4 and 6/4, $1 to $3.50 per foot. Steve Fowle, Hillsboro, NH (603) 464-5058.

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Combination 5-in. flap and 9-in. balloon sander w/3-PH 220 motor and stand. Will accept best offer over $425. Write Box G, Gray, ME 04039. (207) 657-3800.

Furniture lumber and parts, air-dried, 50+ years, $2 and up/bd. ft. Stanley #45, 23 irons in original boxes, $80. (207) 657-3800 days.

Planes, saws, chisels for sale. Mint-excellent condition. Send for list. W. Zeman, 2419 Ruger Ave., Janesville, WI 53545.

Stanley #45 plane, complete, good condition, $150. Leo Bowler, 6747 Friars Rd. #120, San Diego, CA 92108. (714) 298-3207.

Wood lathe, takes 12 ft. on centers, swings 20 in. No motor or mount. New bronze bearings, 8 rests 4 in. to 28 in., 4 faceplates 4 in. to 18 in., $1,000. Wayne Rafferty, (804) 266-3366 after 5 PM.

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Will buy complete shop suitable for furniture production runs. Heavy-duty machinery, parts and hand tools only. No goodwill or stock. R. Murray III, 3402 Chase, Adrian, MI 49221.

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Buy or exchange issues of Deltagram, Popular Homecraft, Home Craftsman, Workbench. Robert Demers, 761 Blvd. des Iles, Entrelacs, Quebec, Canada.

Thickness planer or combination jointer/thickness planer. Home shop size. Send price & data to C.E. Newman, 9512 Woodbine, Baton Rouge, LA 70815.

SITUATIONS WANTED

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Seek apprenticeship with master cabinetmaker. Have varied experience in sculpture, leather, knives. Will relocate to New England. Chuck Hean, 5112 Sharon Rd., Camp Springs, MD 20031.

Woodworker with M.A. in Furniture Design seeks position in limited-production shop in Rocky Mt. states/West Coast. Ron Diefenbacher, R 1039 School St., Indiana, PA 15701. (412) 465-7427.

Craftsman with 8 yrs. cabinet/furniture/boatbuilding experience seeks to share space in Maine shop or employment in same. B. Schwartz, 17645 Crabb La., Huntington Beach, CA 92647. (714) 842-0777.

Craftsmen, put a reliable apprentice with carpentry and forestry background in your cabinet/furniture-making shop. Age 24, single. Tom Berry, 916½ N. 10th St., Lafayette, IN 49704. (317) 742-8102, 482-2869.

The CLASSIFIED rate is $3 per word, minimum ad 15 words. Payment must accompany order. The WOOD & TOOL EXCHANGE and SITUATIONS WANTED rate is $2 per line, minimum three lines, maximum six lines, limit two insertions per year. Allow 30 letters or spaces per line, including name and address. The Wood & Tool Exchange and Situations are for private use by individuals only. Commercial accounts must use Classified. Please inquire for DISPLAY CLASSIFIED rate. Send to: The Taunton Press, Advertising Dept., Box 355, Newtown, CT 06470. Deadline for the March/April issue is Dec. 24th; for the May/June issue, Feb. 25th.

Connections

In CONNECTIONS, *we'll publish membership calls for guild-style organizations, letters from authors compiling directories in which craftsmen might like to be listed, and appeals from readers with special interests looking for others who share them.*

An established Pittsburgh art gallery wants wood art in the form of carvings and constructions for resale. Contact the Gallery, 3898 Old Wm. Penn. Hwy., Pittsburgh, Pa. 15235.

The Western Pennsylvania Woodworkers Club met Sept. 20, 1980, at the Parkway West Technical School in Allegheny County. The highlight of the meeting was a toolmaking and steel-tempering demonstration by Ernie Conover of Conover Woodcraft Specialties. The club now has 61 members, and new members are welcome. Club activities include four meetings a year, three with guest lecturers and/or presentations, and a spring show/sale to display talents and raise funds. Write Thomas Peer at Box 8520, Pittsburgh, Pa. 15220.

We are opening The Northwest Gallery of Fine Woodworking at 115 S. Jackson, Seattle, Wash. 98104, in order to make custom handmade furniture and sculpture available to the public. This is the first showroom of its kind in the area. For further information, please contact David Gray or Kate Joyce at the gallery, or visit us between 11 A.M. and 6 P.M., Tuesdays through Saturdays.

Out of the Woods, a gallery exhibiting fine contemporary and traditional woodwork, whose owners are professional woodworkers, is seeking new work to sell. Please send at least 10 slides representative of your work. Write Dan Atwood or Mike Keleher, Out of the Woods, 16 South Pack Square, Asheville, N.C. 28801.

Bob Prothero, Sr., an experienced builder of wooden boats, is starting a school in the art and craft of wooden boatbuilding. During the six-month, full-time course, students will build medium-displacement cruising sailboats with decks, cockpits and cabins. About 85% of the time will be spent in the shop, the rest devoted to the classroom and visits to local boatyards. The school opens in January, 1981; tuition is $300/month. For more information, write Libby Palmer, Administrator, the Prothero School of Wooden Boatbuilding, Box 401, Port Townsend, Wash. 98368.

For a survey of general and special-interest woodworking schools, see pp. 92-95.

Gimson and the Barnsley clan pose at Pinbury around 1895. From left to right: Sidney Barnsley, Lucy Morley (later Sidney's wife), Ernest Gimson, Mrs. Ernest Barnsley, Ernest Barnsley with his daughters Mary and Ethel. Photo: Leicestershire Museums, Art Galleries and Records Service.

Gimson and the Barnsleys

Fathers of contemporary craftsmanship

by Roger Holmes

To retreat from the din of industrialized life and to begin anew as an individual craftsman making furniture one piece at a time seems an idea very much of our day. Our current disenchantment with mass production and its shoddy, monotonous products is pervasive—so much so that it is easy to forget that the ideas motivating today's generation of designer/craftsmen are almost a century old. New Yorkers fleeing to small workshops in rural Vermont and Midwestern bankers taking up mallet and carving gouge are not pioneers, but the descendants of three young architects who in 1893 left London for Gloucestershire's Cotswold Hills. They were Ernest Gimson and the brothers Ernest and Sidney Barnsley. Moved by a dissatisfaction with industrially made goods and by a philosophical rejection of anonymous, impersonal methods of production, they found in the Cotswolds a living tradition of craftsmanship that had been sheltered from the ravages of the industrial revolution.

Here they hoped to revive the dying crafts of building and to restore to them the dignity and purpose of making things by hand. Not an isolated trio, they shared these goals with others in what became known as the Arts and Crafts Movement (see box, page 54). The traditions they rescued and the standards of design and aesthetics they set are still with us today. Their social experiment, based on cooperative manual labor and disdain for the machine, failed. Nonetheless, their workshops remained open and their craftsmen busy for almost 30 years. This was possible only because Gimson and the Barnsleys all had independent sources of income. Their successors were able to carry on only by accepting the machine.

Gimson and the Barnsleys made their move by leasing Pinbury Park, a 17th-century Cotswold stone house in a lovely wooded valley near Sapperton village. Ernest Barnsley and his family took the main house, while the two bachelors converted outbuildings into cottages. A third outbuilding became a workshop, where Gimson set up his pole lathe and plaster molds and the Barnsleys their cabinetmaking benches.

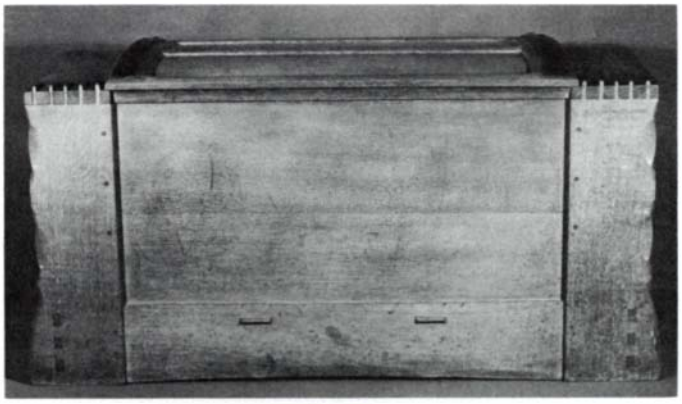
Pinbury fulfilled their dreams of gentlemanly country life. It was idyllic, perhaps too much so, for around 1900, Gimson's friend Alfred Powell chided Gimson for his lack of application. This prodding was taken to heart; Gimson and Ernest Barnsley formed a partnership to establish larger workshops. At the same time their landlord, Lord Bathurst, reclaimed Pinbury Park and leased them Daneway House, at the other end of the valley, giving land and money to build cottages for themselves between Pinbury and Daneway.

Daneway was a godsend. A beautiful stone house dating from the 14th to 17th centuries, it still had its original open stone fireplaces, oak doors and fittings, stone-mullioned windows and modeled plaster ceilings. Repaired and whitewashed, it became showrooms; adjacent stables accommodated enlarged workshops. Although Gimson was a big man, he was not strong enough to do sustained work at the bench; both he and Ernest Barnsley saw the need to employ professional cabinetmakers if their business was to expand and succeed.

By 1902 Daneway was ready and the future looked bright. Sidney Barnsley wrote to the architect Philip Webb, "My brother and Gimson have already started workshops at Daneway having 4 or 5 cabinetmakers and boys so far, with the hopes of chairmakers and modelers in the near future. I am remaining an outsider from this movement—still going on making furniture by myself and handing over to them any orders I cannot undertake, and orders seem to come in too quickly now as we are getting more known." Things went well for several years, but in 1905 a disagreement ended Gimson and Ernest Bansley's partnership. Gimson took charge of the Daneway workshops, while Ernest Barnsley returned to architecture.

Ernest Barnsley rarely built furniture after 1905. His private income allowed him to practice architecture at an unhurried pace. Rodmarton Manor, begun in 1909, was his most important building, and it occupied him for the rest of his life. Built of Cotswold stone and pitsawn timber from local woods, it was probably the last house of its size in England to be built in the old way. With furnishings designed and executed by Sidney Barnsley, Rodmarton was a complete expression of their shared ideas.

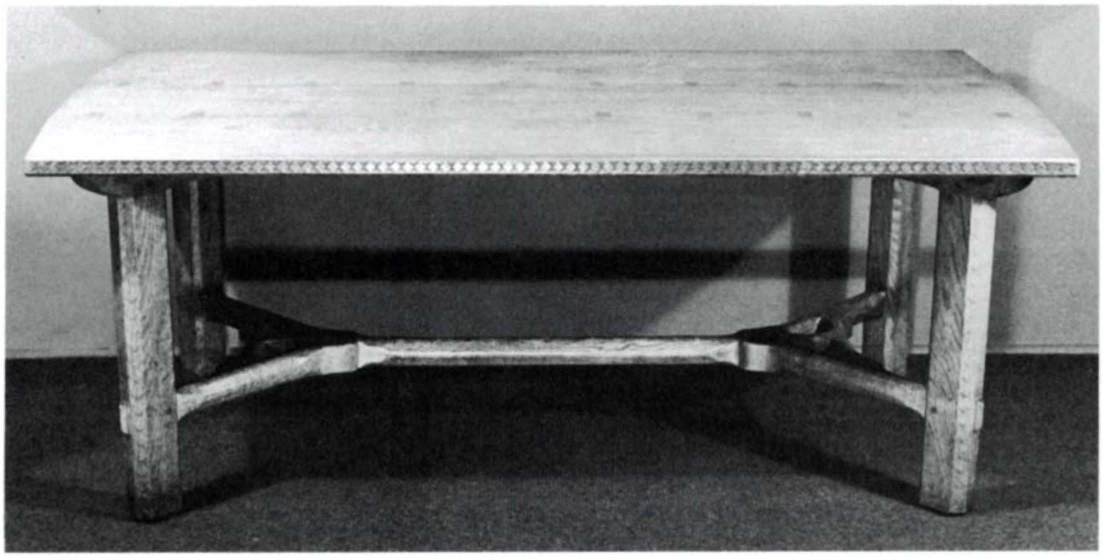
During the Pinbury years, Sidney Barnsley had steadily made furniture; much of the friends' future success may be attributed to his persistence. In the workshops next to his cottage he continued to work on his own, believing it wrong to delegate work to others. His own words, written to Philip Webb in 1904, best describe his life and work: "My workshop which I have to my 'lone self' is a great improvement upon the Pinbury one, much better lighted and being thatched is warmer and drier. . . . I am still occupied principally in making good solid oak furniture with occasional pieces of a more elaborate kind as a rest and change. I have just finished two tables of English oak. . . and they have given me a fair dressing down and by night time I have felt fairly tired out."



Domed oak chest made by Sidney Barnsley at Pinbury around 1896. With its through tenons, protruding dovetail pins, wide stiles and paneled lid, the chest resembles 13th-century examples. Its edges have been cunningly shaped and scalloped with controlled cuts from a drawknife.

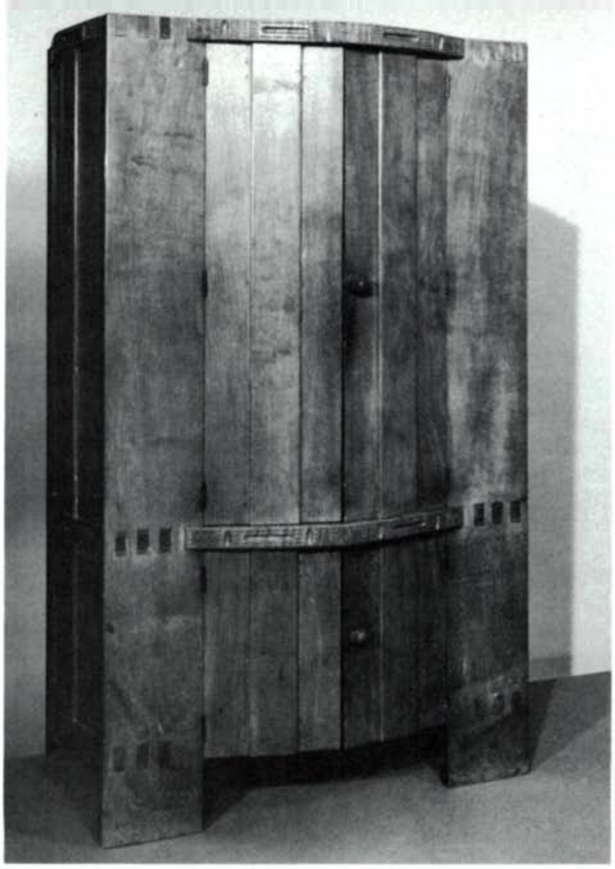
Of the three, Gimson was and is the best known. The Daneway workshops provided the perfect outlet for his talents. While still a student, Gimson had spent some weeks with a bodger learning to make traditional, rush-seated chairs. At Daneway, he set up young Edward Gardiner, son of the owner of the local sawmill, as a chairmaker, and this became Gardiner's life's work. Gimson later established a blacksmith's shop and found another local lad, Alfred Bucknell, who had a deft and sensitive touch. Gimson often combined function and decoration in cabinet latches and hinges, which Bucknell and three assistants forged, along with door hardware, firedogs and decorative wall sconces.

But the center of Gimson's activities was the woodworking shop. There a dozen or more men and boys made the furni-

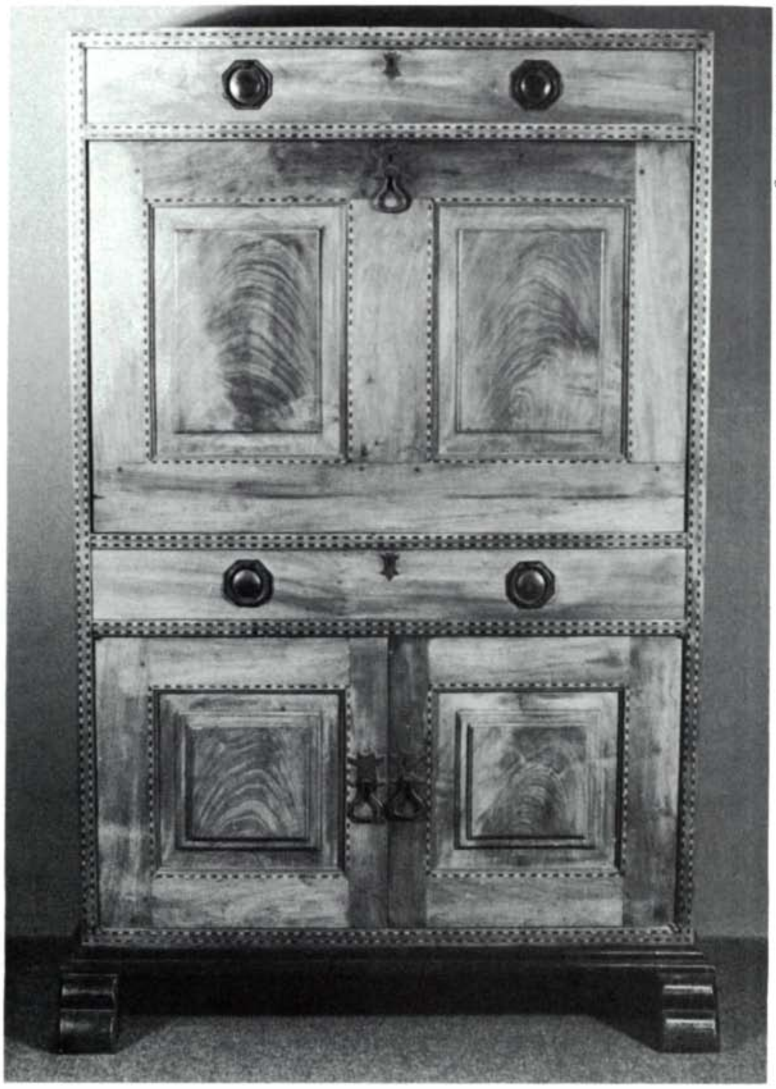


Sidney Barnsley's oak dining table has a top reinforced with inlet butterfly keys, and its edges are decorated with a chip-carved diaper pattern, as are the outer edges of the legs. Heavy chamfering and hay-rake stretcher enhance the subtle geometry of the piece.

Photos, except where noted: Cheltenham Museum and Art Gallery



Victoria and Albert Museum



Council of Industrial Design

Ernest Barnsley made the oak wardrobe shown above in 1902. Its massive simplicity, exposed joinery, batten doors and chip-carved embellishments exemplify qualities that William Morris admired in medieval furniture. These heavy oak pieces of the Pinbury period were far too severe for most customers. Later pieces, like Sidney Barnsley's walnut fall-front desk, c. 1908, shown at right, are lighter and more refined, though they still incorporate many of the same design elements as the Pinbury pieces. The fall-front desk, though simple and rectilinear, is elaborately detailed. The panels in the lower doors are double fielded and have rounded shoulders. The frames and carcase edges have been defined with holly and ebony stringing. The iron hardware, particularly the horned escutcheons, has an oriental appearance.

The living room of Sidney Barnsley's cottage at Sapperton, left, with its whitewashed walls and unpretentious furnishings, shows the influence of William Morris' dictum that furniture should be 'solid and well made in workmanship, and in design have nothing about it that is not easily defensible, no monstrosities or extravagances, not even of beauty lest we weary of it. . . well made and well proportioned, but simple to the last degree.' At right, oak cabinet on stand designed by Ernest Gimson and made in his workshop in about 1910. This unusual chest has drawers in its sides. The central door surrounded by drawers was an arrangement used often by Gimson and the Barnsleys, as was the latticework stand, a feature adopted by Gustav Stickley (see FWW *#2, Spring '76, pp. 44-45) and others in the United States. Through tenons and finger joints, along with banded inlay, punctuate the flat surfaces of the piece.*

ture, churchwork and joinery for which Gimson is remembered today. They were prolific; a 1907 London exhibition included 45 pieces of cabinetry, small chests and tables and 14 different chairs, as well as 20 pieces of ironwork. From the exposure Gimson's work received in exhibitions and articles in periodicals like *The Studio* and *Country Life,* it was sought after by those who wanted and were able to pay for meticulous handwork and original designs.

Gimson believed strongly in the virtue and superiority of handwork, and the only machine at Daneway was a small treadle circular saw used to cut decorative inlays. His men were highly skilled but not unique. In those days, woodworking machinery was crude, cumbersome and expensive, and handwork was still necessary, even in industry. Late Victorian and Edwardian cabinetmakers were perhaps the finest in history, rendering the tortuous curves of an Art Nouveau sideboard and the architectural extravagance of a Gothic Revival cabinet with equal facility. It was design, not execution, that distinguished Gimson's furniture from its fashionable rivals.

Gimson and the Barnsleys reduced furniture to its functional parts and allowed the natural beauty of the wood and the vigor of the basic construction to stand as its own ornament; they practiced what earlier theorists had preached. Multiple fielded panels and various geometric inlay bandings set off and controlled the grain and figure within the furniture's simple forms. Through dovetails and wedged tenons, formerly hidden beneath applied ornament, now declared structural honesty and the presence of the maker.

During the Pinbury days, working on their own, they built simple, massive oak pieces, with heavy chamfers and chip carving, left unpolished and clean from the tool. At Daneway, they made lighter, more elaborate and finely finished pieces in solid walnut, mahogany and ebony, using satinwood, elm burl and flamed crotch mahogany veneers. But the basic simplicity of line and form remained.

They did not use new methods or new materials. Occasionally their principles overruled sound cabinetmaking practices, as in their refusal to use screws or to polish drawer sides and runners. Their principles also led them, at Pinbury, to try to make furniture that working-class people could afford, but, like William Morris before them, when they had to choose between low cost and quality, they chose quality.

The year before World War I dragged the Cotswold valleys into the 20th century, Gimson employed 10 cabinetmakers and a number of apprentices. Peter Waals, the foreman, Harry Davoll, Percy Burchett, and Ernest Smith had been with him since the move from Pinbury; they were the heart of the workshop. Their skills allowed Gimson a freer hand in design, and their practical experience broadened his own knowledge. This was particularly true of Waals, a talented and sensitive maker whose training in Holland and experience in Belgium, Germany and Austria gave him a wide knowledge

This walnut sideboard represents a refinement of Gimson's style under the influence of his skilled cabinetmakers. Though Gimson himself preferred a rougher look, one 'akin to that of the village wheelwright's,' Waals insisted on the flawless execution of details and a near perfect finish.

Unlike Gimson and the Barnsley brothers, Peter Waals was not averse to the use of woodworking machinery, though even in his shop at Chalford shown here (c. 1925), most of the work was done with traditional hand-tools. Note the treadle-powered table saw in use in the rear of the shop. Edwardian cabinetmakers such as these were perhaps the finest in history. Photo: Graham Light, Abbey Studios.

Gimson was fond of using the kind of quarter-round molding shown below on the single and multiple fielded panels of this macassar ebony chest-on-stand, shown at the 1907 London show. The drawer pulls are steel. The legs of the stand have been chamfered with a drawknife and inlaid with mother-of-pearl diamonds. The floral patterns on the panels, also mother-of-pearl inlay, are probably derived from examples in medieval parish churches he visited.

Photos: Leicestershire Museums, Art Galleries and Records Service

of the craft. Wages were low and so were retail prices, but many pieces sold for more than their maker earned in a year. It is fair to assume that the workshops just paid for themselves and that Gimson lived on his private income.

Gimson and his men undertook a wide variety of work in wood. From February, 1914, to January, 1915, over 200 items were made, from fine cabinetwork to carpentry. Gimson had designed two cottages for Morris' daughter at Kelmscott Manor, and their windows, doors and two elm staircases were made at Daneway, as were similar items of joinery for a nearby farm. Churches required a higher class of joinery and provided them with much work through the years. Most of the work, however, was on domestic furniture, including every conceivable item from cakestands and trays to elaborate writing desks and wardrobes. Gimson's customers were aristocrats, or well-to-do members of the middle class, who might furnish several rooms completely with his furniture. In addition, boxes, picture frames, sideboards, chests of drawers and writing cabinets were made speculatively.

Gimson may have visited Daneway as few as two or three times a week. Waals ran the workshops from day to day, organizing and distributing the work, purchasing materials, assisting the younger men, as well as making pieces himself. Usually one man, working from Gimson's scale drawings, was responsible for a job from beginning to end. Traditional techniques were second nature to these men, precluding the need for detailed working drawings, except for unusual features or curves, which were set out at full scale.

Gimson and the Barnsleys were modest men. According to Edward Barnsley, Sidney Barnsley's son, they "never thought of themselves as artist/craftsmen or spoke of design or designing: They were just doing a job as well as they could." Their best was very good indeed, and increasingly in demand, but World War I forced Gimson to close his shops in 1918, and they were reopened only briefly before his death in August,

1919. Ernest and Sidney Barnsley continued working, dying within nine months of each other in 1926.

During their thirty years in the Cotswolds, Gimson and the Barnsleys put many Arts and Crafts theories to the test. The design principles stood up: Their furniture was well received and the workshops were busy. But they existed, until the last few years, only with the support of Gimson and the Barnsley's private incomes. Handwork, and the good life of the craftsman, were still at odds with modern society; the Arts and Crafts Movement had not won that battle.

Gimson and the Barnsleys had rejected machine production as artistically and socially tainted. But by 1900, when the movement's aesthetics had been accepted, its attitude toward the machine was being questioned. Two years earlier, a fashionable London store had introduced a line of plain oak furniture whose austere simplicity contrasted with much contemporary Arts and Crafts work. Abroad, the Germans had embraced industry; in 1905 the Arts-and-Crafts-influenced designers of the Deutscher Werkstatten exhibited furniture "specifically developed from the spirit of the machine."

The English, always ambivalent towards industry, waited until 1915 before establishing the Design in Industries Association to improve the standards of industrial design and the public's appreciation of them. Its early adherents included Gordon Russell, who was to become its advocate in furniture design. Russell, born in 1895, lived in the Cotswold village of Broadway, and his early work resembled Gimson's. By the mid-1920s he saw, like Gimson before him, the potential for expansion. He also saw its necessity. Since the war, wages had risen steadily, the older craftsmen were dying and the young preferred the unskilled but highly paid work in industry to the long apprenticeship and low wages of craftwork. Russell enlarged his workshops and installed machinery, but he set high standards, using handwork where machines were not its equal. Russell's designs reveal an Arts and Crafts approach to materials, form, function and craftsmanship. Moderate, sensible and pleasant, this furniture set a standard for British industrial furniture that continues today.

The handcraft spirit was kept alive in the Cotswolds by Peter Waals, who set up his own business following Gimson's death, and he employed many of Gimson's men. Waals was a competent designer in the Gimson style, and an astute businessman. His workshops, modeled on Daneway but incorporating basic machines, successfully produced fine furniture until his death in 1937.

During the 1920s a few small woodshops were established, but the interest in craftwork was waning. The man who did the most to ensure its survival was Edward Barnsley (*FWW* #16, May '79), who still works today in his Surrey workshops. Like Gimson, he employed craftsmen and apprentices to execute his designs. During a career spanning over half a century, his style has evolved from the sturdy severity of his father's oak pieces to a refined classicism reminiscent of the late 18th and early 19th centuries. Throughout, he has maintained the high standards of Gimson and the Barnsleys, stressing the sensitive use of fine woods, but showing a greater willingness to use new materials and new techniques. His furniture and his many former apprentices and students have helped to extend the small-workshop tradition of the Arts and Crafts Movement through Britain, the Commonwealth, and the United States. →

Roger Holmes, an American cabinetmaker, lives in London. His analysis of the Arts and Crafts Movement begins on p. 54.

Elegantly simple walnut side chair with drop-in rush seat, below right, was designed by Ernest Gimson around 1919. Many variations of this chair were produced by other craftsmen in the following years. Ladder-back ash armchair with rush seat, below left, was made by Edward Gardiner, whose career in chairmaking was encouraged and supported by Gimson. Neville Neal, a former Gardiner apprentice, continues to make these armchairs today.

The doors on this wardrobe by Peter Waals have multiple-fielded panels—octagons laid over rectangles and squares, which add depth and interest to the unadorned surfaces. The holly and ebony stringing sits proud of its grooves and enlivens the outline of the form. The heavy sled feet have stepped profiles and characteristically chamfered edges. Wardrobes, a necessity in large homes that seldom contained built-in storage, were staple workshop items of the period.

Photos: Leicestershire Museums

The Arts and Crafts Movement and its Influence

The Arts and Crafts Movement was a broad movement of social and artistic reform that rose in reaction to England's Industrial Revolution—its impersonal mechanization, its dehumanizing exploitation of working-class people and its prolific outpouring of cheap, pedestrian goods. William Morris, artist, craftsman, writer and reformer, dominated the movement. Son of a prosperous broker, Morris was born in 1834 in an England where industrial expansion was rapidly transforming the physical and social landscape. Under the pressure of this change, architecture and industrial design became matters of public concern and much heated debate. As a theological student at Oxford in the early 1850s, Morris was drawn into the controversy, and soon redirected his energies from religion to art, though he always retained great concern for man's spiritual needs.

Pine and mahogany cabinet on oak stand, above, designed by Philip Webb and painted by William Morris, was made in 1861. Colorfully decorated with scenes from the life of St. George, this sturdy and simple piece evokes the spirit of the Middle Ages. Pugin's huge cabinet, facing page, was shown at London's Great Exhibition in 1851; though the baroque appearance of the piece seems at odds with Pugin's own ideal of design and aesthetics, it well illustrates his mastery of Gothic forms and motifs.

Morris was most engaged by the ideas of A.W.N. Pugin and John Ruskin, men who headed the movement in the nineteenth century for a Gothic Revival in architecture and industrial design. Pugin, an architect and polemicist, believed that art and architecture reflect the moral conditions of society, that a good society will produce good architecture. For Pugin, the good society had been that of medieval England. Its Gothic architecture was true Christian morality writ in stone; from it Pugin distilled "two great rules for design. . . first, that there should be no features about a building which are not necessary for convenience, construction, or 'propriety;' second, that ornament should consist of enrichment of the essential construction of the building."

Ruskin shared Pugin's enthusiasms for the Middle Ages, but for Ruskin, architecture's essence was ornament, not construction. In Gothic ornament he saw the free craftsman, happy in his work; he saw a wholeness in medieval society. Beauty, he maintained, was as necessary to man's survival as food and shelter; in the Middle Ages it had dignified man's labors and given them meaning. Modern mass production degraded both the product and its maker.

Pugin had sought to revive the architecture of the Middle Ages; Ruskin now sought to revive the spirit that created it. Accordingly, he set down three principles for a just society of free and equal craftsmen: "First. Never encourage the manufacture of any article not absolutely necessary, in the production of which invention has no share. Second. Never demand an exact finish for its own sake, but only for some practical or noble end. Third. Never encourage imitation or copying of any kind, except for the sake of preserving records of great works."

Morris' readings of Ruskin gave him a firm direction and purpose. After trying architecture and painting, Morris discovered his talent for designing decorative patterns, which he soon tested in furnishing his new house. This "Red House," an attempt to apply principles derived from Ruskin and Pugin, was built in 1859. It marks the practical beginning of the Arts and Crafts Movement. Designed by Philip Webb in what Morris called "the style of the 13th century," it was a large and pleasant brick house with steeply pitched roofs and simplified Gothic details. Inside, however, it was richly decorated with specially made wallpapers, stained glass, painted tiles and oak furniture painted with medieval scenes.

Pleased with the results, Morris and seven friends in 1861 formed a company to produce similar furnishings commercially. They began with stained glass and furniture, adding carpets, wallpapers and printed fabrics. Morris believed that the designer must be a craftsman, learning of processes and materials firsthand. He threw himself into each new pursuit, learning to weave, to print and to dye fabrics; later he helped revive the art of bookmaking. In the crafts he did not practice himself he encouraged others, like Gimson and the Barnsleys.

The company was a commercial and artistic success, but Morris found his cooperative ideal in conflict with industrial society. By the late 1870s Morris felt compelled to lecture widely, determined to raise the spirit of utopian socialism he associated with the Middle Ages. In January, 1884, Morris lectured on "Art and Socialism" to the Leicester Secular Society, an evening organized by Sydney Gimson, whose recollections of it give us a portrait of Morris. "Ernest [Gimson] and I went to the station, and, two minutes after his train had come in, were at home with him and captured by his personality. It was impossible to feel constrained. . . in his company. He was not a good lecturer. His lectures were always read, and not too well read, but they were wonderful in substance and full of arresting thoughts and apt illustration. In their phrasing and forms they were beautiful."

Later, Sydney and Ernest talked until nearly two in the morning. Morris was much impressed with Ernest and furnished him with letters of introduction, one of which got young Gimson a two-year position with the London architect J.D. Sedding. At Sedding's, Gimson

Photos: Victoria and Albert Museum

met Ernest Barnsley, whose brother Sidney was articled to another London architect. The Barnsleys had much in common with Gimson, and they became close friends. All three had private incomes and traveled extensively during the late 1880s, passionately studying architecture. Sidney Barnsley spent many months in Greece making detailed analyses of Byzantine churches; Gimson traveled widely in England, France and Italy. They admired the great and famous buildings on the Grand Tour, but were equally moved by the modest buildings of rural England—its parish churches, cottages and farm buildings.

In London, Gimson and the Barnsleys were in the midst of a craft revival among architects, who sought to reestablish the cooperation between artists and craftsmen that had existed in the Middle Ages. The Art Workers' Guild was founded in 1884 to encourage "a renaissance of the decorative arts which should act through and towards more humanized conditions for the workman and employee."

In 1886 the Arts and Crafts Exhibition Society was formed to present the movement's ideals and products to a wider public. The Society (from which the movement took its name) staged exhibitions and public lectures for more than thirty years, winning public acceptance for the movement's aesthetics, but not for its politics. In addition, a number of small firms modeled on Morris and Co. were set up by architects. Among these firms was Kenton and Company, established in 1890 by Gimson, Sidney Barnsley and four others to make and sell furniture, plaster friezes, lead work and needlework. But they were forced to abandon the business in 1892 because of a lack of capital. Such failures were only minor setbacks, and by the 1890s the Arts and Crafts Movement was already well known in England and had reached the continent through exhibitions, lectures and magazines, the most influential of which was *The Studio*, first published in 1893.

The influence of the Arts and Crafts Movement in the United States was strong and diverse, from the splendid organic forms of Louis Sullivan's architectural ornament to ex-soap salesman Elbert Hubbard's craft community, Roycroft. Hubbard's magazine, *The Philistine*, and Gustave Stickley's *Craftsman* spread the word.

In 1900, C.R. Ashbee, a frequent visitor to the United States, reported that Philadelphia, Boston and Chicago were "producing among young men that force which with us has developed in the Art Workers' Guild and the Arts and Crafts Movement, which. . .sees in the work of the architect or the practice of his art a moral and ethical responsibility." Ashbee sought out Frank Lloyd Wright in Chicago and met the brothers Greene in California, where the English Arts and Crafts Movement was given a Japanese flavor (for more on the Greene brothers, see *FWW* #12, Sept. '78).

The Arts and Crafts Movement set out to transform society, demanding that the workman find creative fulfillment and pleasure in his work. But the Movement's ideal was frustrated by the industrial society's insistence on seeing the worker as consumer and mass-producer. So, while the design principles of the Movement gained widespread acceptance, its social reforms were thwarted, achieved only in small and differing ways by men like Morris, Gimson, Sidney Barnsley and a few others. They made of the Movement a personal quest for fulfillment, anticipating many of today's craftsmen.

Although Morris, Ruskin, and Pugin misjudged the force of the Industrial Revolution and their imaginings of medieval life were often fanciful, their call for a new order based on the unity of art, work and life was compelling, and has inspired many of today's architects, designers and craftsmen.

However, the most enduring legacy of the Arts and Crafts Movement is its coherent body of design precepts, exemplified in the works of Ernest Gimson and the brothers Sidney and Ernest Barnsley. Simple, functional forms, the restrained use of subtle decoration and a delight in and respect for natural materials are the hallmarks of pieces made by these men. We may still learn from their sturdy, pleasing furniture, which was designed to enrich its owner in use as it had fulfilled the craftsman in its making. —*R.H.*

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The Mosaic Door

Possibilities of the plywood sandwich

by James Rannefeld

Many woodworkers have become dissatisfied with the design limitations imposed by the typical frame-and-panel door, while others are frustrated by the structural problems of the batten door, which weathers rather poorly. There's another way to make a door, one that presents new design possibilities and offers structural improvements over traditional methods. For the past six years I have been refining a technique for building the mosaic door. Essentially a three-layered composite structure with a dimensionally stable plywood panel as its core, this particular type of door can be treated in an endless variety of ways—even made to look like the traditional frame-and-panel door it supplants.

Mosaic technique offers strength, dimensional stability and design versatility. Playing on Art Deco motifs, this design required joining the central components with splined miters.

The core panel itself is best made from a single sheet of ½-in. exterior-grade plywood, which is overlaid front and back with solid wood. Though similar in several respects, my doors differ considerably from the two-layered doors that have been made traditionally in New Mexico by Spanish craftsmen, who typically nailed a rail-and-stile facade over a tongue-and-groove panel, or covered the panel with applied trim. These doors often become leaky from wood shrinkage, not only around the jambs, but also between boards in the door. It was this problem that led me to sandwich a stable plywood core between two outer layers of solid material of virtually any thickness.

An exterior door must withstand great stresses. On the inside, the home environment is typically warm in winter and cool in the summer—the exact opposite of climatic conditions on the outside of the door. Normally the home is uniformly dry, while winter snows and summer rains lash the door's exterior. Yet the greatest problem is direct sunlight on the door, which raises the temperature of the outer surface considerably higher than the ambient temperature, especially when dark woods are used.

Because of these conflicting stresses, I spline together adjoining mosaic pieces on the outer surfaces in addition to laminating them onto the stable core. Even under optimal laminating conditions using a press, there is often enough cupping in larger mosaic pieces, or enough variation in the plywood core, to create a less than perfect bond. But with a matrix of splines covering the whole surface, it is virtually impossible for any single piece to become dislodged from the panel. The splining technique also accommodates the expansion and contraction of individual pieces that may be of different species with differing expansion coefficients.

Overlaying the surface with individually splined pieces allows not only mixing wood species, but also using various thicknesses in the composition, sculpting, carving and shaping them at will or whimsy—as long as the spline grooves are in alignment. Additional possibilities include piercing the door and incorporating glass mosaics in the design.

My technique for making mosaic doors is not unlike that used to make stained glass windows. First I design the patterns for the panel surface (inner surface too if it's different) and lay out the design full-size on paper. Then I cut to rough size the larger mosaic pieces, where the same species and lumber thickness will permit. Next the mosaic pieces are bandsawn out and touched up where necessary with a belt or drum sander to achieve an optimal fit along their contoured edges. This part is like making a giant jigsaw puzzle, fitting the pieces together on top of the paper cartoon.

Then I relieve the adjoining perimeters of the pieces on my

Photos: James Rannefeld

shaper, though the same thing can be done with a router, using a chamfering or rounding-over bit. You may, of course, want to sculpt each individual piece with hand and power tools in whatever combination suits you. When all the pieces are shaped, I use my shaper to cut a groove ½ in. deep by ¼ in. wide all the way around their edges. Rather than using a standard depth collar for this, I recommend a ball-bearing collar. Again, a router equipped with a proper slotting cutter can do the same job. Remember, all the grooves must be cut a uniform distance from the bottom of each piece. Next I cut the contoured splines from tempered hardboard or plywood (dark-colored splines look best), but you could use other suitable materials for this.

I cut the plywood panel for the core oversize, and after trial-fitting all the pieces, I start gluing them to the panel, beginning flush at one edge of the design and proceeding outward from there. Then I put the whole thing in my glue press, which has enough screws to handle mosaic tiles of varying thicknesses, apply even pressure and let it sit overnight. The next day I repeat the process on the door's other face, which might have a totally different pattern.

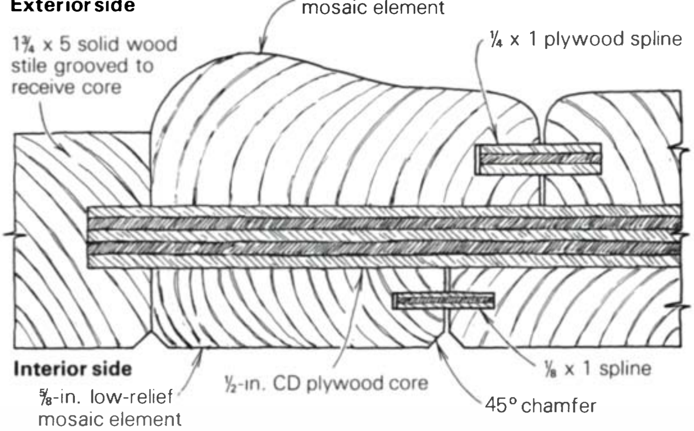
With gluing complete, I cut the mosaic panel to finished size, allowing the core to protrude ½ in. on all four edges. I used to allow a ¼-in. thickness of the mosaic tiles to remain flush with the edges of the plywood, in effect rabbeting them, but the size of the groove this requires in the frame leaves too little stock overhanging the panel sandwich. So now I cut back the tiles to allow only the plywood to protrude. Then I groove the rails and stiles to fit snugly on the "tongue" that's been formed by the protruding core. The joinery of the frame members themselves can vary according to your preferences—½-in. by ½-in. tongue-and-groove plus ¾-in. through-dowels do nicely, though sometimes I spline them together. Next I finish both sides with two coats of a 50/50 mixture of exterior polyurethane and Watco Danish oil and follow these with additional applications of exterior Watco.

I recommend keeping the mosaic pieces reasonably small so that expansion and contraction are minimal. The only problem I have experienced to date has been with a mixed-wood mosaic—a couple of walnut pieces loosened up. At the time I was using a dry marine resin glue. Now I use a resin-emulsion type glue called WP-2200 made by National Casein, 3435 W. MacArthur Blvd., Santa Ana, Calif. 92704. It's a fast-cure (closed assembly time of 20 min.), exterior Type 1 bond that's ideal for doors.

No matter how tight the joints or how good the gluelines between the laminations, the spaces between mosaic pieces on the exterior side of the door will grow and dwindle with seasonal changes—just as a loose panel will move around in its enclosing frame. However, by chamfering or otherwise relieving the edges of individual mosaic elements, these changes appear minimal and often enhance the overall textural quality of the surface.

Recently I have begun to treat the individual mosaic pieces sculpturally, and this has widened the horizons for my designs. Now I'm using the technique on headboards, murals and tabletops. And I'm contemplating the use of stone, ceramics, plastics and glass as potential materials for overlaying wood. □

James Rannefeld (JAWAR), 33, designs and builds furniture and architectural components in Taos, N. Mex.



Gap between mosaic pieces is determined by season and location of manufacture, and by the relative size of the individual elements.

The mosaic pieces on this door, called Curvilaminar II, are of different thicknesses; individual press screws with padded feet apply uniform pressure to each piece.

Curved Dovetails

Secret miter is the key

by John F. Anderson

The appearance of through dovetails is ordinarily determined by the thickness of the pieces being joined, and the exposed end-grain surfaces of both pins and tails usually make a straight line parallel to the corner of the joint. But this baseline need not be straight. By varying the thickness of the pins and tails, you can create curves along both sides of the joint. Curved dovetails open up new design possibilities. Incorporated into a cabinet, drawer or box, this joint can enhance and accent the overall composition.

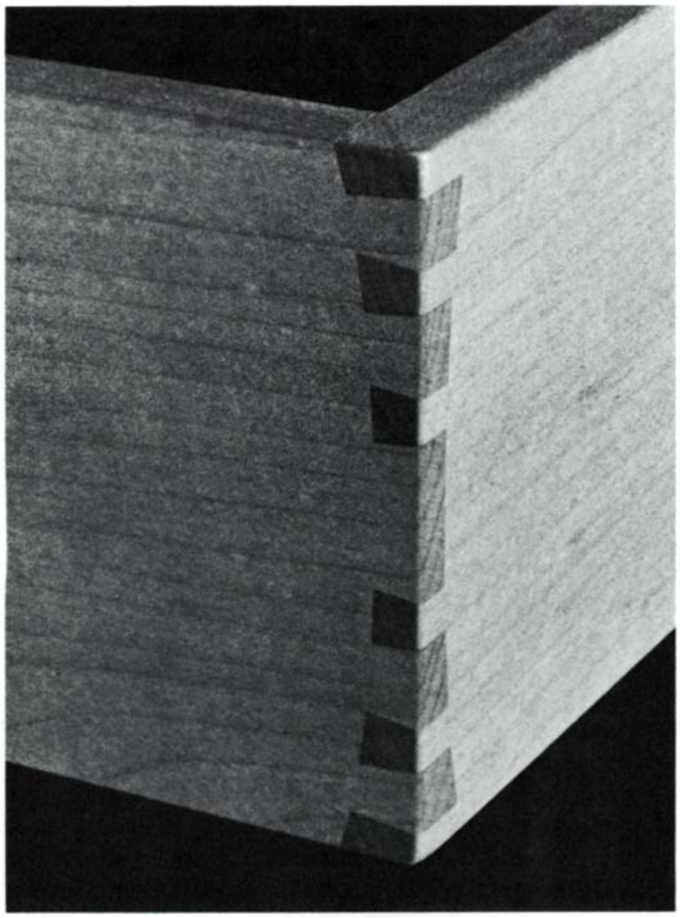
The procedure for making curved dovetails is basically the same as for cutting regular ones. But there are two notable exceptions—you need a curved template block for laying out the curved baselines and for chiseling, and you have to cut a curved-bottom blind miter along the inner edges of the joint. You'll need a sharp pencil, a marking gauge, a dovetail saw, chisels and mallet, and a good eye.

The inside miter is the key to curved dovetails because it lets you make pins and tails that are thinner in section than the thickness of the stock and thus permits a wide range of curves to be used. They can be either concave, convex or reversed, symmetrical or asymmetrical, and the thicknesses of the pieces joined need not be the same. The curves on each side (pin and tail) need not be the same either, though to accomplish such a joint you need to make two templates and to lay out the curved cuts alternately (figure 5). The procedures described below will work for any curve, so long as the miter is cut properly.

First make the curved template block from a piece of wood at least ¾ in. thick. It should be large enough to be clamped firmly to the workpiece (without the clamp getting in the way) and precisely the width of your case sides, for ease of alignment. After laying out the curve, take care in cutting it, making sure that the curved end-grain edge is perpendicular to the bottom face. You'll use this edge to guide your chisel when making vertical cuts, so it has to be a true 90°.

Next, set a marking gauge to the thickness of the stock and score the inside faces of the work in the usual way (*FWW* #2, Spring '76, p. 28). The inside faces should be finish-planed or sanded to avoid knocking off the edges of the curves after the joint is completed. Don't strike a baseline across the outside face of the stock; rather, score marks at the outer edges that will allow you to position the curved template. Trace the curve from the template onto both faces of the stock, using the straight baselines for registration; also trace the curve onto the end-grain edges (figure 1). After careful consideration, mark out the pins first; I do this freehand, but you can use any means you like. Clamp the piece in a vise and saw down the waste side of each pin to the curved line.

Sawing done, lay the piece, outside face up, on the bench and clamp the template on top in its original position. Using the edge of the template as a guide for the back of your chisel (figure 2), chop into the waste deep enough so that no chipping or tear-out will occur when you finish chiseling through from the other side. Turn the piece over, clamp the template into position on the inside face, and chop straight down, removing chips near the edge of the template with oblique paring cuts (figure 3). Don't go any deeper than the curved line marked on the end-grain edge, and don't try to remove the waste between the pins just yet. Clean up the bottom of the cut by paring in from the edge with a narrow chisel or incannel gouge. This must be done acurately because the results will determine the fit of the miter on the inside corner. Now remove the template, secure the workpiece again to the bench and cut this miter using a sharp chisel, beginning at the baseline and paring to the intersection of the vertical shoulder and the curved bottom (figure 4). This will automatically produce a miter at the proper angle.



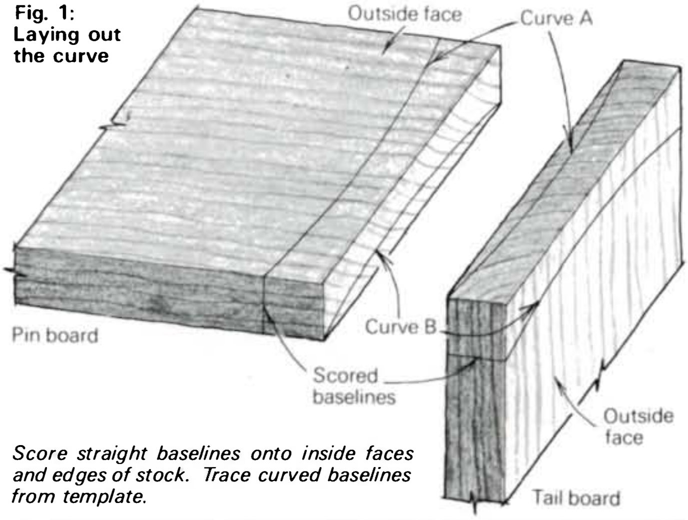
Through dovetails with curved baselines can enhance case joinery and provide visual interest. Making pins and tails a different thickness from the stock being used involves cutting a curved secret miter on the inside corner of the joint.

Now that the miter has been cut, return the template to its former position and use it as a guide for removing the waste between the pins. Cutting the miter comes before this because the entire bottom curve is still visible then, making it easier to cut to this line, which is partially obliterated when the waste between the pins is removed.

Now lay out the tails from the pins as in standard practice. Saw down on the waste sides of the tail lines to the curved line. Then simply repeat the procedures used for mitering the inside corner described above, chiseling out the waste between the tails last. The pieces should fit together correctly, leaving no gap on the inside of the corner. □

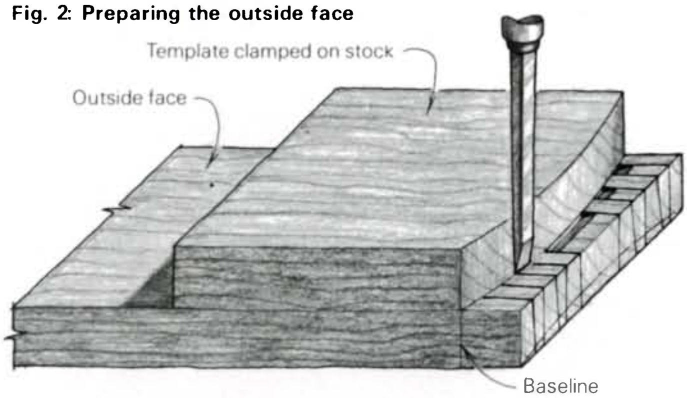
John Anderson, a cabinetmaker, lives in Bottineau, N. Dak.

Fig. 1: Laying out the curve



Score straight baselines onto inside faces and edges of stock. Trace curved baselines from template.

Fig. 2: Preparing the outside face



Using template edge to guide chisel, sever the waste tissue across the grain to prevent tear-out when chiseling from the reverse side. Note that tail board (photo below), which will be marked from completed pin board, is prepared similarly.

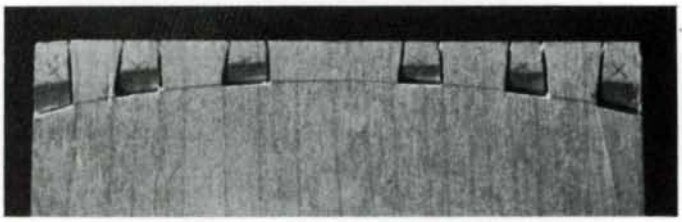
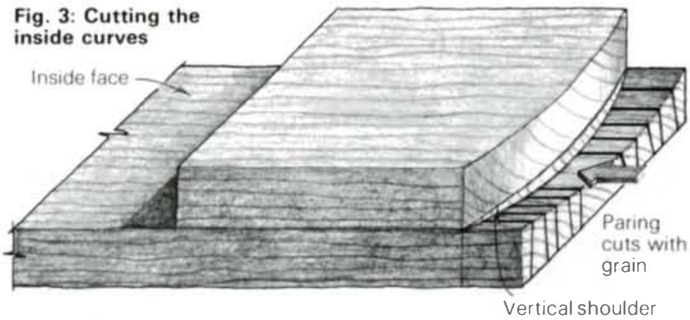


Fig. 3: Cutting the inside curves



Again using template as a guide, cut the curved vertical shoulder and pare away waste along curved line on inside face of pins. Photo below shows tail-board shoulder similarly cut.

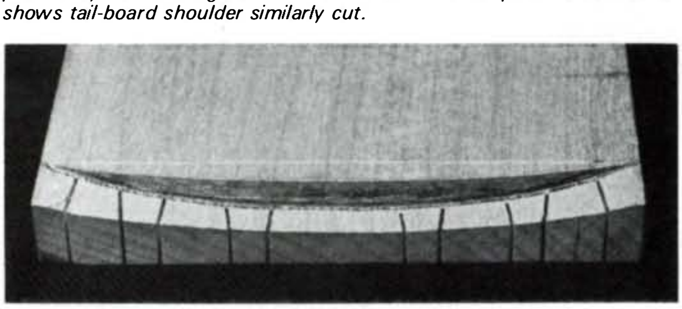
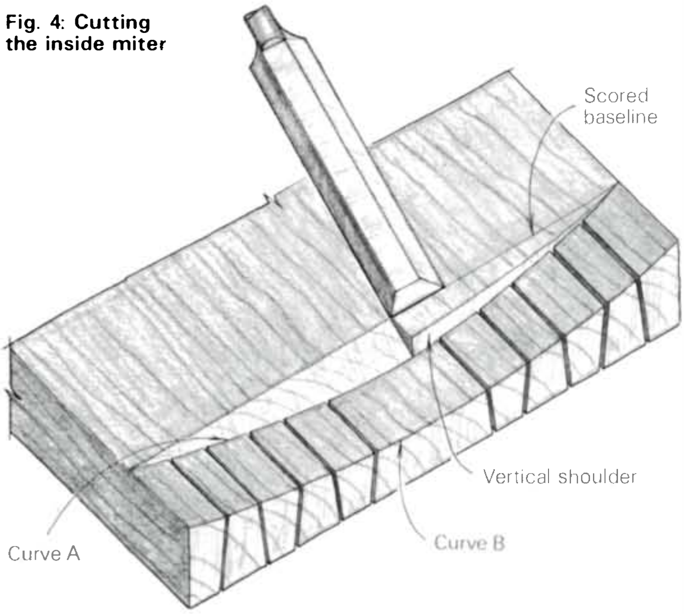
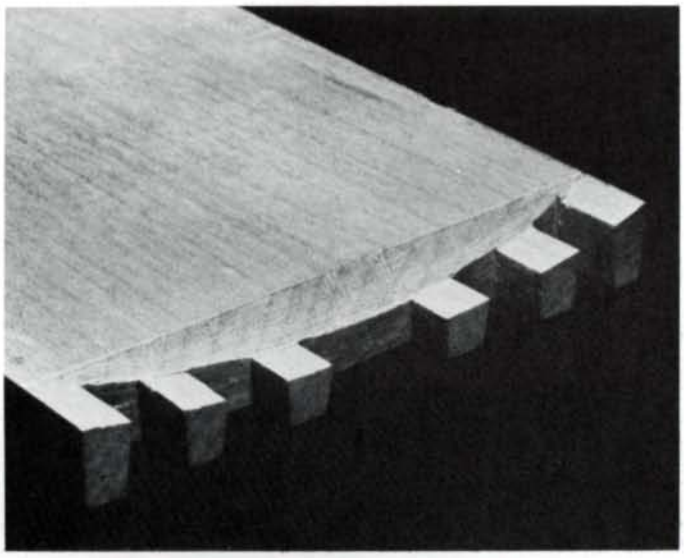


Fig. 4: Cutting the inside miter

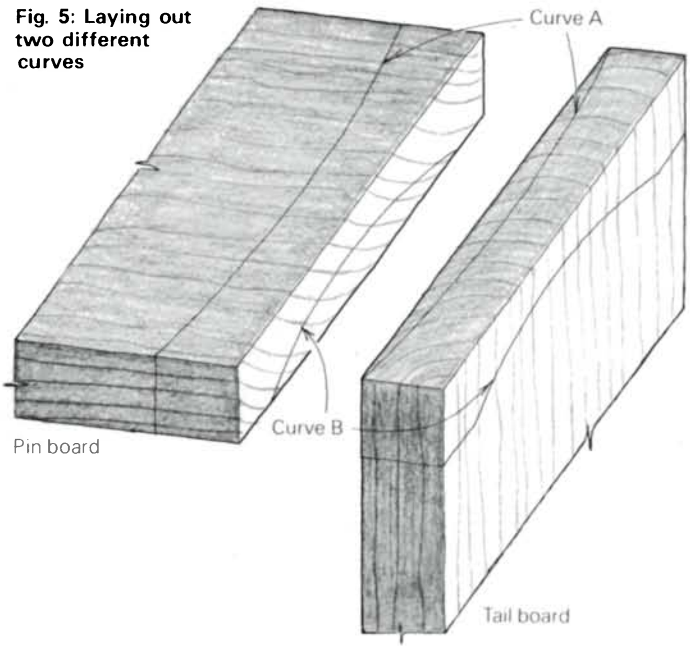


Cut the miter from straight baseline to curved one. Remove waste between pins only after cutting miter.



Curve A and curve B need not be the same. If they are, as in the example above, then the miter is a true 45°. If curves A and B are dissimilar, as in the drawing below, then the angle of the miter will vary along the length of the joint, like a slightly twisted ribbon.

Fig. 5: Laying out two different curves



Curved Slot-Mortise and Tenon

Contoured joinery for enhancing frames

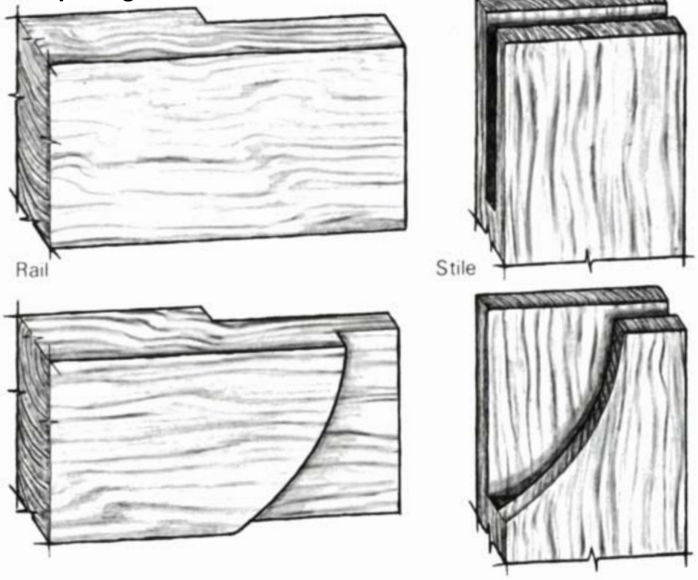
by Ben Davies

Design decisions in woodworking cannot be made entirely for aesthetic reasons. Wood is not a plastic medium but a rigid one, and we usually shape it by removing portions of it. Our designs are thus limited by the capabilities of our cutting tools and our skill at using them. To achieve new shapes—to experiment with line and form and the basic geometry of joining wood—we either develop specialized tools or adapt our old tools to perform in innovative ways. Highly specialized hand tools, like molding planes, have limited applications, while more versatile modern tools, like computer-controlled carving machines, can be afforded only by industry. So there's considerable reward for the craftsman in being able to extend the use of general-purpose tools—the router in particular—in imaginative ways.

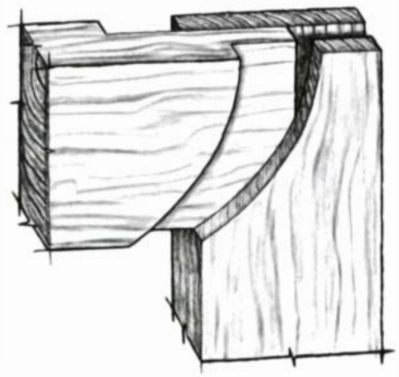
The following description of making a curved joint is not meant to be definitive. Rather, it is a tentative first step toward adding a dimension to our work when struggling to achieve a balance between geometric and organic forms. When we build we are faced with a dichotomy—crisp and differentiated forms on the one hand, soft and flowing forms on the other. Consider the rigid control exemplified by Shaker and Cubist formalism contrasted with the flowing asymmetry of Art Nouveau. The dichotomy transcends woodworking and the visual arts. For more, read Nietzsche's discussion of the Apollonian/Dionysian duality in his essay "The Birth of Tragedy from the Spirit of Music."

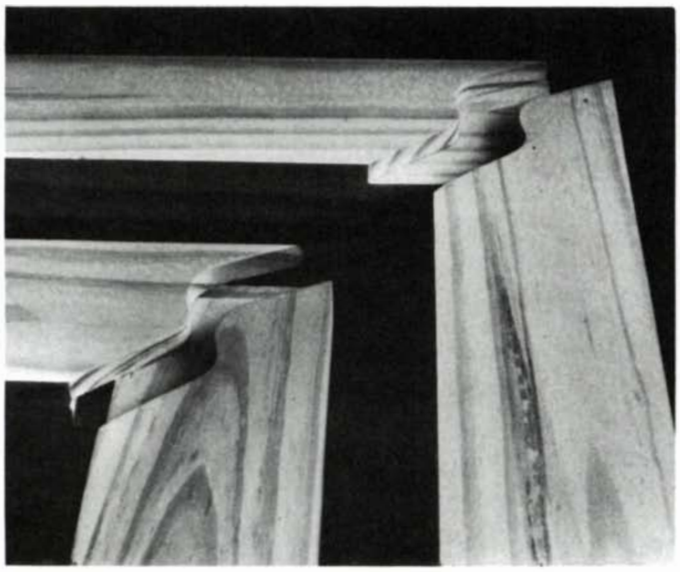
Using a router equipped with an ordinary straight-face bit and a pair of guide bushings, plus a shop-built fixture to hold the work and a bearing template to guide the router cut, you can quickly contour the adjoining shoulders of rails and stiles with little chance for error. But making the fixture and template requires careful planning and accurate work.

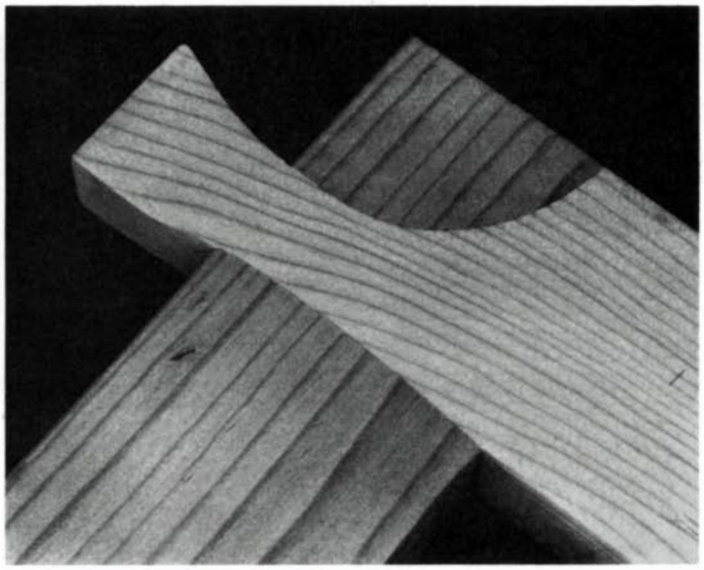
Preparing the stock



Facing shoulders of joint are contoured; rear shoulders remain square. This compensates for the loss of mechanical strength that comes from reducing the gluing surface on the front cheek of the tenon. To prepare the stock, dimension frame members and cut to length. Slot the ends of the stiles as though making an ordinary slip joint; then cut a tenon cheek on the rear face of each rail, but don't remove any stock from the front faces, as these will be routed to produce the curved shoulder shown.

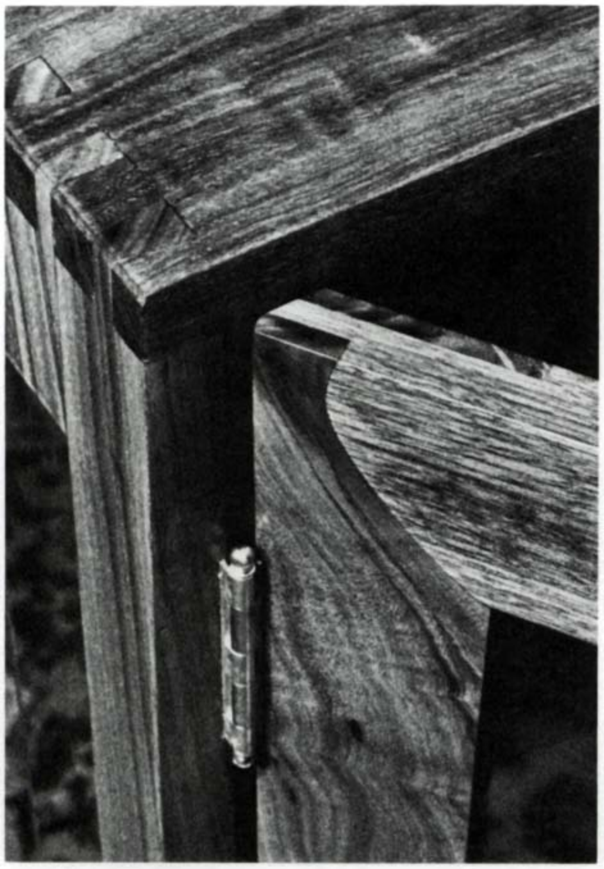






Reverse curve defines joining shoulders of rail and stile, left. A variation of the technique can produce a curved half-lap joint, right.

Photos: Charles Turner



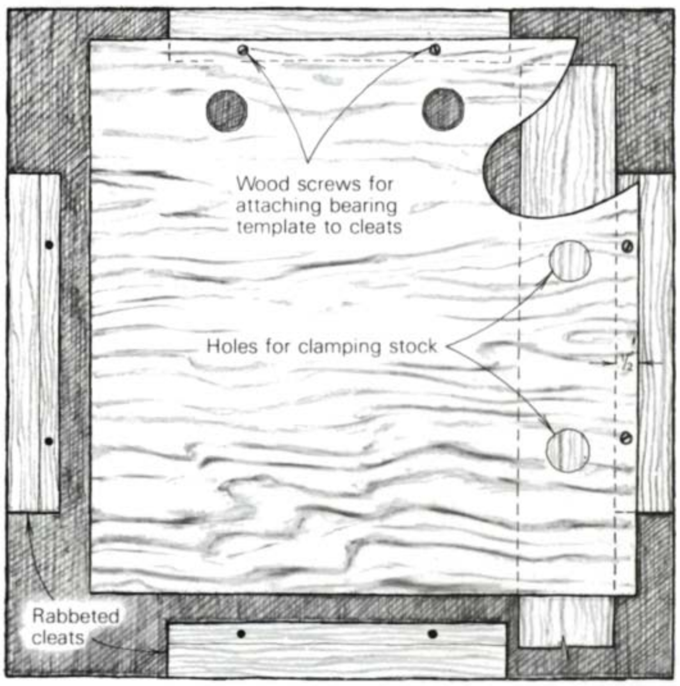
The door on this cabinet shows how contoured joinery can be used to advantage. The wood has been carefully selected so the grain conforms to the curvature of the joint, which repeats the gentle curve made by the bottom sides of the cabinet. The two bottom joints of the door frame have been cut square, complementing the upper corners of the case.

Making the fixture—This part of the system consists of a plywood base and four rabbeted cleats as in the drawing at left. Its job is to hold the rails and stiles and to support the bearing template. The base should be made from a piece of ¾-in. plywood about 15 in. to 24 in. square, a suitable size for joining the frames of cabinet doors. The cleats should be cut from stock whose thickness equals the thickness of the frames plus the thickness of the bearing template, usually ½ in. If you're joining ¾-in. thick frame members, the cleats must be 1¼ in. square, rabbeted to an exact depth of ½ in. and to a width of about ½ in.

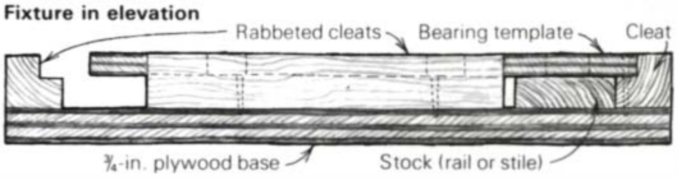
To set up the fixture, position the cleats, rabbets in and up, on the edges of the square base; use a true framing square to orient the cleats at precisely 90° to one another (other angles are possible), and screw them to the base with countersunk wood screws. The cleats should not meet at the corners; you have to space them far enough apart so your stock will slide easily through the gap.

The guide bushings—Most routers are designed to accept standard guide bushings generally available as accessories. With a ½-in. bit, use a ⅝-in. O.D. bushing with your router, but any bushing of this general size will do. Because the bushing bears against the curved template when making a cut, and because you're cutting complementary curves using the same bearing template, the line of the cut must be offset from the curvature of the template, and two bushings are required—a large-diameter one for making the cut on the rail,

Fixture Plan view showing bearing template screwed in place



Fixture in elevation



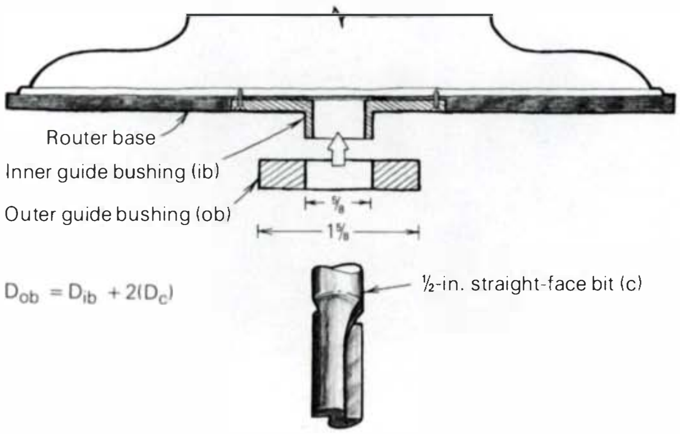
and a small-diameter one for cutting the stile (as is the case with the examples here).

Purchase two ⅝-in. guides from the manufacturer; one will serve permanently to hold the outer bushing (epoxied to it), the other as the inner guide bushing. The outer bushing should be turned from brass or aluminum. It is necessary to observe the following mathematical relationship between the diameter of the cutter (D_c), the O.D. of the inner guide bushing (D_{ib}) and the O.D. of the outer guide bushing (D_{ob}): $D_{ob} = D_{ib} + 2(D_c)$.

The bearing template—This step involves making three separate templates: one that exactly duplicates the curved line of the joint, another whose profile is offset from this curve and parallel to it, which serves as a pattern for the third tem-

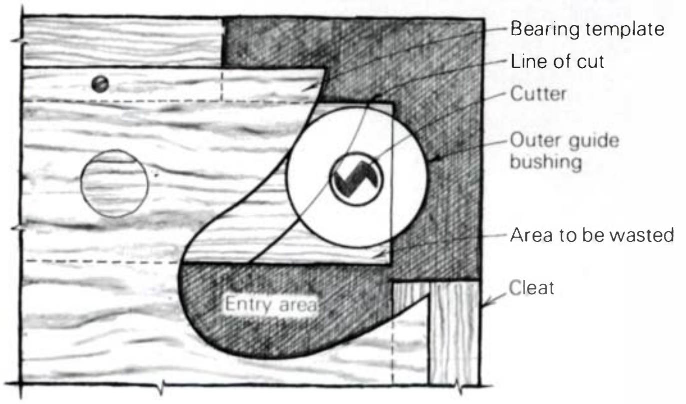
Guide bushings

Section through router base and bushings

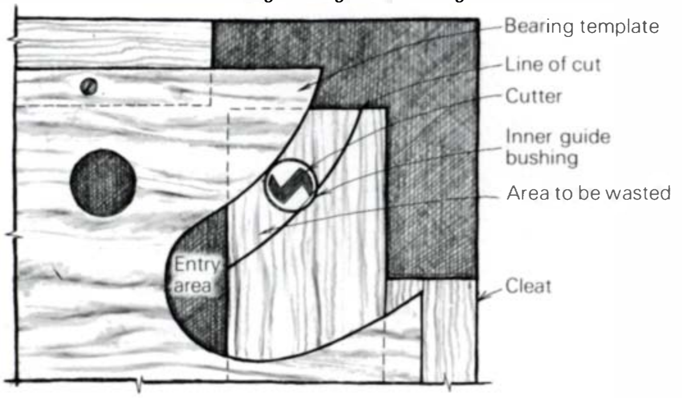


Guide bushings in use

Rout shoulder on rail using outer guide bushing.

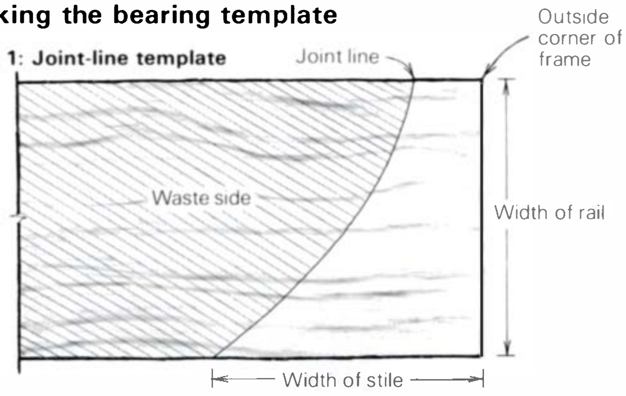


Rout shoulder on stile using inner guide bushing.

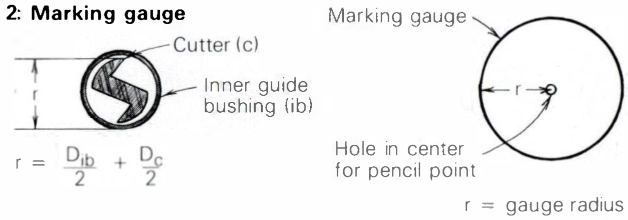


Making the bearing template

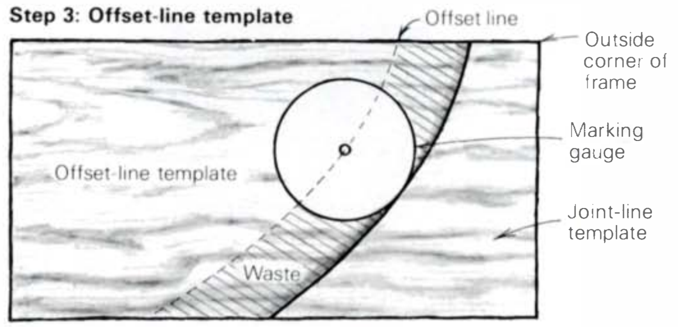
Step 1: Joint-line template



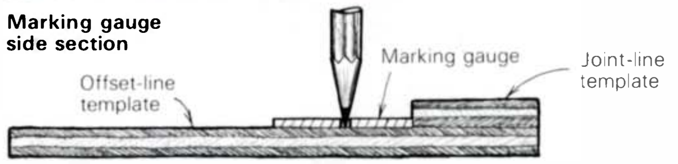
Step 2: Marking gauge



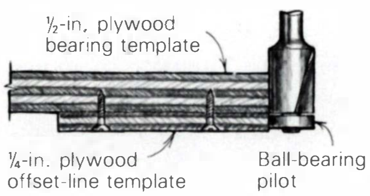
Step 3: Offset-line template



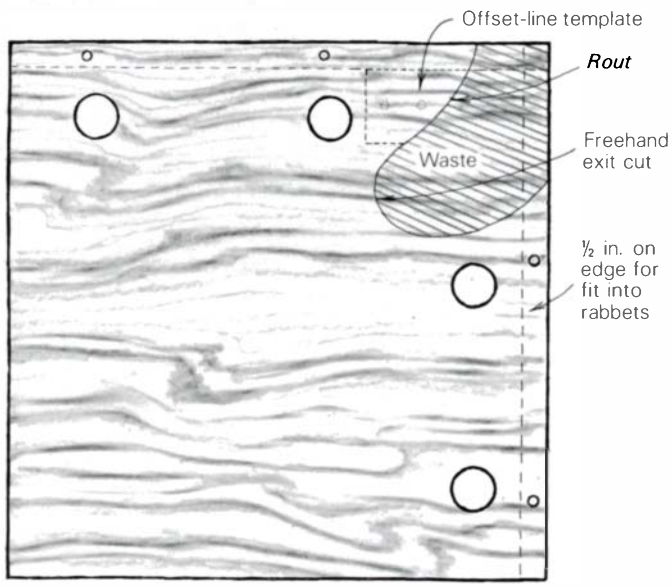
Marking gauge side section



Step 4: Bearing template



Screw offset-line template to bottom of bearing template to guide router-bit pilot during cut to produce a smooth, precisely vertical edge.



plate, the bearing template itself. After composing the curve of the joint on paper, taking into account the width of the rails and stiles, transfer the line to a piece of ¼-in. plywood; then cut along this line with a band saw or jigsaw and smooth the contoured edge with a file. This becomes the joint-line template (step 1 in the drawing at left).

The next thing to do is to make a marking gauge that will allow you to scribe a line on a second template parallel to the curve of the joint-line template. The gauge is made from a plastic disc with a hole in the center for a pencil point, as in step 2. The distance from the outside of the gauge to the pencil point equals the distance from the cutting circle of the router bit to the opposite outside edge of the inner guide bushing (*r*), which also defines the smallest possible radius of curvature in the joint.

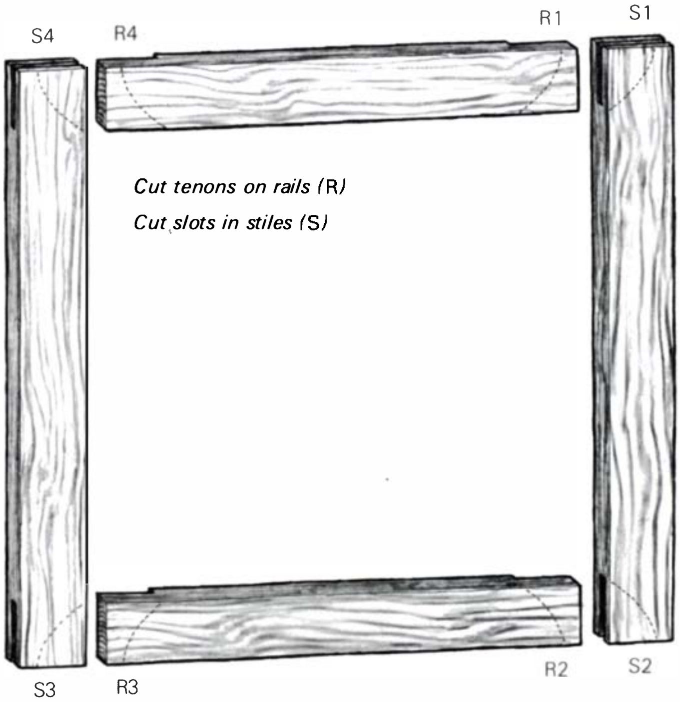
Cut along this offset line and smooth the sawn edge with a file. For the bearing template itself, dimension a piece of ½-in. plywood so that it is slightly smaller than the inner dimensions of your fixture and so its corners are absolutely square. On two adjacent sides, scribe lines that are exactly ½ in. in from the edge and parallel to it. These lines mark the boundary defined by the inner edges of the cleats on the bottom of the bearing template. Now position the offset-line template as shown in step 3 and screw it to the bottom of the bearing template. It should abut one of the cleat lines and be positioned out from the joint line (drawn on the bearing template) with the help of the marking gauge. Using a straight-face flush cutter with its pilot bearing against the offset-line template, cut the curve in the bearing template (step 4). It may seem like a lot of trouble to make one template just to cut another, but only by routing the curve on the bearing template can you get walls that are smooth and perpendicular to both faces.

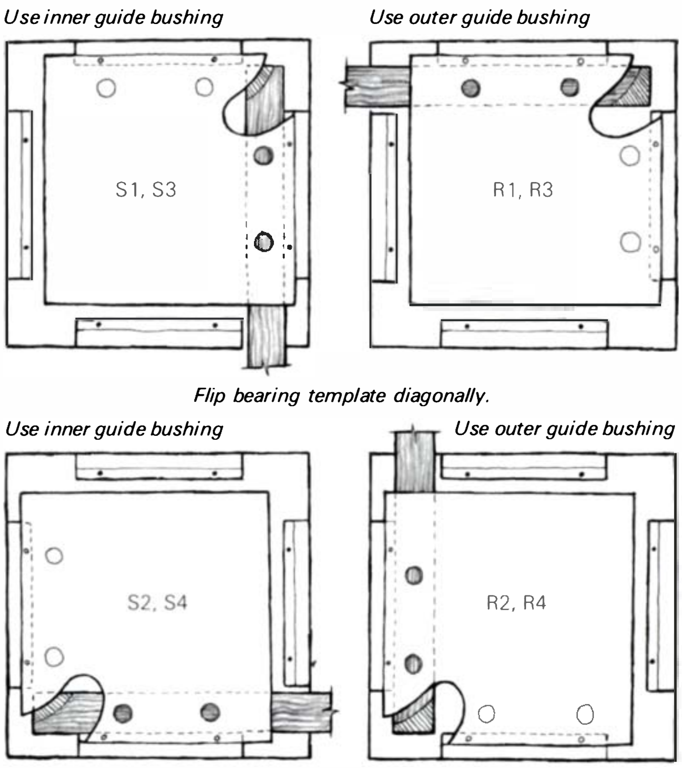
Next bore four 1¼-in. diameter holes in the bearing template; these permit you to clamp the rails and stiles into place for routing. Also bore four pilot holes for wood screws on the template's edges and countersink them on both sides—top and bottom. This completes work on the fixture and bearing template.

Routing the joints—After preparing the stock, place the frame members in their respective positions and mark each end as shown in the drawing at right so you can orient them properly in the fixture. With the bearing template screwed into position, clamp one of the stile ends (S1) into place so it is flush against the inside cleat and so the end-grain edge is lined up with the inside edge of the top cleat. Attach the inner guide bushing to the router, and set the bit to a depth that equals the thickness of the cheeks of the mortise on the stiles. Insert the bit and bushing into the entry area and rout towards the corner, holding the bushing firmly against the bearing template. Make only a single, careful pass when routing the shoulders on the stiles. Now rout the opposite end of the other stile (S3).

Remove the inner bushing and attach the outer bushing. Insert one of the rail ends (R1) into the fixture so it is flush against the top cleat and its end-grain edge is in line with the inside edge of the right-hand cleat. Rout the tenon on the rail, first wasting most of the stock and finally making one decisive pass with the bushing pressed firmly against the curve of the bearing template. Now rout the tenon on the opposite end of the other rail (R3).

Positioning of stock for routing sequence





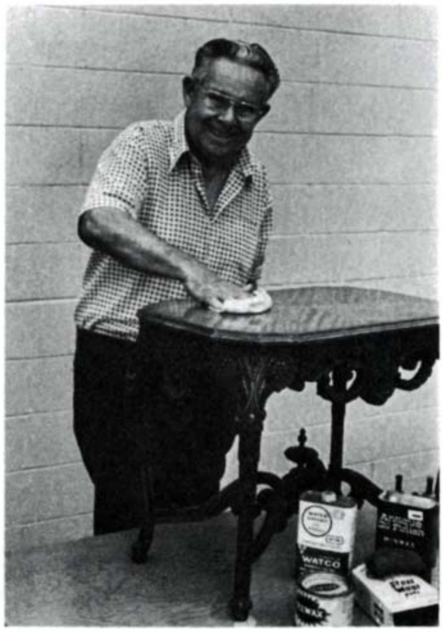
At this point you've cut half the joints for one frame, and they are diagonally opposed to one another. To cut the other pair of joints, you will have to flip the bearing template and screw it in place on the opposite corner of the fixture. Then repeat the entire process described above, now for S2, S4, R2, R4. On the back side of the frame the joints are left square, which increases the strength of the joint. When you're done, all four joints should fit snugly, and their curves should match up without a flaw. □

Ben Davies, 35, owns and operates Muntin Woodworks in Chattanooga, Tenn., where he designs and builds furniture and doors.

Notes on Clear Finishes

Why I use Watco, Minwax and Deft

by Oscar MacQuiddy



Bill Stankus

Oscar MacQuiddy buffs a carved Italian table (c. 1929) he's refinished. The smooth, glossy surface is achieved by rubbing Watco into the wood with fine-grit wet/dry paper. The oil/sawdust slurry fills the grain and protects the wood.

I became interested in wood finishing after I acquired a house full of antique furniture. Most of it needed repair and refinishing, and I enrolled in an evening class where I was assured I would learn all I needed to know to restore my prized antiques. But I was displeased from the start with my instructor's approach. He was meticulous about preparing the surfaces, but then he would brush on a coat of colored plastic, and everyone would stand around admiring this shiny object. And if the next day you dragged your fingernail across the shiny surface, you'd leave a visible gouge. That wasn't what I was after.

I felt that a good finish should go into the wood and then build up a protective layer on the surface. I didn't like this business of applying plastics on top of the wood and then calling it a finish. The way this instructor liked to remove old finishes irritated me as well. Everything went. Good, bad, indifferent—it was all stripped away. I recall my shock one evening when a man brought in several strikingly beautiful pub chairs he had bought in Ireland. After some gluing and minor repairs he asked, "Now what should I do?" The instructor said, "Well, let's get that old finish off." At that point I'd had enough.

I found a day class with an altogether different approach to refinishing. My new teacher, Charles Kishady, was a most remarkable man, thoroughly in command of his subject and able to inspire his students. He came to this country at the end of World War II. Though his parents were Hungarian, he had spent four years in Germany as an apprentice restoring a 13th-century cathedral, and later he graduated from Heidelberg University with a degree in industrial arts. I told Mr. Kishady how I felt about furniture refinishing and what I wanted to do. He said, "Well, go ahead and do it and we'll see how you make out." He left me alone and would simply observe and make occasional comments, such as, "Wouldn't it look better if you did this. . . ?" Or "Wouldn't it look better if you did that. . . ?" I began to understand his suggestions and began also to develop an attitude toward wood that I had never seriously considered before.

As my relationship with this man deepened, together we decided to organize and teach a wood-finishing course at a professional level. But we wanted everything to be done as simply as possible, with all the frills knocked out. Though I'd never thought about teaching before, after a while I found what I had to communicate was extremely well received by my students. Once our program was underway, we tried to teach each student to respect the natural finish that was on the article and to restore it when possible. It was really amazing the things we could bring back, and we were committed to saving the patina that develops on wood with time. When we used color, we tried to put it only where it belonged. We removed old finishes only when necessary, cleaned the wood and applied hand-rubbed oil finishes.

It is not necessary to remove old finishes completely, especially those possessing an attractive patina. It is often worth the effort to restore an existing finish, and really it is not that hard to do. Part of the secret is the ability to match the colors. There will be areas where the finish is totally gone, and sometimes these require almost heroic efforts, but they can be restored. Frequently, as when doing kitchen cabinets, all the surfaces will have to be cleaned. Scrub them thoroughly with TSP (tri-sodium-phosphate), which is probably the safest approach, sometimes adding a little Purex to do some bleaching along with the cleaning. In this case you need to wear gloves and avoid splashing the liquid in your eyes.

When the old finish must be removed, methylene chloride remover seems a good choice. No remover is completely safe, but as available products go, it's one of the less toxic members of a highly toxic group called chlorinated hydrocarbons, and it has to be used with adequate ventilation. Ideally, a strong air current should carry the fumes away from the user. Once in the bloodstream, methylene chloride metabolizes to carbon monoxide. Breathing the vapors is harmful to healthy persons, but is especially hazardous to those who suffer from cardiac problems, and they should not use the product.

How do you choose a good brand? When you go to the store, pick up all the cans. The heaviest cans put to one side, because methylene chloride is the heavy ingredient. The can which is the heaviest at the lowest price is the best buy. Standard Brands makes good remover that's as heavy as Jasco. Jasco costs $12; Standard Brands costs $7.

Methylene chloride is an efficient remover. When you apply it, use a brush with a natural wood handle because the remover will take any paint off the handle and stain your work. Working in a shaded area, apply a heavy coat by slopping it on. Don't brush it, just let it sit there. You paid a lot of money for it, so let it do all the work. Let it sit for 15 minutes and slop more on any dry spots that show up during that

Oscar MacQuiddy, 71, of Southgate, Calif., has been teaching antique restoration and refinishing for 11 years. Before he retired in 1968, he worked for Shell Chemicals. This article is the first of two parts, extracted by Alan Marks from lectures given at The Cutting Edge in Los Angeles.

time. At the end of 15 minutes the finish will soften and lift, and you're ready to remove it. The instructions on the can will tell you to scape it off with a putty knife or to use a rag or steel wool to wipe it off. None of these methods is effective. But if you have access to a supply of planer or jointer shavings, dump a handful in the middle of that table or on that cabinet door and start scrubbing, and you'll clean that surface flawlessly. The wood shavings will get into routed, grooved, relieved and carved areas. They will do a terrific job of cleaning without scratching the wood. With this method you'll be able to strip very rapidly and efficiently, and stripping can turn out to be not such a terrible job after all.

If you find you still have some old finish on the surface, there is an auxiliary method of attack. Get a can with a tight cover and fill it with planer shavings and then saturate the shavings with lacquer thinner or, perferably, acetone. If you can afford it, methyl ethyl ketone would be even better. Take a handful of the wet shavings and continue the scrubbing. The solvent has a paint-remover action and generally by the second application you will have a surface almost clean enough to finish. These chemicals are highly flammable, so use them with great care. Work outdoors if possible or use adequate ventiliation inside.

This method of stripping is very simple, and shavings can be used several times. Even floors can be stripped this way, but you must pay special attention to ventilation. Afterwards, how can you tell if your wood is clean? Sand the surface lightly with 150-grit finishing paper. If it doesn't clog, you know the work is done. If the paper loads up, clean the surface with 1-0 steel wool soaked in either lacquer thinner or a mixture of lacquer thinner and acetone or methyl ethyl ketone. This technique is well suited for cleaning around turnings. Occasionally a little picking will have to be done with a pointed tool, and sometimes a piece of heavy cord can be used to clean the bottoms of grooves. We have used abrasive cords, but they cut so quickly and so deeply that you have to be very careful with them, particularly on old finishes where you don't want to expose bare wood.

When working with paint removers and strong solvents, you must wear gloves to prevent skin irritation as well as possible poisoning from the absorption of toxic chemicals through the skin. Neoprene gloves are best because they hold up longer and are tougher than gloves made from other materials. But when working with oil finishes, it's better to use your bare hands, not only to generate heat necessary for good penetration but also for increased awareness of what is happening on the surface of the wood. During all my years as an instructor, I've seen only one case of dermatitis resulting from contact with an oil finishing product. If you should have an adverse reaction despite the odds against it, consult your doctor about it right away.

Clear finishes are of two basic types—penetrating finishes and surface finishes. It is possible, though, to build up a surface layer by using a penetrating finish that hardens in the wood. As far as penetrating finishes are concerned, you can use an oil that dries or one that doesn't. Non-toxic linseed oil is slow-drying, but it was discovered that by heating it and adding chemicals its polymerization rate could be increased. They used to put lead in it. Today they can't and have to use a cobalt drier, making the oil just as toxic as it was with lead. Originally I worked with linseed oil, but the drying time was slow and unpredictable. Now I use Watco Danish oil, and it has become standard in my work and teaching. To make Watco they take linseed oil and convert it to a resin. They dissolve this resin in a solvent and add driers to make it penetrate, and this penetrating solution has the property of combining chemically with oxygen to become a polymerized solid. It saturates the wood and solidifies in the cell cavities. Watco oil is quite easy to apply, and the results that it gives are excellent. You just apply it on raw wood until it won't absorb any more and then wipe the surface dry. Repeat this procedure the next day. Watco does alter the color of wood and it does darken somewhat with age, characteristics it shares with linseed oil.

Pure tung oil—not to be confused with heat-treated (polymerizing) tung oil, which is actually a varnish for hand rubbing—is a product I use with reservations. Once applied, its effects are irreversible, though it never completely hardens. But it's a beautiful finish, often producing spectacular results and requiring little preparation, aside from original sanding. On light woods, you get about the same color change as you get with Watco; and on some dark woods, the color change seems to be even less. But heat-treated tung oil will turn other dark woods almost black. I worked once with a man who finished some redwood altars with heat-treated tung oil; they ended up extremely dark, and you couldn't recognize them as redwood. If he had used three or four coats of Minwax Antique Oil, the natural beauty of the wood would have been revealed. When I first began to work with Minwax Antique Oil I was skeptical—it seemed almost too good to be true. It contains such effective driers that it will congeal in the can if half the volume is airspace. You need never worry about it drying hard—it'll dry. You wipe it on the surface, and it acts as a penetrating sealer and sets very hard. I have diluted it slightly on occasion and sanded it in wet as I do with Watco. But you must work quickly because it gets tacky fast, and you wind up with a sticky mess if it's not wiped off in time.

One interesting variation of the penetrating-oil finish is the "salt-pork finish." It is non-toxic, and because the pork fat contains salt, it does not become rancid. I have used it several times to refinish very old raw-wood chests and the paddles bakers use to remove bread from ovens. It can be used to finish all wooden kitchen utensils. Mineral oil has also been used for this purpose; it is definitely a spreading oil. If you take a piece of warm metal and put a drop of mineral oil on it, the oil will disperse and coat the whole surface. Salt pork does the same thing. In the old days people apparently just recoated with it when needed, and it has been claimed that this finish was used by the Shakers.

A friend of mine with broad experience in antique restoration observed that often old kitchen tables were not finished at all; they were just scrubbed at intervals with caustics and water. He speculates that during washing, the oil and tallow spills on the wood surface were observed to resist moisture and to shine with rubbing. So the practice of oiling wood to preserve it was probably a logical development of this observation. The old oil finishes applied by our great-grandparents by way of maintenance perhaps account for the fact that their furniture has survived. The oil was enough to preserve the wood and prevent moisture penetration and moisture-related decay and degradation. I am quite certain that glue joints in old furniture owe their preservation to this application of oil.

In the old days people bought cedar oil, a mineral oil that was colored red and scented with a cedar extract. Today we use lemon oil—the same oil but colored yellow, and scented with lemon. But we don't use it as generously as our grandparents did. Instructions on the bottle say to use only one or two drops. I suggest that you go to a drug store and buy a pint of light mineral oil and use it as a furniture polish. You'll be getting the same basic ingredient of "lemon oil" but paying a lot less for it. There would be nothing wrong with using this light mineral oil as a non-toxic furniture finish. If the furniture needs cleaning, why not add a small amount of vinegar to it and a small amount of turpentine? Some restorers of antique clocks recommend cleaning and reviving old clock cases with a mixture of turpentine and vinegar and mineral oil.

The first oil/resin mixture used for finishing was varnish. From the Orient came lacquer and shellac which, when mixed with alcohol, yields the formula for the "French polish." The French-polish finish is a beautiful high-gloss, durable finish very slow to create (*FWW* #20, Jan. 80, p. 66). It possesses poor moisture resistance, is very difficult to repair and is quite impractical for commercial use. In order to create a durable, rapid-dry commercial finish, nitro-cellulose lacquer formulations were developed, but because of their fast dry time, spraying was the required method of application. Some years later, Deft Inc. formulated a modified water/white-coconut-oil-base, nitro-cellulose lacquer with special solvents that proved to be an improved brushing lacquer. The product is self-leveling, non-yellowing and easily repaired; it quickly rubs to a beautiful satin sheen and can be applied directly to raw wood. Three coats are recommended, and will produce a bar top finish. Each successive coat melds with the preceding one. When brushing Deft, I prefer satin for a final coat, although gloss is the more durable material. If you are going to rub it out, you might just as well apply two coats of gloss before putting on the final coat of satin. The only mistake you can make is not to use enough finish for the job, but several thin coats are better than thick ones.

The original oil/resin varnish has undergone many formula changes. One of the more recent has been to replace the resin with a polyurethane, a plastic resin. The result is a highly versatile coating. Defthane, a brand of polyurethane varnish, can be applied to raw wood or clean metal, inside or outdoors. Three coats are recommended. Thirty minutes gives a dust-free surface, and you can recoat in six hours. The finish is hard and rubs to an elegant satin sheen. With Defthane, as with Deft lacquer, the best procedure is to start with two coats of gloss followed by a third of satin.

You might wonder, with such a tough, hard finish, how the second and third coats can be made to adhere. Since it will dry in six hours, at the end of four hours it is two-thirds dry. I put on the next coat before the end of six hours. If I rub the surface lightly with 4/0 steel wool and wipe it down thoroughly, the subsequent coat will bond tightly to the first. Buy a large can of gloss and a small can of satin. When the last coat, the satin coat, is thoroughly dry at the end of 12 hours—36 hours is even better—rub the surface with 4/0 steel wool and wax it with Trewax (50% carnauba).

It is at first unsettling to use a water clean-up finish in place of varnish, lacquer and oils. It's hard to believe that anything that can be dissolved initially by water can dry to a durable, non-water-soluble state. But this is true of the new water-wash acrylic finishes. They give excellent results, and I predict that eventually they will enjoy wider use, especially in areas with smog problems. One such product, Wood Armor, is easily applied with a rag, roller, brush or spray gun. It dries quickly, has a pale color, and is non-yellowing. In 30 minutes after application it's dust free, and has a two-hour recoat time. It has no noxious odor, cleans up with water, and it is a beautiful finish for fine paneling where a minimum color change is desired. It comes in gloss and satin, though I prefer satin. I feel that the inside of drawers, the underside of drawers and even the back should have a finish, and Wood Armor works well for this purpose. Cabinet interiors are done to advantage with it. If you want to remove the still-wet finish for any reason, wipe it with a damp cloth before it skins over.

Let us pick up at the point where a piece of furniture has been stripped and prepared for finishing by a light sanding with 150-grit paper. We selected for our purposes a penetrating sealer/oil finish because we're after a traditional look with a soft sheen that doesn't obscure the grain of the wood. Many experts advise rubbing the oil in by hand or with rags or steel wool. We found a method, in the course of instruction, that we believe to be superior to any of these methods.

Working with the grain, start by pouring a small puddle of Watco on the surface. Then wet a pad of 320-grit wet/dry carbide paper and start sanding in figure eights, beginning at a corner and working across the surface. Within a few minutes you will have a slurry of oil and very fine sawdust that is continually being worked into the pores of the wood, which is quickly filled with its own substance due to the sharp cutting action of the carbide grit. After it gets tacky (15 minutes), I wipe off the excess with a rag. The resulting surface possesses an almost glass-like smoothness. Finish sanding across the surface and then sand with long strokes in the direction of the grain to obliterate any cross-grain marks. Actually with 320-grit paper it's almost impossible to leave any such marks except in the hardest of woods. At this point, you have smoothed the surface with a minimum of sanding, prepared and applied a filler, and put on a penetrating sealer.

You really can't simplify it much more. I've done a lot of beautiful work using this method. When I first started using it I applied raw linseed oil, but I didn't like it because the drying time is unpredictable. Watco is relatively fast drying. I know with certainty that in four hours it can be recoated. I felt that it did everything a linseed oil did and did it better. When you consider the amount of sanding saved and drudgery eliminated in achieving this kind of finish, there is no better alternative. A small sandpaper pad will do moldings. It fits anywhere and it will not quickly wear out, because the oil lubricates the cut and keeps the paper from clogging.

Your second coat is applied after the first has dried for at least four hours, or preferably overnight. Rub the second coat in by hand, having again poured oil on the surface. The heat of the hand friction aids in the penetration of the oil. Let it sit for a few minutes, and if you see any dry spots, spread oil from the wet spots over them. Keep the surface wet with oil until there is no more absorption. It is very important with each successive coat to wipe away all excess surface oil. Because this is not a surface treatment, but a penetrating finish, everything on the surface must be wiped away or rubbed into the wood. Excess oil on the surface will become sticky and take a long time to dry. When the second coat has dried, preferably overnight, the third coat is applied similarly to the second, and during the third application, the question of coloring comes into play. And that's another story. □

Tall-Case Clock
The typical 18th-century design

by Eugene Landon

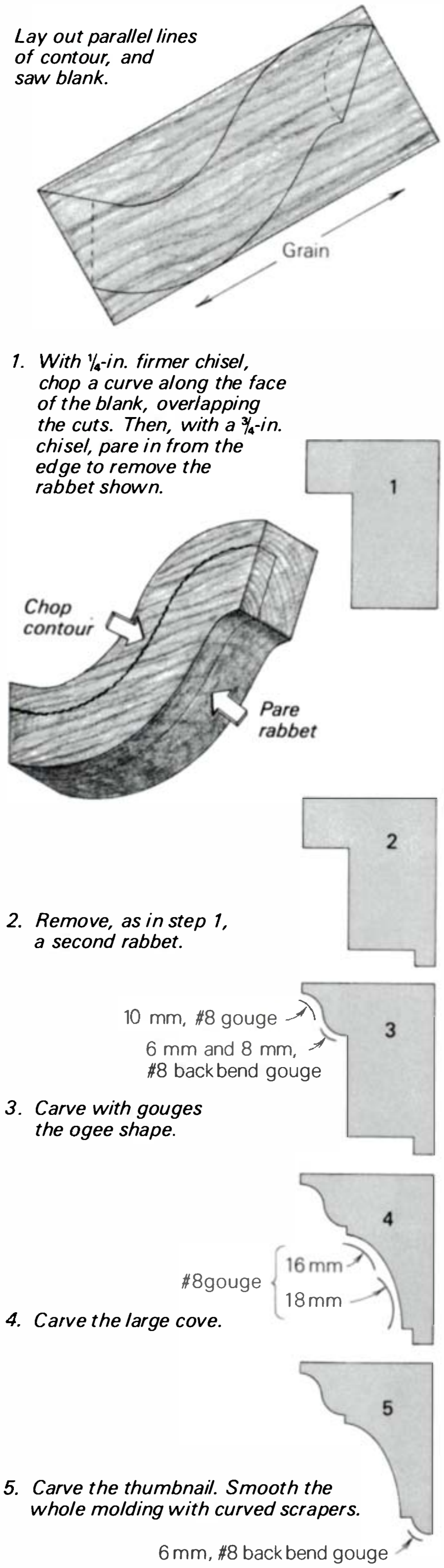
During the 18th and early 19th century, tall-case clocks were made in infinite varieties, yet their basic construction is the same. They consist of a base, a waist section enclosing the weights and pendulum, and a hood, which houses the clockworks. The feet could be ball, straight-bracket, ogee-bracket, French or simply straight-turned. The base might have a plain board front, a raised panel and fluted quarter-columns, or a scalloped panel front. The waist could have a flat, rectangular door with a "bull's-eye" (a window to see the pendulum), a "tombstone" door or a carved arched door flanked by fluted quarter-columns. The top could be flat, stepped, broken-arched or bell-shaped. The combinations seem to be inexhaustible. By detailing the construction of one particular clock, Philadelphia style c. 1770 by James Gillingham (my reproduction of which appears at right), I will present the basic elements necessary in the construction of any typical tall-case clock of this period. Note that this particular clock is exceptionally tall, approximately 109 in. to the top of its carved cartouche. If the room in which this clock is to be used cannot accommodate such a height, obviously this piece must be scaled proportionately.

It is best to construct the hood first because dial size and shape determine all other dimensions. The dial size for the drawings that follow is the most frequently used size during the 18th cen-

Reproduction of tall-case clock (original by James Gillingham) follows typical 18th-century construction, as shown in the drawings on the following pages. The cartouche in place of the center finial and the applied carvings on the scrollboard are ambitious, optional embellishments.

tury, 12 in. by 12 in. with a 5-in.-radius moon dial atop. Dials this size are available from James A. Zerfing, 123 Lincoln St., Williamsport, Pa. 17701, and high-quality reproduction clockworks from Merritts, RD 1, Douglasville, Pa. 19518. Begin with the base frame of the hood, which is mortised-and-tenoned together and mortised through its upper face to receive the hood sides (be sure to make a right and left side). Glue the hood sides to the base frame, set it aside and begin to construct the pediment box. The front of this box is called the scrollboard, and to it attach the moldings, rosettes and center cartouche. Note that the arch is cut in the scrollboard and its backing board before they are assembled as part of the pediment box. After gluing up the half-blind dovetails that join the pediment box together, you can apply the moldings. Over the years I have taken to making my moldings using the old wooden planes; however, one can use a shaper or other tools to make them. I carve the gooseneck molding of the broken pediment by hand, as shown in the drawing at left.

Carving the gooseneck molding



To attach the moldings I rough the glue surfaces with a toothing plane, glue them in place, and then brad them after the glue is dry. This is the way the old clocks were done, and reproduction brads are available from Tremont Nail Co., 21 Elm St., Wareham, Mass. 02571. To ensure that the miter will look tight, I relieve the surface behind the visible corner.

Next make the corner plinths and caps. Drill a ½-in. hole in each plinth top to receive the finials, which will be carved later. The plinth in the center of the broken pediment has the same molding as the scrollboard. Glue on all these pieces; later, when the pediment box is capped, you will mount a block behind the center plinth and bore it to receive the cartouche.

Now make the dial frame so that it will overlap the dial no more than ⅛ in. on all sides. The inside edge is molded with a thumbnail to match the front of the hood sides, and the corners are coped. Half-lap the frame together and cut the arch for the moon dial, also ⅛ in. smaller than the radius of the moon dial itself. Then carve the thumbnail molding into this arch. Slide the completed dial frame into the 5/16-in. channels in the hood sides; it will be secured in a moment.

Mount the pediment box on the hood sides. The front and rear of the hood sides are cut away, and the pediment box should fit snugly enough over the wide tongues of the sides that it must be tapped into place with a hammer and block. Secure the hood sides to the pediment box with glue and/or nails and screws from the inside. Also secure the dial frame to the backing of the scrollboard with small brads. It is not necessary to glue the sides or bottom of the dial frame because a good fit in the channels will secure it indefinitely—I've seen it so on many a tall-clock hood. Last, nail the top (use a secondary wood, such as pine) to the pediment-box sides.

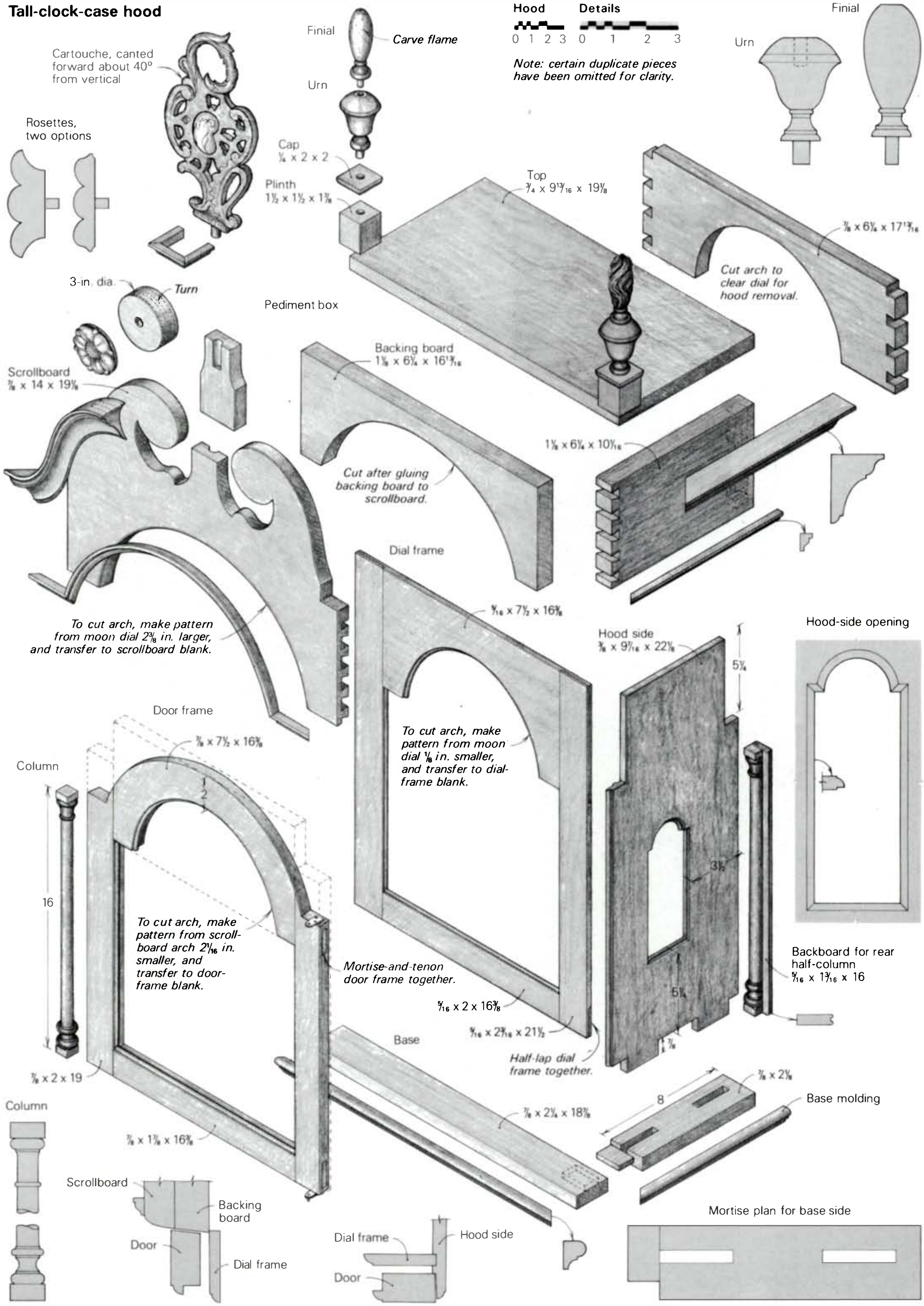
The door is the next element of the hood to be made. Don't cut the arch until after gluing up; otherwise short grain in the top member makes clamping dangerous. Use a paper pattern to transfer the hood arch to the door-frame blank, allowing about 1/16 in. for clearance. Lay out the arch, the inside with a radius 2 in. shorter than the outside. Cut the thumbnail and the rabbet for the glass on the inside arch before cutting the outer arch; again, once the outer arch is cut, the piece is fragile. Now cut the outer arch with a bevel to correspond with the hood-arch bevel and fit the door. Its outer edge should line up with the shoulder of the dial-frame thumbnail. Brass hinges hold the door at the top and bottom so it swings from the right. I don't know why, but almost all tall-case clocks have hinges mounted to swing this way. I made my own clock-case hinges, but you can order them from Merritts.

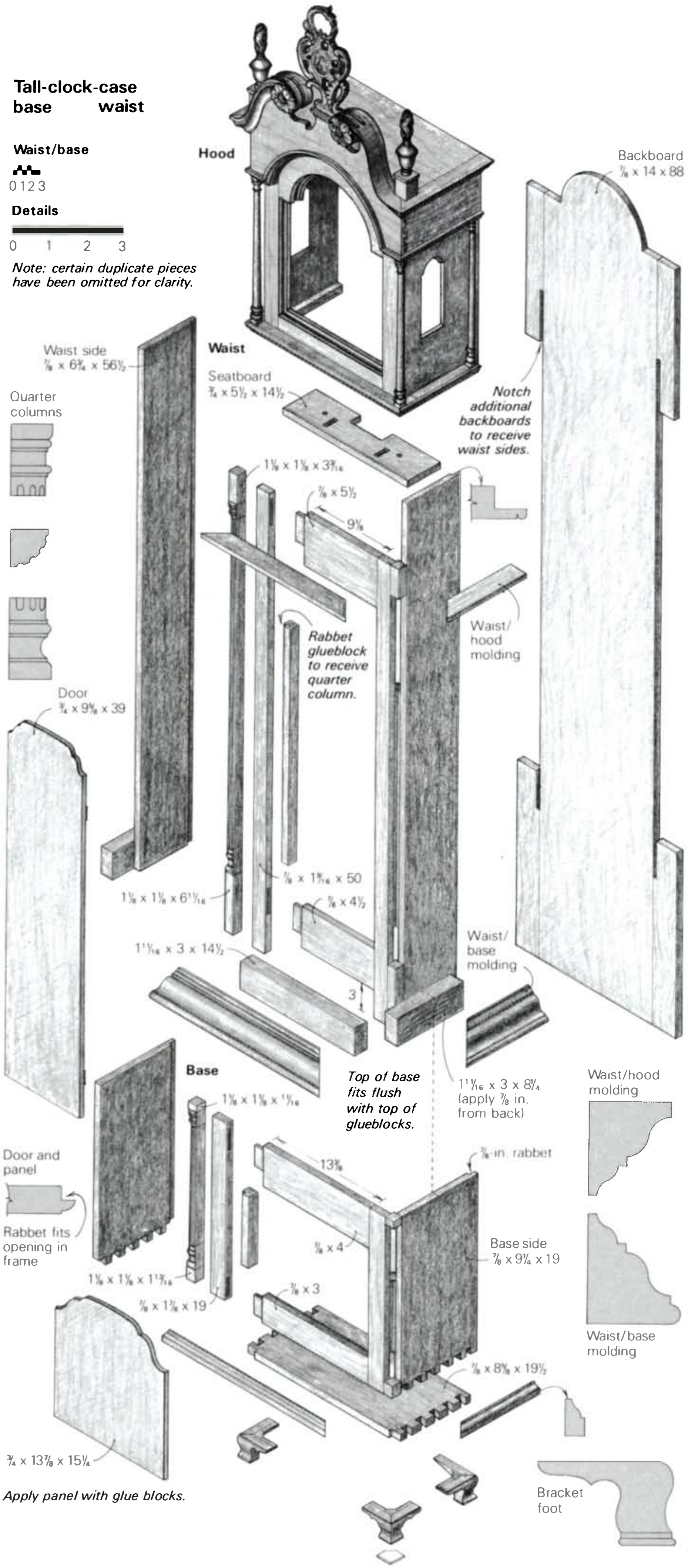
Next the columns can be turned and fastened to the hood. Four free-standing columns can be used, or, as shown in the drawing, two free-standing front columns and two half-columns mounted on backboards applied to the side. I like to flute the columns with a 2-mm #9 gouge, though a scratch beader can also be used.

The rosettes can be carved and applied next. They start as turnings. Since I made two of these clocks concurrently, I varied some of their elements, the rosettes being among them. Two options are given in the drawing. Flame finials in the 18th century were usually made in three parts—the plinth, the urn and the flame, which makes the last easier to carve. The cartouche in place of a center finial and the applied carving of the scrollboard are ambitious embellishments that could be omitted.

Now that you have the hood finished, set it aside and begin construction of the base unit. Cut a rabbet in each of the side pieces to receive the back before dovetailing the two sides to the pine bottom. The bottom is to be flush with this rabbet and extend ¼ in. in front; the reason will be clear when

Tall-clock-case hood





the quarter-columns and front are attached. Mortise-and-tenon the front frame together, as in the drawing, and to it glue 1⅛-in. by 1⅛-in. blocks that will become the tops and bottoms of the quarter-columns. Then glue the frame to the sides and base using glueblocks with a rabbet cut along one corner to receive the quarter-column. The quarter-columns I turn from oversize stock, about 2¼ in. square (turn to 2⅛ in.), leaving an unturned square section at each end to support the stock while I flute and slice it, first in half, then in quarters, on the band saw. I then plane the two sawn surfaces until I have quarter-columns with 1-in. radii. Turn the quarter-rings that form the capital and base of each quarter-column from separate stock, 2½ in. square, then glue these to the 1⅛-in. blocks and mount the quarter-column between.

Apply the base molding around the bottom of the sides, covering the exposed dovetails, and to this molding apply the feet (for a way to make bracket feet, see *FWW* #21, March '80). Reinforce the feet with glueblocks. The front panel can now be attached to the base unit with glueblocks from behind. Choose attractively figured wood—bookmatching is common here. A thickness of no more than ⅜ in. should extend beyond the face of the frame; however, the panel can be made thicker with a rabbet around the sides. Now set the base aside and construct the waist portion of the clock.

First prepare the back and sides. The backboard is made of pine or some other secondary wood. Begin with a piece 88 in. long—the excess will be trimmed to fit under the dial arch later when the hood is slipped on from the front. Rabbet and bead the two walnut sides along their back edges and attach them to the backboard, 16 in. up from the bottom. Be sure the sides are square across from each other (scribe a line across the back of the backboard) as this will determine if the waist sits straight in the base. Along the lower edge of each side, on the outside face, apply a glueblock of pine ⅞ in. from the back to allow for the thickness of the backboard. To these blocks will be attached the base. Now make a front frame, which is joined with mortise and tenon like the frame used for the base. Again, attach 1⅛-in. by 1⅛-in. blocks to the corners for the top and bottom of the quarter-columns and apply this frame to the back/side assembly, keeping the frame and side bottoms flush. Make and apply the quarter-columns with quarter-ring capitals and bases, all the same in section as for the base. Cut the mortise for the lock, and mount the door using butt hinges, again on the right.

After completing the waist unit, the waist is slipped into the base, and the blocks previously glued to the bottom of the waist sides are now glued and clamped to the inside of the base sides. The backboard will extend to the bottom of the base, where it is nailed, but because it is only as wide as the waist, additional backboards must be fit to cover the extra width of the back of the base. Make and apply the waist moldings, upper and lower.

If you have bought an authentic reproduction clockworks, you will have to mount it on a seatboard, slotted for the cables and pendulum. Then you can fit the hood to the top of the waist. The base molding of the hood slightly overlaps the upper waist molding; if necessary, shave the edges of the waist molding, so the hood will slide over and rest on this molding. Note that the hood will not slide all the way on because the backboard and the back of the pediment box have yet to be cut. Remove the hood and place the seatboard, with the movement attached, atop the waist sides, which are over-long. Replace the hood, measuring the distance that the dial sits high in the dial frame. Remove the hood and the seatboard, and cut down the waist sides the distance the dial sat high plus ⅛ in. When you replace the movement and the hood, the dial should be properly framed in the dial frame. All that remains is to cut an arch in the pediment-box back and in the backboard, as shown in the drawing, so the hood will pass over both the dial and the backboard when being slid on and off. With the hood finally in place, glue additional backing boards to the backboard to cover the extra width of the hood.

After you have done all of the above, apply your favorite finish, and you should have something that resembles the clock for which James Gillingham was paid in 1770 the princely sum of 15½ lb. of veal. □

Gene Landon makes and restores period furniture in Montoursville, Pa. For more about his work, see FWW *#23, July '80, p. 40.*

Tall-case clocks are adorned in various ways. Hood of a Philadelphia clock (left) from the same period as the Gillingham example has basket of ferns for central finial and diminishing spirals in place of rosettes. Tobacco-leaf finials top country clock (right) from Reading, Pa., c. 1770.

Photos: Gene Landon

Philadelphia clock (1725), left, with step top and fretwork bell-speaker is high-style compared with Lancaster County clock, above, whose arched pediment is probably a country cabinetmaker's rendition of various elements he'd seen.

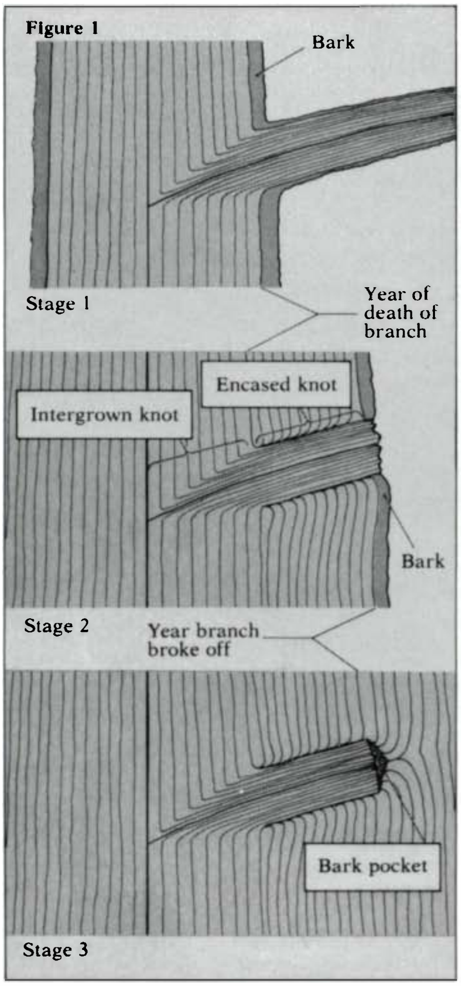
Abnormal Wood
Dealing with knots and reaction wood

by R. Bruce Hoadley

While some irregularities in wood may increase value, as when a distinctive figure is produced, others decrease value. By tradition, any irregularities that decrease value are branded as defects. Although some of the features described below seem to be negative in woodworking, the woodworker is urged to reserve judgment on nature's irregularities. These were indeed defects when hand tools could not deal with them, but now many of these irregularities can be routinely machined using power tools.

Knots—The commercial hardwood lumber-grading system assumes that every knot is a defect and bases grade on the size and number of clear areas among the knots (and other blemishes). On the other hand, many beautiful works of craftsmanship and art have been produced using, or even featuring, knots. The woodworker should first of all understand what knots are and how their structure relates to the rest of the wood. Knots are simply the parts of limbs that are embedded in the main stem of the tree (figure 1).

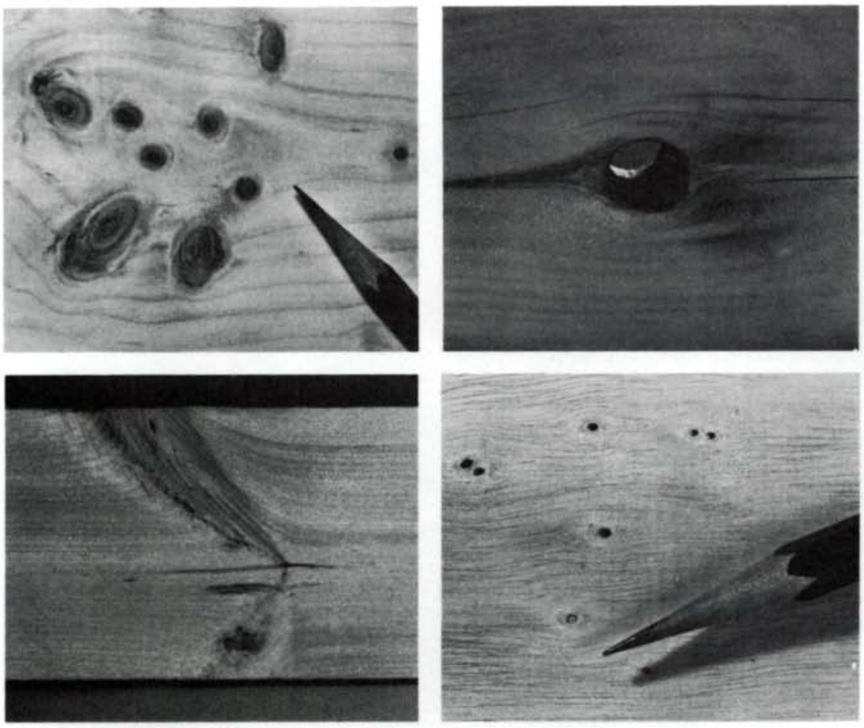
As the tree grows, branching is initiated by lateral bud development from the twig. The lateral branch thus was originally connected to the pith of the main stem. Each successive growth ring or layer forms continuously over the stem and branches, although the growth ring is thicker on the stem than on the branches and the branch diameter increases more slowly than the trunk. As the girth of the trunk increases, a cone of branch wood—the **intergrown knot**—develops within the trunk. Such knots are also termed **tight knots** because they are intergrown with surrounding wood, or **red knots**, especially in conifers where they often have a distinct reddish tinge. At some point the limb may die, perhaps as a result of overshadowing by limbs higher up. The limb dies back to approximately the trunk surface, its dead cambium unable to add further girth. So subsequent growth rings added to the main stem simply surround the dead limb stub, which may begin to rot. A number of years of growth may be added to the main stem, surrounding the branch stub. The dead part of the stub becomes an **encased knot**. It is not intergrown and therefore is also called a **loose knot**, often with bark entrapped. Knotholes result when an encased or loose knot falls



Bruce Hoadley

Coniferous trees, left, are characterized by excurrent form, i.e., a dominant stem from which whorls of lateral branching occur at regular intervals, or nodes. The pattern is often present on plywood made from rotary-cut softwood veneer, right.

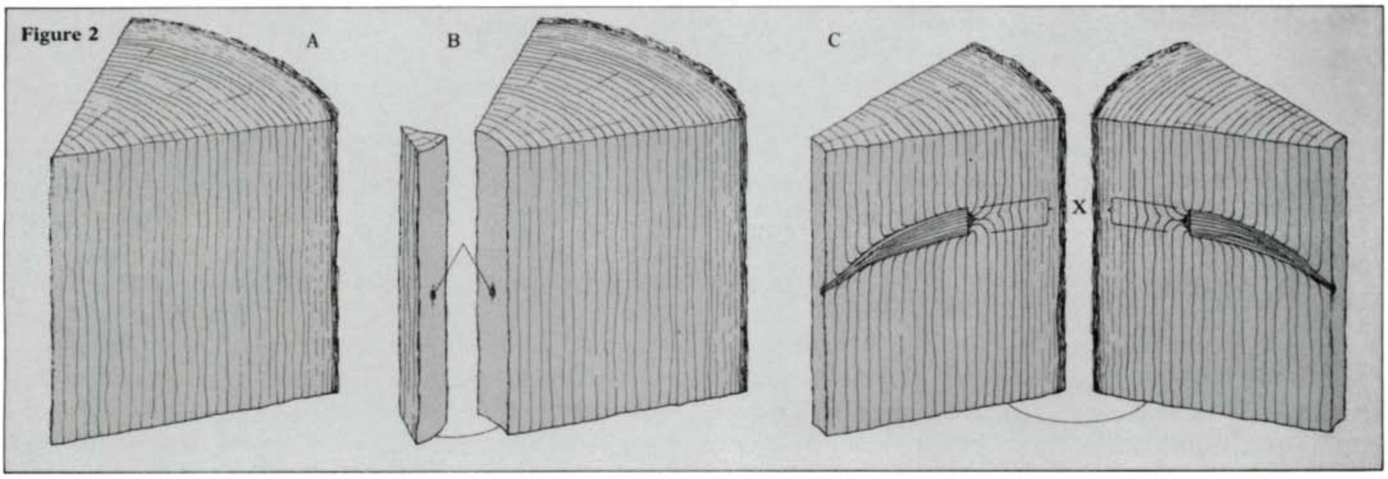
A knot is the basal portion of a branch whose structure becomes surrounded by the enlarging stem. Since branches begin with lateral buds, knots can always be traced back to the pith of the main stem.



Knot types (clockwise from top left): tight round, loose round (knothole), pin, and spike.

Bruce Hoadley

A carving chunk may appear flawless at first glance (A *in drawing below*). *Removing wood adjacent to the pith* (B) *will locate internal knots* (C *and photo above*). *Scars in the bark* (*at* X) *may be a sign of knots large enough to ruin the block for carving.*



out of a board. Encased knots are also called **black knots** because they commonly are discolored by stain and decay. In time the stub may become weakened by decay and fall or be broken off, or it may be pruned back flush with the trunk. Further growth layers will enclose the stub, and eventually the cambium will form a continuous layer. From this point on, solid layers of wood and bark will be formed beyond the overgrown knot. But as the cambium moves outward, the knot-scarred bark layers persist for an amazing number of years, providing a clue to the buried blemish.

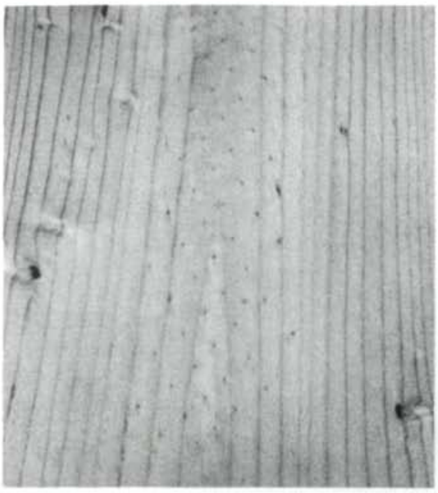
Knots may be classified by how they are cut from the tree. If they are split by radial sawing and extend across the face of the board they are termed **spike knots**. On flatsawn boards they usually appear round or oval and are called **round knots**. Knots smaller than ¼ in. in diameter are called **pin knots**.

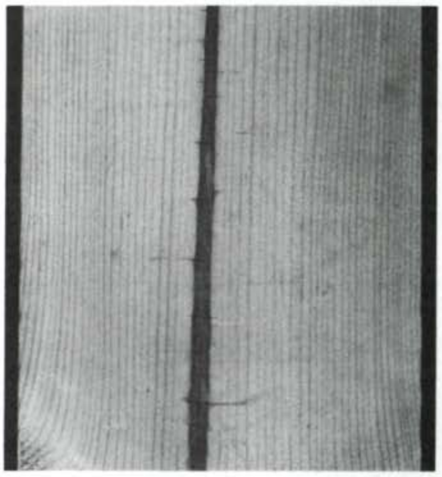
Understanding knots can be useful to the woodworker. Nothing is more devastating to a carver than to work halfway through a block of wood only to uncover an interior knot flaw. Yet the trained eye can usually predict such a blemish. If a wedge is taken from a log and the first few growth rings near the pith are removed (figure 2), any branches will be seen at least as tiny knots. If none are present, there will be no knot-related defects in the piece. If any are located, the bark should be carefully examined for scars. Experience can tell much about the size and depth of such defects.

Since every knot originates at the pith, every knot that appears on the bark side of a flatsawn board will also appear on the pith side of that same board. On the other hand, some knots on the pith side may have ended and grown over before reaching the bark surface. Therefore, the bark side is often the clearer, higher-quality face.

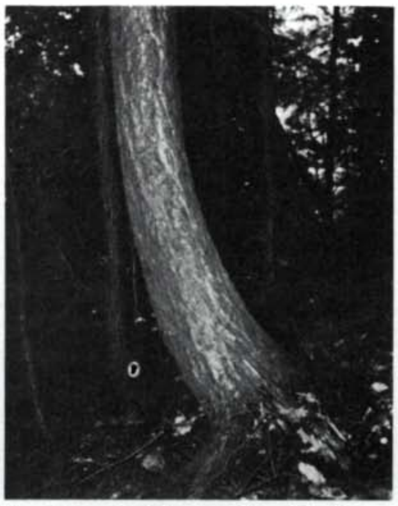
There are a variety of reasons why knots commonly are considered defects. The wood of the knot itself is different in density (usually higher), and its grain orientation is more or less perpendicular to the surrounding wood. Because shrinkage is greater across the knot than in the surrounding wood, encased knots may loosen and drop out. Although intergrown knots remain tight, they may develop radial cracks. Encased knots are usually considered worse defects because of the discoloration and the entrapped bark associated with them. From the standpoints of strength and machining properties, the disorientation of grain direction is troublesome not only because of the knot itself but because the entire area is influenced by the knot. For example, a spike knot extending

Photos, except where noted: Richard Starr

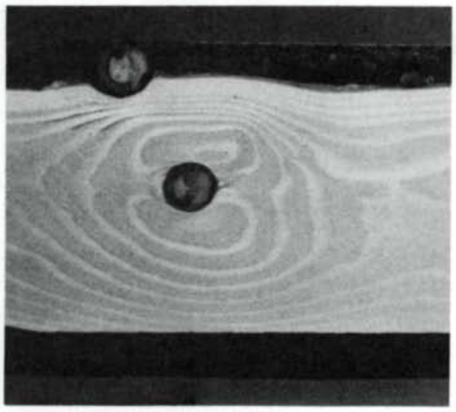


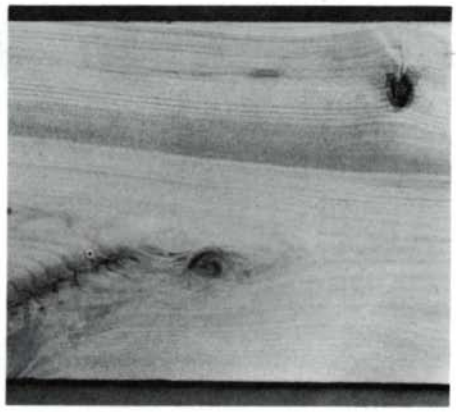


Top, wide growth rings surrounding the pith are juvenile wood, which is lighter and weaker than narrow-ringed mature wood. Needle scars also indicate juvenile wood.



Reaction wood forms in trees that lean. The curving sweep of the tree at left, although picturesque, means that unpredictable compression wood will be found within. Right, pronounced reaction wood from leaning hemlock tree, shown in cross section.





Abnormal appearance of earlywood and latewood on a flatsawn surface, left, indicates compression wood. Compression wood in white pine may appear as a dark streak on a flatsawn board, right.

across a board may cause it to break in half under small loads.

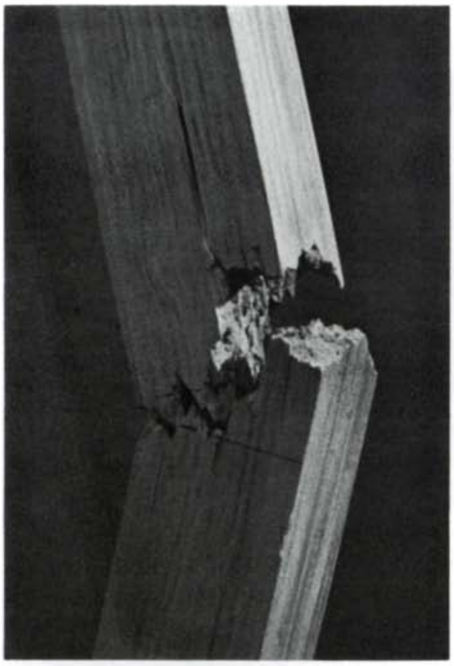
Knots may also be an asset, and have been valuable features of figure in many ways. Knotty pine is often thought to be characteristic of Colonial decor, though in reality, knots were mostly avoided, plugged or painted over by early cabinetmakers. Knotty pine as wall boarding seems to be a 20th-century invention to use the increasing stocks of common grades of lumber. Other species that exhibit knots with some degree of regularity, such as spruce, cedar and other western softwoods, have been successfully marketed to feature their knots. Individual pieces of wood with knots increasingly are fashioned into masterpieces of cabinetry and sculpture.

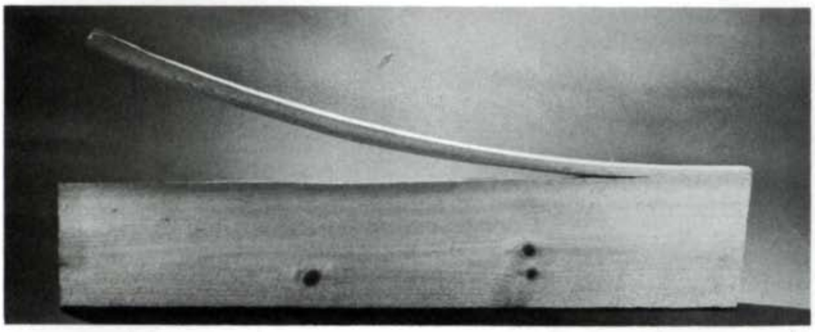
Juvenile and reaction wood—The first few growth rings added around the pith may not be typical of the mature wood formed by the tree. This core of atypical tissue is termed **juvenile wood**. It is prevalent among conifers, especially plantation-grown trees, which grow rapidly until crown closure, when competition with other trees slows growth to a more normal rate. Juvenile wood is characterized by wider growth rings of lower-density wood and less strength. It may also shrink abnormally, resulting in greater tendency to warp, especially by twisting. Pieces of wood including (or very near) the pith should be suspect. Some trees and species show little or no juvenile-wood abnormality.

Reaction wood is a term applied to abnormal wood formed in tree stems and limbs that are other than erect, that is, parallel to the pull of gravity. The principal concern to woodworkers is the occurrence of reaction wood in leaning trunks from which otherwise defect-free wood might be expected. Causes for leaning stems include partial uprooting by storms, severe bending under snow or ice, and tree growth toward sunlight available from only one direction. Reaction-wood formation seems to include a mechanism for redirecting stem growth to the vertical, resulting in a bowing of the stem. Therefore boards or pieces from a log with noticeable bow should be suspected of containing reaction wood and should be examined very closely for it.

Reaction wood has different traits in softwoods and hardwoods. In softwoods, reaction wood forms mainly toward the underside of the leaning stem. Because the pull of gravity presumably puts the lower side of the leaning trunk in compression, reaction wood in conifers is termed **compression wood**. The part of the growth ring containing reaction wood is usually wider than normal, resulting in an eccentrically shaped stem with the pith offset toward the upper side (photos, above). The abnormal tracheids usually appear to form wider than normal latewood. Even-grained woods, such as eastern white pine, therefore appear uneven-grained. However, in woods that are notably uneven-grained, such as southern yellow pine, the latewood is duller and more lifeless than normal and tends to even out the contrast.

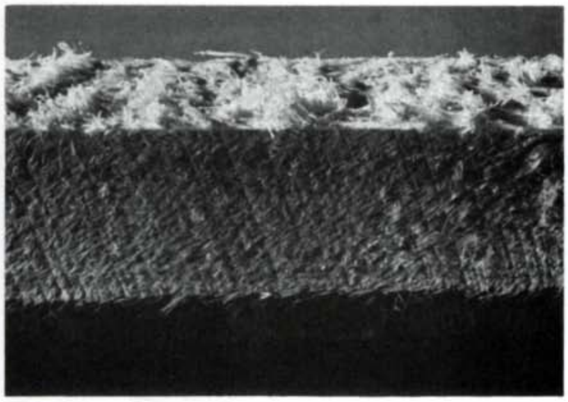
The two main disadvantages of compression wood for the woodworker are its effects on strength and shrinkage. Since





Strength and shrinkage of reaction wood are unpredictable. Brash failure, top left, can be disastrous. Abnormal shrinkage in compression wood, top right, is a frequent cause of warp. Above, reaction wood on edge of pine board has split and bent away.

Eccentric rings on cross-sectional surfaces of red oak log indicate tension wood.



The abnormal fibers of tension wood, containing a greater-than-normal amount of cellulose, left a woolly surface on this cottonwood board when it was sawn from the log.

reaction-wood tracheids are thick-walled, the wood is usually denser than normal. But because they contain less cellulose, and the cellulose chains are not parallel to the long direction of the cells, the wood is weaker than normal. The woodcarver is especially aware of the abnormally hard but brittle qualities of compression wood. In finishing, compression wood may not stain uniformly with normal wood. The carpenter notices the difficulty in driving nails and the greater tendency to split. For structural uses where load-bearing capability is vital, as in ladder rails, unknowing use of reaction wood has resulted in fatality, because the wood breaks suddenly when bent, and at lower-than-expected loads.

Abnormal longitudinal shrinkage is the second major problem. Normal wood shrinks so slightly along the grain that it is usually negligible. Compression wood shrinks up to 10 to 20 times the normal amount. What's more, because reaction-wood formation is non-uniform in a given board, the shrinkage is uneven. Drying of reaction wood, or changes in moisture content, creates uneven shrinkage stresses in the wood. This, along with juvenile wood, is a major cause of warp in framing lumber. Most distortions that develop in stud walls probably result from reaction wood. In woodworking, attempts to ripsaw pieces containing reaction wood may result in the wood's pinching against the saw or its splaying widely apart as the cut progresses, both potentially dangerous occurrences.

In hardwood trees, reaction wood forms predominantly toward the upper side of the leaning stem. Because gravity causes the upper side to be in tension, it is termed **tension** wood. In hardwoods, however, there is less tendency than in softwoods for the pith to be off-center in the stem, and tension wood may develop irregularly around the entire stem. Tension wood is often quite difficult to detect. Sometimes it looks silvery, other times dull and lifeless, and in some cases there is little if any visual difference. Indications of crookedness or sweep in the log are signals of possible tension wood. The abnormal fibers of tension wood actually contain a greater than normal amount of cellulose. This wood is commonly stronger than normal. Of concern to the woodworker is the way this wood machines. Fiber structure does not sever cleanly but leaves a fuzzy or woolly surface. Aside from the immediate problem of machining tension wood, seemingly successful efforts to smooth the wood leave a microscopic woolliness upon the surface. Upon finishing, stain is absorbed irregularly and the surface appears blotchy. As with compression wood, longitudinal shrinkage in tension wood is both irregular and greater than normal, resulting in warping and machining problems. □

This article is excerpted from the chapter "Figure in Wood" in Hoadley's book, Understanding Wood: A Craftsman's Guide to Wood Technology *($18, hardcover; 272 pp.), published last fall by The Taunton Press, 52 Church Hill Rd., Box 355, Newtown, Conn. 06470.*

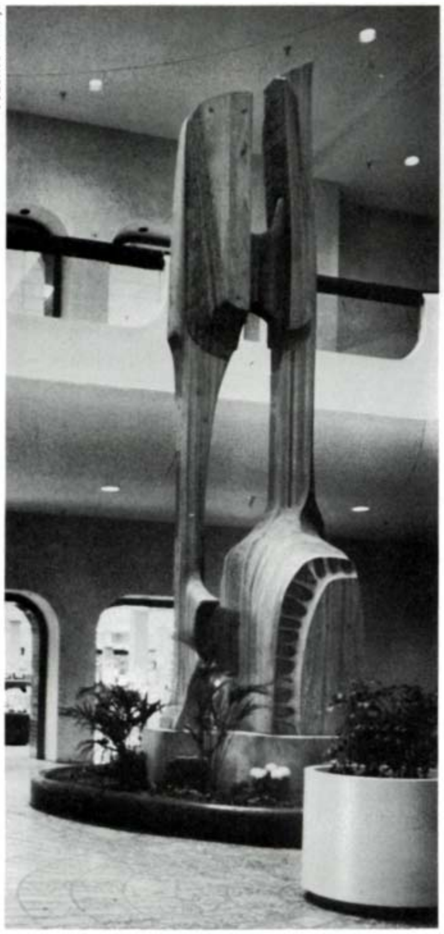
Making It Big

Constructing and carving large sculptures

by Federico Armijo

Quite by chance in 1972, after completing a commission to design and make sculptured door handles and benches for a shopping mall in Phoenix, Ariz., I got a phone call from the developer asking if I would be interested in creating a large-scale sculpture for the Sears Court in the same mall. I was elated. I'd always wanted to do a large-scale piece, and here was my opportunity. Two months later my studio completed the 20-ft. high oak sculpture. It weighed six tons and required a crew of seven people to build.

Federico Armijo



Though the following is a description of how I planned and built another of my commissioned pieces, the sculpture for the Broadway Court in Phoenix, the basic design and construction techniques I'll talk about can be adapted to handle almost any large-scale project requiring long, heavy laminations. For example, variations of the clamping form I'll describe later could be used to make laminated beams for curvilinear roof structures or other architectural components. A good source of general information about large laminated beams is Chapter 10 of the *Wood Handbook*, published by Forest Products Laboratory, U.S. Dept. of Agriculture. Write to the U.S. Government Printing Office, Washington, D.C. 20402, and ask for stock #0100-03200.

The Broadway Court sculpture is 30 ft. high, weighs two tons and is made of Philippine mahogany. Its design began with several meetings with the developer and the architect; the conversations centered around aesthetics, materials, costs and scheduling. Then I visited the site. Architectural drawings are helpful, but if you're going to comprehend the possibilities of the space, there's no substitute for seeing where the sculpture is supposed to go.

Designing a large-scale sculpture demands care and continual sensitivity to the relationship between the materials used and the composition of the piece. One mistake in judgment or planning, given the huge size and weight of such a sculpture, can turn into a serious financial loss or, even worse, injury to a workman or a bystander. Many things therefore must be considered—milling and fabricating the laminations, mobility of component pieces, transportation and setup of machinery, insurance and costing. And all of these factors must be kept in mind while you are still designing the piece.

The first step in the actual design is to construct a scale model from a series of

Paul De Gruccio

Large-scale sculpture demands careful planning and close cooperation between builder, client, structural engineer and installation crew. Above, Armijo's oak sculpture for the Sears Court in Phoenix is 20 ft. high and weighs close to six tons. Right, 30-ft. sculpture of laminated 8/4 Philippine mahogany at the Broadway Court Mall in Phoenix leans 5° and is supported by an I-beam that runs through the central spine and is anchored in a concrete footing below. The cement base was poured after the sculpture was installed.

sketches. Sometimes, if the original idea is strong enough, I bypass the sketching process and compose directly on the band saw, working with suitable-sized scraps of wood. The modelmaking phase is slow, often taking a week or more to fully develop a pleasing design. Experience has shown me that for a formal presentation to a prospective client, it's best to have prepared two or three different models.

Because selling a design to a client involves a lot of subjective considerations on both sides of the bargaining table, you should have several "design packages" in your presentation, each of them within a different price range. Don't underestimate the importance of your presentation, and try to have a ready answer for every question you might be asked about design, materials costs and time schedules. Winning your client's confidence is necessary to getting his contract.

Once I'd gotten the contract for the Broadway Court sculpture and the model had been approved, I hired a structural engineer to study the model and to determine the minimal required sectional properties for static and dynamic stresses. His job was made more complicated because the sculpture leans 5° from vertical in one direction. On completing his assignment, he handed me 10 pages of computations, and I was legally bound to follow his specifications in every detail. After purchasing several thousand board feet of 8/4 Philippine mahogany, we began to laminate the stock for one of the sculpture's 30-ft. long central beams and its adjoining wings or fans. Fortunately the design allowed for uniformly dimensioned plies throughout, though the length and thicknesses of the different laminations varied. So our initial step was to glue up the stock for the plies by edge-joining 4½-in. widths of the 8/4 stock, which we cut alternately into 14-ft. and 16-ft. lengths. The boards were clamped so that the end-grain joints were staggered, and we reinforced these with dowels for added strength. When gluing was complete (we used Titebond throughout), we surfaced each ply to a finished thickness of 1½ in., having oriented the grain during assembly to minimize tear-out as the laminated boards were fed through the planer.

While one part of the crew was making the plies, another group was busy preparing the forms for laminating the curved beams, which when glued together would form the basic shape of the sculpture. We began by making the base of the form from a number of wood pylons (figure 1, detail *A*). We spaced these 2 ft. apart, then aligned them with a level/transit and bolted them to the concrete floor. Next we bridged the pylons with lengths of 6/4 fir planks, which we bolted onto the tops of the pylons (figure 1). We double-checked with the transit to make certain the base was absolutely level and perfectly straight. Wedges driven between the floor and pylons let us bring the whole length of the base into a single plane. This required a lot of tedious work, but to build an accurate, workable form requires a true base, else you'll end up with twisted laminations.

With the base complete we built the curved superstructure that would determine the arc of the lamination (figure 2). Fir uprights (2x8s) were cut to appropriate length, depending on the part of the arc they supported, and then nailed to the ends of the pylons and cross-braced with short lengths of 2x4s. On the back side of the form, every other upright was cut to extend 12 in. above the surface of the form. Their purpose was to align the stacked laminations and to provide vertical clamping surfaces. The bed of the form we made from 6/4 fir planks sheathed with ¾-in. plywood to smooth out the junctures and add strength to the curved platform. Figure 2, detail *B* shows an end elevation of a typical pylon assembly. To finish the form, we covered it with plastic film so that glue squeeze-out from the laminations would not foul its surfaces.

First we laminated the two halves of the central supporting beam, each half consisting of six plies 1½ in. thick, 9 in. wide and 30 ft. long. Each board was

Fig. 1: Base of form

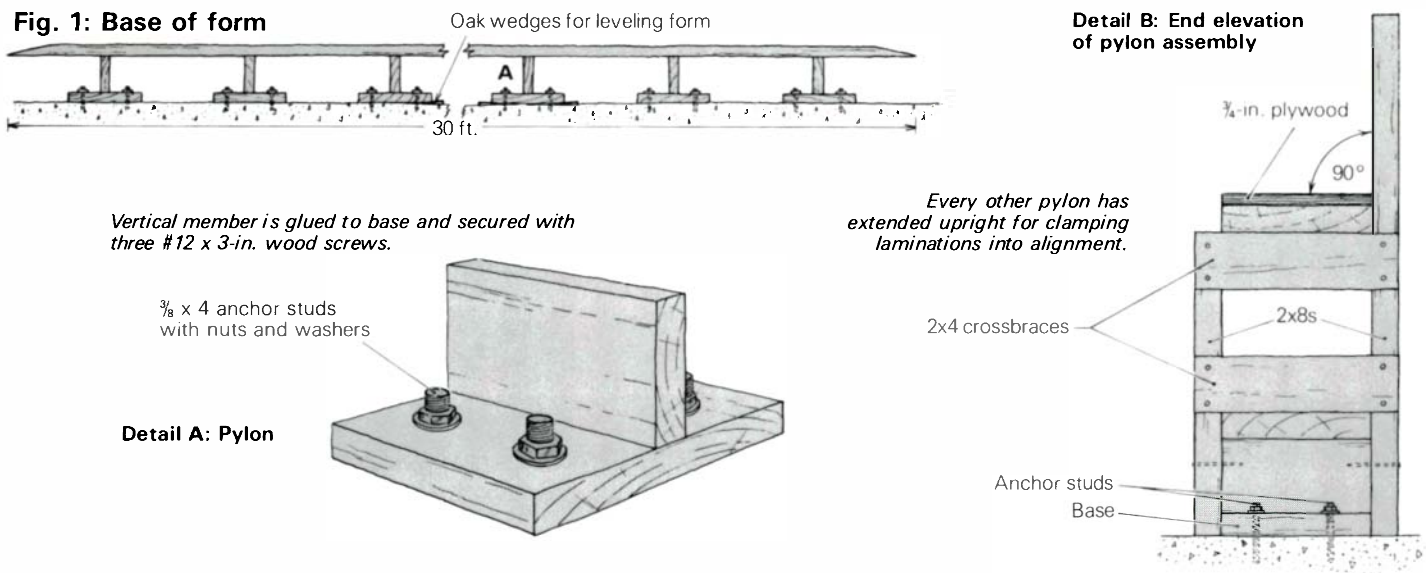
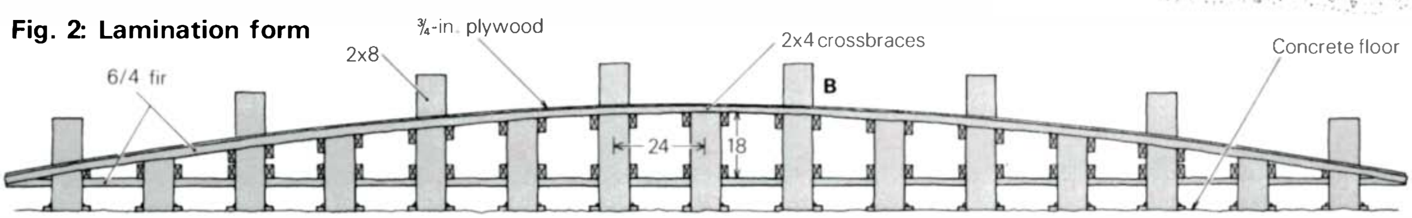


Fig. 2: Lamination form



Drawings: Christopher Clapp

scraped free of mill marks left by the planer, which was carefully tuned and adjusted to produce no snipes that would interfere with the strength of the glue lines. Making sure that all gluing surfaces were clean, we oriented the grain the most advantageous way, staggered the butt joints in the plies and stacked the boards on sawhorses in their proper sequence so the first one on would be the last one off.

Gluing up a beam of this size required close cooperation among the three team members to eliminate unnecessary, time-wasting movements and foul-ups that might ruin the lamination. Gallon glue bottles were prepared, and 100 bar clamps were adjusted and placed into positions along the form where they could be gotten to quickly, and the whole procedure was rehearsed to ensure that everyone understood what to do and when to do it. To keep the glue from setting too quickly, we stopped the airflow through the shop. One person poured a substantial bead of glue down the center of each ply, while another spread it evenly. Then all three men placed the ply on the form. Spreading the glue and stacking the plies was done as rapidly as possible, and when all six plies were stacked, we clamped them to the extended uprights (figure 3) using battens to align them before we clamped them down to the curved surface of the form. The clamps holding the plies in alignment against the uprights weren't so tight as to make clamping downward difficult. We also used battens across the width of the plies to provide even clamping pressure. To avoid bubbles and ensure uniform distribution of the glue, we began clamping the beam in the center and proceeded outward to the ends.

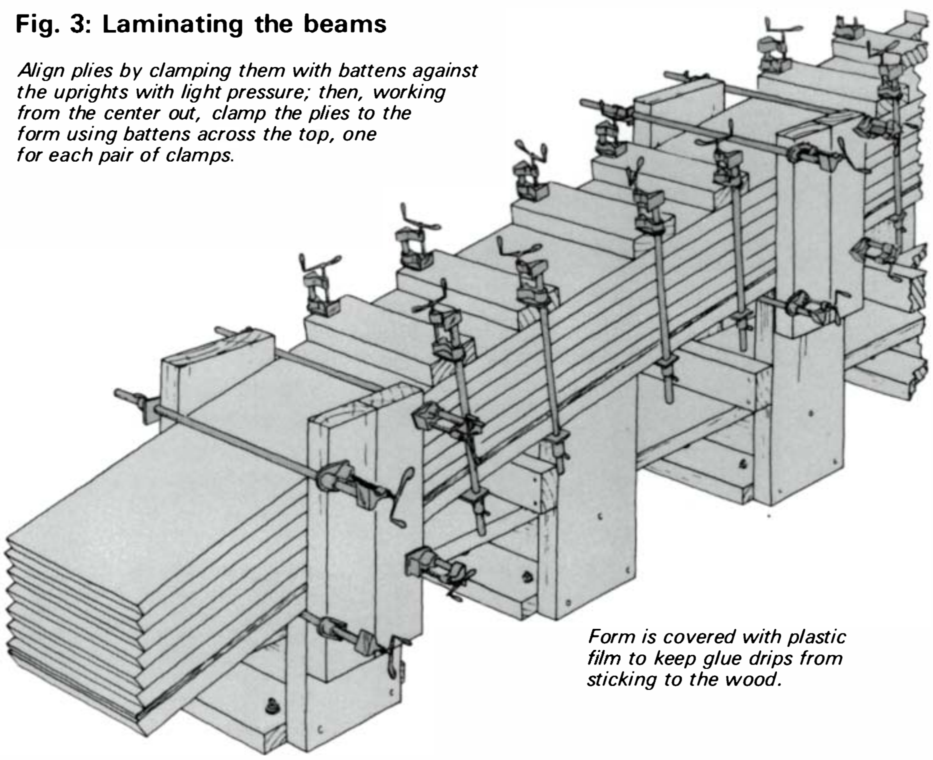
The next day we removed all of the clamps and scraped off the excess hardened glue. Then with the help of roller tables to support the curved beam, we ran it through the thickness planer to joint the edges. The second half of the main beam was made in exactly the same way, and when it too was jointed with the planer, the two surfaces mated perfectly. Before gluing the two halves of the main beam together, we slotted the bottom portion of it to receive an I-beam, which became the supporting member of the sculpture.

After bolting it in place we glued the two halves together. Then the six curved laminations for the wings, each two plies thick, were glued to the main beam, three on each side, and staggered to form blanks for curved surfaces. The other half of the sculpture was fabricated in the same way, only it was not as long. These two halves were not to be joined until the entire piece was installed at the site, where they would be connected by a central mass of shaped wood and four 1-in. tempered steel bolts (figure 5).

Being interested in making the wings graceful, slightly concave and convex forms along the length of the sculpture, I devised a sliding jig for my portable circular saw and router (figure 4). Ingenious variations of this basic jig can produce more complex forms, but the simple one I made slid along the length of

Fig. 3: Laminating the beams

Align plies by clamping them with battens against the uprights with light pressure; then, working from the center out, clamp the plies to the form using battens across the top, one for each pair of clamps.

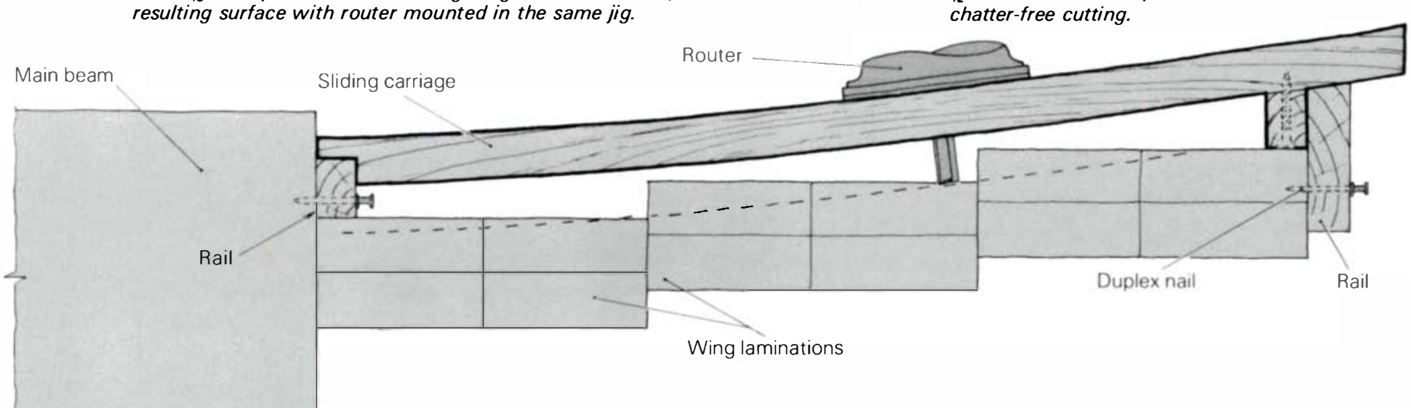


Form is covered with plastic film to keep glue drips from sticking to the wood.

Fig. 4: Jig for saw and router

First, mount circular saw in jig to waste most of the stock by cutting kerfs ⅛ in. apart. After removing ridges with hammer, level the resulting surface with router mounted in the same jig.

Use 3¾-in. long bit with ½-in. shank for clean, chatter-free cutting.



Temporary rails, on which the carriage slides, run the length of the sculpture.

the sculpture's wings and allowed me to cut a series of kerfs across the grain with the circular saw. Spacing the kerfs about ⅛ in. apart, it was easy to remove the rest of the wood by striking along the grain with a hammer. Next I mounted the router in the jig and leveled the surface using a ½-in. straight-face bit with a ½-in. shank. All four wings of the sculpture were treated in this manner, and we simply turned the jig over to produce the convex surfaces.

Turning the sculpture over was not an easy matter so we finished one side of each half before attempting to invert it. This was done with the use of an overhead chain hoist. To sand the surfaces, we used pneumatic sanders with foam-backed discs, which minimize swirl marks and gouges. In appropriate places we used vibrating sanders, and where necessary we sanded by hand. We started with 80-grit silicon-carbide abrasive and then finished the surfaces with 120-grit paper. Given the size of the piece and the fact that I was going to lacquer it, further sanding and smoothing seemed a waste of time.

First we stained it with Watco "decorator red." Then we stained with "black Danish oil" to get the look of vermilion (padauk), followed by a coat of Thompson water seal. Next came a coat of sanding sealer, followed by two coats of Sherwin-Williams moisture-resistant lacquer, rubbing between the sprayed coats with 400-grit wet/dry paper. With a wool wheel charged with buffing compound, we burnished the entire piece, then applied a final coat of natural Watco oil wiped off with a soft cloth. The sculpture glowed with a subdued luster.

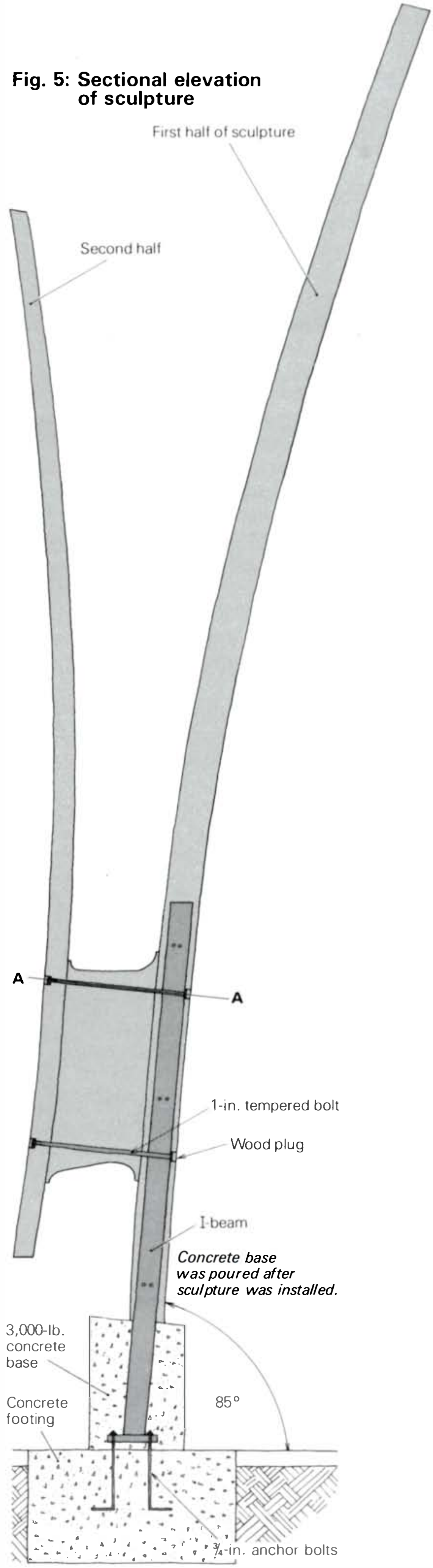
We loaded the sculpture on a flatbed truck with a forklift in the middle of a blizzard. It was no fun at all. But the next day, sculpture and crew arrived intact in Phoenix.

We rolled the two halves of the sculpture into the mall on heavy-duty dollies where the crane operator could pick them up and hoist them into position—using a 12,000-lb.-test nylon strap. Since cranes and their operators charge by the hour, I had met earlier with the operator, and we had rehearsed the whole installation process using a model of the sculpture. So the actual installation went quite smoothly. Figure 5 shows how the sculpture was mounted on its concrete footing.

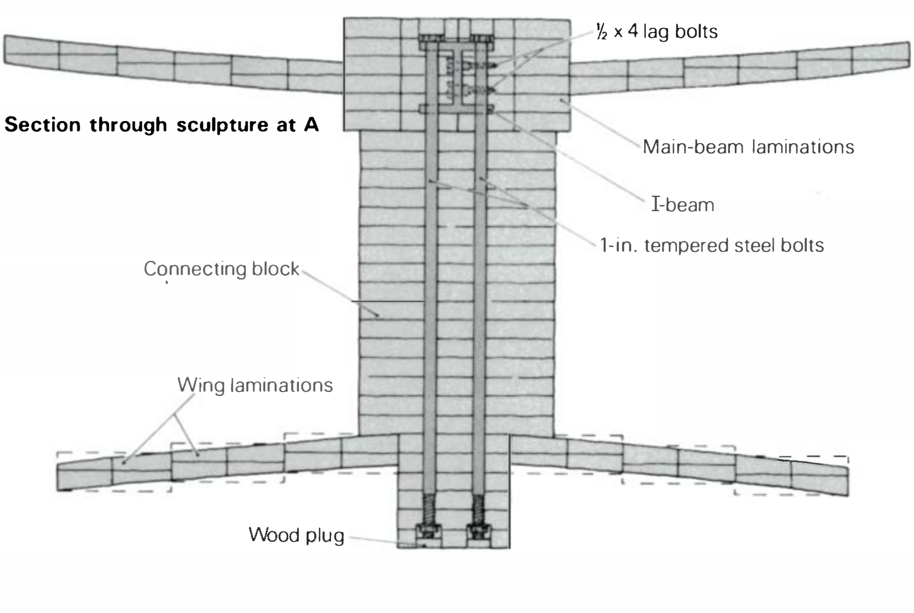
For a project like this, I can't overemphasize the importance of communication and collaboration. It took the combined efforts of more than 50 people to see it through to the end. And from beginning to end, every aspect of the project was insured. Workmen's compensation protected the craftsmen in the shop from accidental injury; a general liability policy covered non-employees in the shop on business, and a product liability policy protected me against possible loss from an injury caused by a defect in the sculpture. I also required certificates of liability from the transportation company and from the crane company, and all of these policies and certificates became part of the contract file. If you decide to build a large-scale sculpture, be prepared to spend as much time in your office pushing paper as you do in your shop working wood. □

Federico Armijo, 34, of Albuquerque, N. Mex., makes sculpture, furniture and doors in wood, metal and stone.

Fig. 5: Sectional elevation of sculpture



Section through sculpture at A



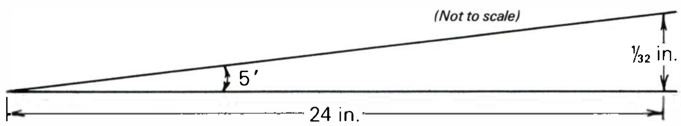
Mitering on the Table Saw

Scribe reference lines for accurate alignment

by Henry T. Kramer

Recommendations for cutting good miter joints rarely include using the table saw, although we commonly use this machine to crosscut 90° angles. While it is cheerfully conceded that the Lion Trimmer and other shearing cutters are best for many miter cuts when their fences are properly adjusted, these are expensive single-purpose tools and can't perform many of the operations a table saw can, such as blind or shoulder cuts, or dadoes at 45°. Because the only difference between setting up the table saw for miter cuts and for 90° crosscuts is a change in the angle on the miter gauge, logic tells us that there ought to be a way of setting the gauge to produce a true 45° cut.

The trouble usually lies in the degree markings, positive stops and pointer on the miter gauge, which are usually too far off to be of any use. Given the dynamics of angular measurement, they would still be hard to set accurately even if their calibrations were precise and true. Some manage by trial and error, and while trial is the ultimate check, there is a better way to get set. The answer is to establish a long reference line on the saw table at an accurate 45° to the gauge slots, and with the aid of a long fence and a 3-ft. straightedge, to use the line to set the miter gauge. The principle is straightforward: the longer the radii forming the angle, the less chance for error. In the case of an angle of five minutes of arc, radii 24 in. long define a chord of about 1/32 in., as shown in the sketch below. Now five minutes of arc is the finest reading on the best vernier bevel protractor available, so if you can work



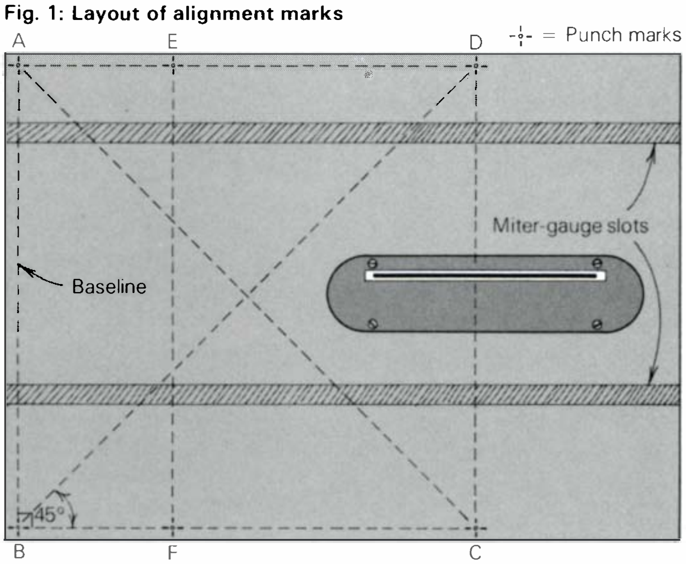
within a lineal error of 1/32 in., you can establish a very accurate reference line.

Before describing how to establish reference lines, I need to point out possible sources for error when crosscutting with a table saw and how I would correct them. First, the blade must run parallel to the miter-gauge slots; if it doesn't, loosen the trunnion bolts and carefully reposition the arbor assembly to true up the sawblade. Heel and toe (a condition when the blade is not parallel to the line of cut) can cause binding, which will burn the wood and produce a bad cut. Second, most miter-gauge guide bars don't fit snugly in their slots, and this play introduces error. You can fix this by holding the gauge firmly against the side of the groove nearest the blade when setting up and cutting, or you can eliminate the play by peening the guide bar or soldering a shim to it.

Third, since most miter gauges have short work-contacting surfaces, you should attach a longer fence to the gauge. You can make one from a carefully jointed strip of wood. In fact, it's a good idea to have on hand several of them of different heights and lengths for different jobs. The long fence provides for more accurate alignment and gives support directly behind the cut, which prevents thin or narrow stock from bowing and binding. A fourth possible source for inaccurate mitering is the tendency of the workpiece to creep into the blade, causing binding, burning and an uneven cut. You can remedy this by gluing a sandpaper strip to the wooden fence of the gauge and holding the workpiece tightly against it during the cut; or you can clamp the work to your auxiliary fence.

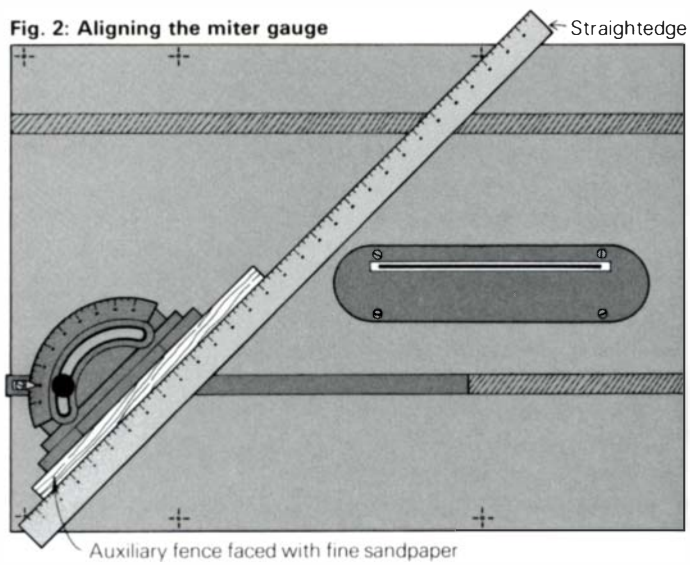
Having done away with these probable causes of error, you are ready to scribe three layout lines on your saw table (extension wings excluded) so you can accurately set your miter

Fig. 1: Layout of alignment marks



Four points at corners (A,B,C,D) define square and diagonals. The two additional points about 7 in. up from baseline (E,F) are used to align gauge for 90° crosscuts.

Fig. 2: Aligning the miter gauge



Even a cheap table saw, at 20 in. by 27 in., can become an accurate mitering tool using this technique.

gauge at 90° and 45°. To begin, you'll need a 36-in. straightedge, an accurate framing square (see *FWW* #17, p. 15 for a way to ensure its trueness) and a strip of wood sized to fit snugly into the miter-gauge slots and to sit proud of the saw table. Because the most reliable way to produce a 45° angle is by drawing a diagonal in a square, you should establish a square on the table. You don't need to scratch these lines into the table; locating the corners of the square with punch marks is sufficient.

The most difficult part of the square to construct is the base, running along the front of the table. The baseline must be perpendicular to the miter-gauge slots (if the slots are not parallel, get a new saw). Use as much of the table for this square as you conveniently can; its sides should be roughly ½ in. from the edges of the table, but don't use the edges for reference, only the miter-gauge grooves. Place the strip of wood in the right-hand groove and hold one leg of the square against it. Lay the straightedge against the other leg of the square, and draw the baseline using a very sharp pencil. Better yet, scribe this line with a machinist's scriber and layout dye. If you want to make a permanent line, use a machinist's scratch awl. Put the strip in the left-hand groove, flip the square, position the straightedge and complete the line so it runs the whole width of the table. Now you have a baseline that is exactly 90° to the miter-gauge grooves.

To establish the top line at the far end of the table, use the straightedge for a rough initial measurement of the height of the sides (precisely the length of the baseline). Then with a pair of dividers set to the exact distance from one groove (the one with the strip in it) to the end of the baseline, transfer this distance up to the top line, just above the expected height of the side. Now measure the length of the baseline carefully with trammels or by scribing the unmarked back of a 36-in. steel rule. With this and your dividers, locate one of the upper corners. Repeat this process to find the other corner, and the square is laid out. Now check all your measurements, beginning with the diagonals, which must be exactly the same length. When everything is right, locate each corner with a punch mark. If you haven't used a centerpunch much, practice first on some spare or scrap cast iron. The punch has to be held upright and hit dead on with a dead blow. A deliberate "rap-whap" will do it. When you're satisfied that you can strike the punch properly, punch-mark the four corners.

To align the miter gauge for 90° crosscutting, you'll need to mark out another line parallel to the baseline and about 7 in. up from the front edge of the table. Punch-mark the points where this line intersects the two vertical sides of the square. To get the most accurate setting you must hold a straightedge against the face of your miter gauge to set it for both 45° and 90° cuts. This straightedge must, of course, be long enough to be lined up on both punch marks at once. Keep in mind that the longer the auxiliary fence on your miter gauge, the more precise the alignment you'll get.

The approach of using long reference lines laid out on the surface of the table lends itself to other geometric constructions for other desired angle cuts. But if you scribe additional reference lines, you'll have to label them to avoid confusion. The key to this system is the length of the lines; the longer they are, the more accurate the results they'll give. In angular measurement, put not your trust in protractors. □

Amateur woodworker Henry Kramer lives in Somerville, N.J.

Aluminum Miter Jig

by Pope Lawrence

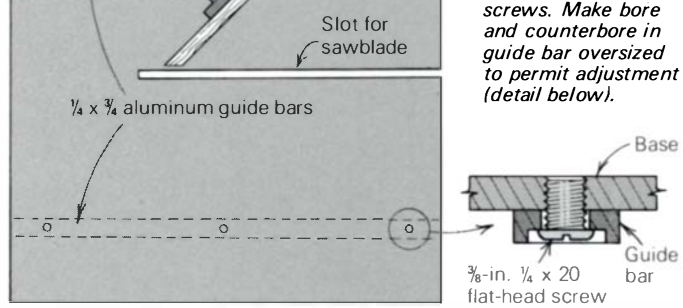
Here is a sliding miter jig for the table saw. Made from aluminum plate, with aluminum guide bars and a standard miter-gauge protractor head, it can be used to cut accurate miters, as well as 90° crosscuts. It is especially useful for mitering wide, thick stock and is adjustable so that other angles may be cut quickly, accurately and repeatedly. To make the base of the jig, get a piece of ¼-in. aluminum plate from a salvage yard or metal supply house and cut it about 18 in. long and 14 in. wide. The size will vary from saw to saw. An ordinary carbide-tipped blade in your table saw will do if you use prudence and care.

Using aluminum instead of plywood for the jig gives it greater rigidity, durability and accuracy, and makes a stable base for other table-saw jigs. Aluminum drills easily and cuts well enough with a carbide-tipped blade, but you must be cautious as it sometimes grabs the tool, especially a drill bit, as it penetrates the stock. Clamp the pieces down when drilling and wear safety glasses when cutting. You can also bandsaw aluminum plate with an ordinary woodcutting blade.

Rip two strips from the plate for the guide bars and file their sawn edges for a snug but sliding fit in the miter-gauge slots. File a little chamfer on their two outer edges. Affixing the guide bars to the plate requires careful measuring and marking. Use ¼ x 20 flat-head machine screws, and tap the plate to receive them. Bore and counterbore the bottom of the guide bars so the holes are slightly oversized. This will allow you to make minor lateral adjustments to get the exact spacing between the bars. With the base complete, attach the protractor head and screw to it an auxiliary wooden fence, which you can equip with one or more toggle clamps (available from De-Sta-Co Division, Dover Corp., 350 Midland Ave., Detroit, Mich. 48302) to hold the workpiece against the base during the cut. Also you can clamp a stop block to the auxiliary fence for repetitive cuts of the same length.

When you've finished assembling the jig, mount a carbide-tipped blade on your saw arbor, set the jig in the slots and saw a kerf in the aluminum base plate so that it runs a short distance past the fence on the miter gauge when it's set for an acute 45° cut. This completes the jig and it's ready for use. □

Pope Lawrence, 32, is a cabinetmaker in Santa Fe, N. Mex.



The Patternmaker's Trade

From sculpted wood to metal castings

by Paul Suwijn

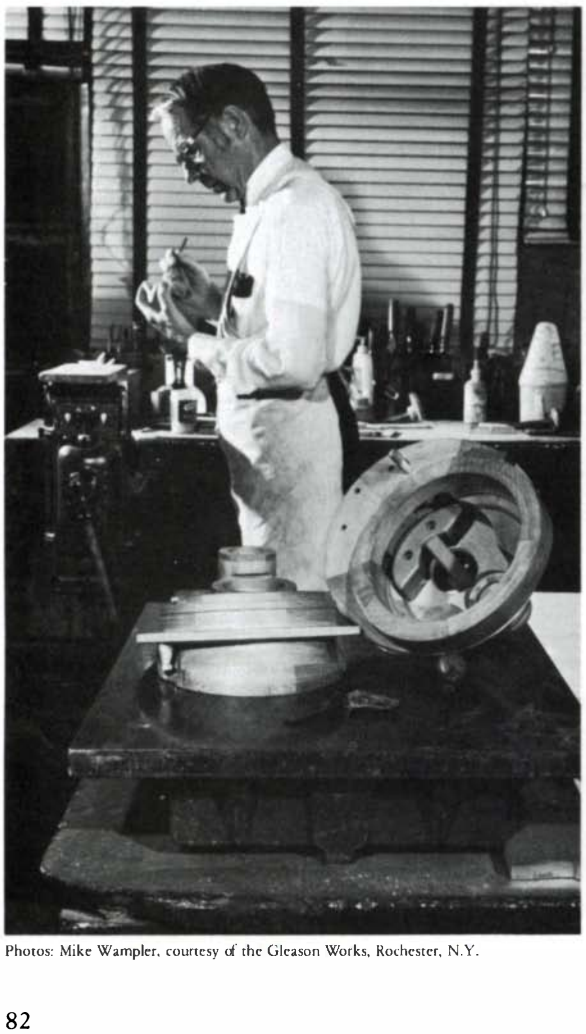
Having become a respectable cabinetmaker by the usual hit-or-miss methods, I found myself in the typical quandary—how to earn a decent living working wood. One day I dropped in unannounced at the shop of an established designer/craftsman, showed him my portfolio and asked him for advice. While I rhapsodized about my interest in design, his emphasis was squarely on craftsmanship. Since he did all the design work himself, he was interested in hiring skilled craftsmen who could take a set of drawings and build a piece from start to finish without asking questions. For this reason, he had just hired a journeyman patternmaker.

I left this fellow's shop determined to find out about patternmakers and what makes them a special species of woodworker. Checking through the phone directory, I found several pattern jobbers listed and proceeded to investigate. Repeatedly I was told by foremen at small shops that if I wanted to land an apprenticeship in patternmaking, I would have better luck applying at a large, industrial outfit with an in-house pattern shop. I did just that, and the fates must have favored me that day, for about a week later I was hired.

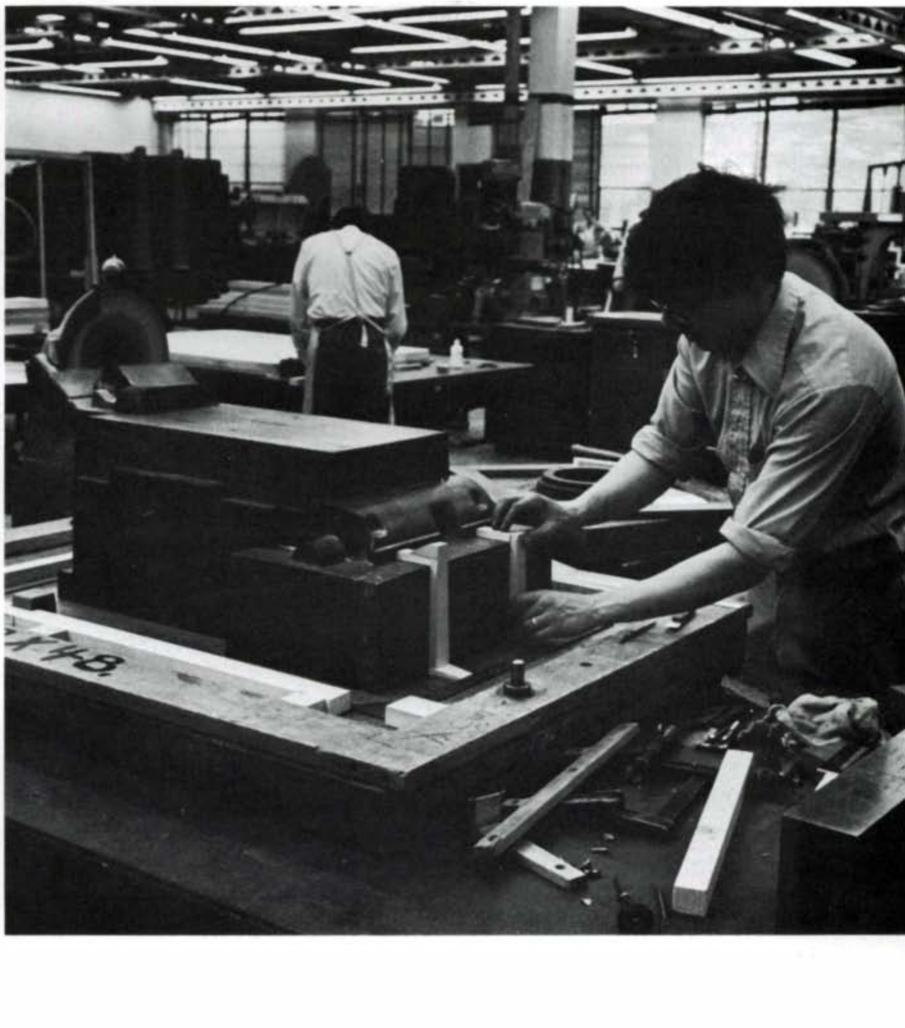
In retrospect, I can fairly say that I entered a world of abstract woodworking unlike anything the average cabinetmaker is likely to encounter. The point of wood patternmaking is a very practical one—to produce the forms that create molds for metal castings—but the work is scarcely less than elegant in its best expressions. For the first time I had the pleasure of working with full-scale machine tools maintained in top condition, and was introduced to several woodworking tools and machines I had never run into before. I am grateful to have experienced, bit by bit, the meaning of master craftsmanship, and to have had the opportunity to watch and learn from the real practitioners.

Modelmaking—Patternwork starts in the engineering office. Designers reach a point where it becomes difficult to fine-tune their conceptions without reference to a three-

Working on a complicated model for a machine part, like this compound-action cutter-holding device, requires precision and broad experience in the trade. Such models as these are built from engineers' drawings.



Author installs the gating (which will produce the pouring channels) on the core-print area of a complex wooden pattern for a machinery casting. The job of the pattern is to define the exterior portions of the cast-metal object by making an impression in a sand mold.



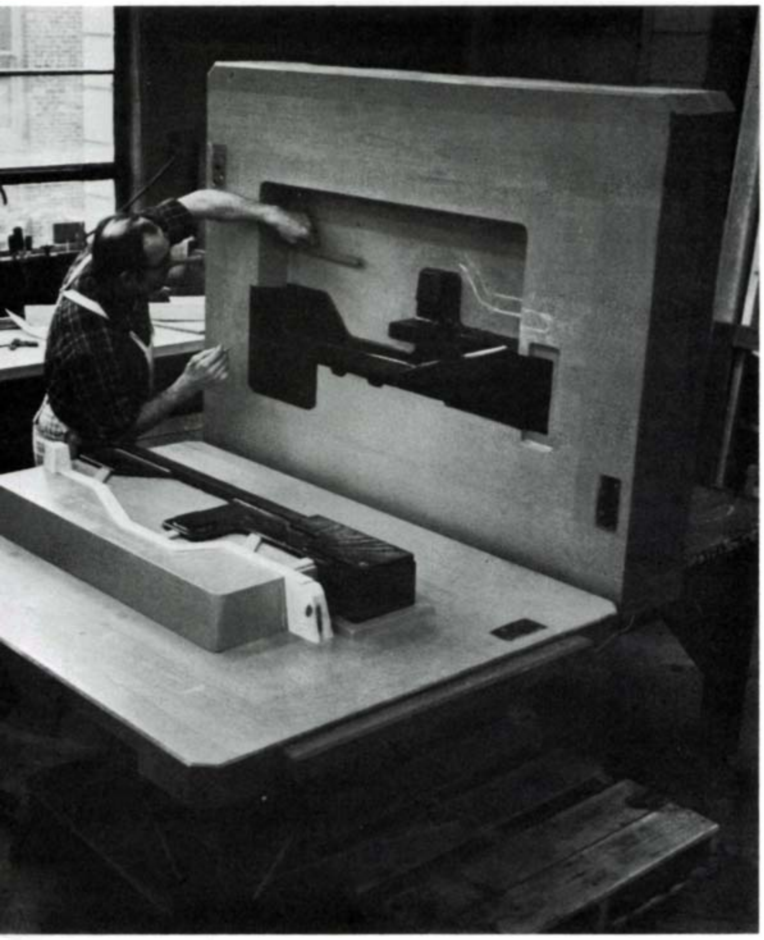
Photos: Mike Wampler, courtesy of the Gleason Works, Rochester, N.Y.

dimensional model. In many pattern shops some tradesmen satisfy this need by doubling as machine-modelmakers. The modelmaker constructs a scale assembly, frequently of wood, from the engineers' layout drawings. The usual sequence for large machinery begins with an explicit ¼-scale model, which can be shuttled back and forth from the pattern shop to the engineering office as improvements are made.

When most of the bugs have been worked out of the reduced-scale model, a full-scale model is made. It incorporates the machine's most important moving elements and represents its troublesome features in detail. All the major electrical cables and hydraulic lines are fitted to the model as are dummy switches, controls, loading apparatus and guarding. The thinking in many firms runs thus: The machine model, whatever its cost, justifies its expense in revealing problems before they prove really costly, and the model can be used to demonstrate a new concept in machine design to prospective customers. Models also acquaint the sales staff with a new machine, rendering it more tangibly than blueprints.

The modelmaker scales his work directly from the layout prints, which are preliminary, often incomplete drawings of the machine. Working within tolerances of about 0.050 in. on large work, he must be patient and diplomatic, as he will be required to tear down and rebuild the model as the design evolves. Modelmakers must have a talent for deciphering complex drawings and for discerning inconsistencies in design as the model progresses. Engineers value the services of a good modelmaker, for he's the one who first gives solid shape to their concepts. The information he provides as the model progresses can be an active contribution to the final product.

In a sand-match pattern, the projecting male half of the pattern will become the female part of the mold, and the female pattern half will form the male half of the mold. This method eliminates the need for separate sand cores. Dark areas represent cast metal.



Patternmaking—Once the final model has been made and its design perfected as much as possible, the machine is broken down into its component elements and detailed blueprints are made for each of these parts. Wooden patterns—precise replicas of the cast parts—are made from these prints. The pattern leaves its shape in a sand mold, which when filled with molten metal yields the finished casting. For more information on how patterns are used, see box, p. 86, on foundry practices. Preliminary prints of the cast parts are sent to the pattern shop for study and comments. Throughout the modelmaking and detailing stages, the engineers consult with the most experienced patternmakers and the foundry metallurgist to avoid designing a part that isn't practical to cast. Difficult castings are debated at length before the collective talent arrives at the best solution.

Patternwork is used for a wide range of casting, from a jack plane to a complex industrial machine frame weighing many tons. Patterns are not always made of wood. High-production foundries use metal patterns cast from wooden masters or built up and machined from standard metal stock. Wax, plaster, clay, Styrofoam, fiberglass and castable urethanes and epoxies (suitably wood-cored) are common pattern materials—each suited to a particular need. Wood patterns, however, are most useful for producing one to several hundred castings because it is difficult to surpass wood for economy, its ratio of strength to weight, and easy tooling.

Patternwork consists mainly of two parts—making the pattern, which defines the exterior form of the casting, and making the core box, which defines the interior shape of the casting, the thickness of its walls, and, in some cases, difficult external features. The combination of external mold halves and the internal and external sand cores describes all the features of a complex casting, inside and out. Patternwork for small and moderate-sized castings is usually assigned to a single craftsman. Blueprints show the parting-line and coring layout marked out plainly by the shop supervisor, with notes about material and machine finish allowances.

To simplify the print and to account for draft and machine finish enlargements, the patternmaker makes a precise, knife-scribed layout of the job on a separate board or sheet of plywood. If he needs layout sticks for core-box or pattern construction, he makes them at this point. The layout process helps eliminate making careless omissions as the patternmaker builds the pattern, and it helps clarify his picture of what he must construct. Separating layout and construction is a very satisfactory arrangement in practice. Calculations that are made during the building process are a source of error and can waste much good effort—as in the common case of too much stock removed.

If a pattern assignment is particularly time-consuming or rushed, several patternmakers may work together under the supervision of a master craftsman, who is responsible for coordinating their work, checking the layout and determining the clearances between the parts. He may prepare a set of templates in advance which will guarantee the fit of all the parts. Every dimension is measured and recalculated by the

AUTHOR'S NOTE: For a comprehensive treatment of this subject, see Ed Hamilton's *Patternmaker's Guide* (American Foundrymen's Society, Cast Metals Series, Des Plaines, Ill. 60016).

Patternmakers use wood lathes with screw-driven crossfeed tool posts, like those on metalworking lathes, to achieve maximum accuracy when turning. Pattern being turned here is made from stacked, segmented rings, glued one atop another.

Patternmakers apply leather fillets to a completed core box. Fillets create radii at sharp junctures of a casting's elements, adding considerably to the strength of the metal at these points and helping to prevent cracked castings.

pattern checker. He uses an independently made layout to reduce further the chance for error. If any features need rework, he reports these to the patternmaker. When the pattern equipment meets with his approval, it is dispatched to the foundry for molding and coremaking.

Since it is very costly to scrap castings, great pains are taken to deliver strong, dimensionally perfect wood patterns to the foundry. Patterns are built durably, and their accuracy is within 0.015 in. on new work, and sometimes closer on light patternwork for non-ferrous casting. The relative position of all the features must also fall within this tolerance. Good joinery and clean appearances are not, in themselves, sufficient. Patternmaking is thus excellent training for any precision woodworking, though it is also rewarding in itself.

Tooling costs for quality wood patternwork are very high indeed, and are written off against long, successful casting runs. Pattern commissions in the $5,000 to $50,000 range are common for heavily-cored patterns, which often resemble exact and foolproof puzzles with marginal clearances provided between the pieces to ease assembly of the mold, built-in markers to clear up the relation between the parts and anchoring and gas-venting devices and pouring systems.

Materials—Top-grade lumber is used in wood patternmaking—clear South American mahogany, cherry, yellow poplar, white or sugar pine, and sometimes basswood, with hard maple used for reinforcement. Pattern lumber is sorted for absence of defects and straightness of grain (figure is unwelcome), and it arrives roughsawn at the shop, since a full spectrum of thicknesses is needed. Our shop stocks from 10,000 to 15,000 board feet, and we consume a great deal of ¾-in. and 1-in. A/B fir plywood for large core-box walls and floors, and for concealed headers in hollow constructions. We also use tempered Masonite, sheet aluminum, brass and band iron for templates and local surface buildups. Frequently, we cast aluminum elements from wooden master patterns for features that would be too fragile if constructed from wood.

Common pine is satisfactory for one-shot work and in stacked constructions (common in wood patternmaking) when capped with more durable material. Massive, stacked work, requiring lots of pneumatic and hand carving or overhead milling—patterns for turbine and pump housings are good examples—is made up from prelaminated sugar pine or mahogany blocks. But where tolerances may be as close as 0.003 in., we use cherry or Spanish cedar because of their excellent tooling qualities and dimensional stability.

Methods of construction—The patternwork in our shop is classified in three grades. First-class means we use the best hardwood with elements spot-glued, doweled and heavily screwed together. Flat-head screws (#14, from 1 in. to 6 in. long, or #10 and #8 for light work) stiffen the pattern against the weight of the molding sand. Screw heads are set in counterbores, capped with tapered hardwood plugs that are pared flush to the pattern surface, and set cross-grain to the surrounding material so they can be spotted quickly. Core boxes have separable interior assemblies, screwed to the box walls and floor from outside so that no section prevents the independent removal of the others. This permits fairly easy breakdown in case of a design change.

Less durable but more easily worked materials, like pine or poplar, are acceptable for second-class work. Nails replace screws in third-class construction, and quicker assembly practices are used so long as flimsiness is avoided and dimensions are correct. Common pine and basswood are suitable for some third-class constructions.

Small patterns are usually built in blocked-up fashion, solid throughout, while larger work begins with a reinforced frame of clear pine or poplar. The frame is then sheathed with vertical planking (mahogany for first-class work) to achieve the finished dimensions. The top planking is housed within the projecting upper tips of the wall sheathing, and care is taken to avoid telegraphing of joints, which causes mold damage, and warpage, which fouls dimension.

It is common practice to saw relief kerfs into the backside of wider planks, or to rip them into narrow strips and glue them up to the required width, reversing (or bucking) the grain of each successive strip to combat warpage. Most such work is glued-up oversize to permit rapid stacking, then scraped and planed to thickness. Finish nails, tacked in at an angle, align the ends of stacked material and prevent the strips or planks from swimming out of position when being clamped.

For developing a cylindrical form we use the stacked-ring approach. Full rings of four, five or six segments are prepared on a perfectly flat surface from an accurate segment template, then glued to height with joints in adjacent rings staggered. The four and six-segment formulas are especially easy to lay out, but we use eight or ten segments per ring for large work to minimize waste. Using the template, we nest the segments on a wide section of plank, allowing just enough room between for bandsawing and cleanup. Stave constructions, reinforced by concealed header/backbone systems, are also common in large cylindrical patterns. Stavework can be adapted also to accomplish transitions in regular contours, or in truncated cones by tapering each stave over its length.

In order to maintain accuracy on turned work, wood lathes with crossfeed tool posts are preferred over those with ordinary tool rests. Where large, regular contours are needed, we employ overhead wood-milling equipment. Large circles are accurately cut on the pattern mill, which has a rotating cutter that reaches down from above at any given angle, while the work is secured on a table that can travel along two horizontal axes or rotate full-circle.

Hand tools, rules and gauges—Most cabinetmaker's hand tools apply readily to patternmaking. Because accuracy in layout and construction is essential, patternmakers use machinist's combination squares and calipers (L.S. Starrett Co., Athol, Mass. 01331 is the best producer). Braces and pneumatic guns are used for driving screws. A good set of trammels, rapid-action dividers and top-quality marking and panel gauges are indispensable for layout (Freeman Supply Co., 1152 E. Broadway, Toledo, Ohio 43604 sells a bronze panel gauge that has no peer). Patternmakers prefer to use bent-shank (also called crank-handled) chisels and in-cannel gouges for flush or contour paring. Recently I counted about 20 special-function tools in our shop, including bent-shank chisels, scrapers, marking and scribing instruments, planes and accessories to standard machine-tools—all shop made—that fill the gaps left by standard cabinet tools.

Pattern assembly is typically done on polished granite or machined-iron surface plates to ensure a true reference surface at all stages of the work. Surface gauges are more reliable than ordinary rules for establishing precise locations on pattern sidewalls. The finer side of wood patternmaking sets aside the ruler, replacing it with the micrometer, the dial-indicator calipers and the vernier height gauge. Some tool-and-die training is helpful in this refined corner of the trade.

Most cast metals shrink fractionally as they solidify. Shrinkage varies according to the metal. It's about $\frac{1}{10}$ in. per foot for cast irons, $\frac{3}{16}$ in. for aluminum, $\frac{5}{32}$ in. for brass and bronze, and $\frac{1}{4}$ in. to the foot for lead. Wood patterns must therefore be proportionately larger than the object they're to produce, and every pattern is scaled to a particular casting alloy. Thus patternmakers work with expanded rules (called shrink rules). They're made in one or two-foot lengths and read in fiftieths of an inch, with a given shrinkage factor stamped on the face. In the finest patternwork, shrinkage for each dimension is calculated in advance, on the blueprint, because the finest measuring instruments read to standard rulings.

Because rough treatment in the foundry eventually ruins a wooden pattern, a run of thousands of castings starts with a very fine wooden master. Its impression is taken, then a new working pattern is cast from wood-cored epoxy or urethane plastic, or from cast aluminum or nickle-plated cast iron. The castable plastics have negligible shrinkage. But if the working pattern is to be aluminum or iron, the wood master will have to account for double shrinkage.

Apprentices, journeymen and masters—Pattern shops take on apprentices when business is good. The period of training runs from four to five years and may include direct experience in the foundry or machine shop to broaden the apprentice's knowledge of the trade. High-precision shops sometimes require, and may pay for, classroom study at a local tool-and-die institute. Some programs are state-mandated and lead to journeyman's certification. New apprentices are sometimes granted a moderate tool allowance.

Patternmakers in our shop are classified C, B, A or Master, according to proven ability to do jobs of increasing difficulty. An annual income of $20,000 is not uncommon for a class-A patternmaker, and a master may earn appreciably more. The foreman bids on outside work and decides questions about design in cooperation with the project engineer, metallurgist and foundry manager, while the patternmaking staff is usually left to concentrate on the good practice of the trade.

The work atmosphere in a pattern shop is disciplined and studious. An industrial-methods approach doesn't work well because the work is one-of-a-kind. Instead, the traditional wisdom, the experience and the intelligence of the individual patternmakers are relied upon. Thus, you'll find in a pattern shop a high level of work motivation and a fairly keen competition for the best jobs.

It takes a couple of years for a good apprentice to find his pace and produce consistent results. The advice given to a new apprentice in our shop is, "Take your time, just make sure you do it right." Expectations increase with experience, but seldom to the point of pressure in a good working situation, since this eventually fouls concentration (and blackens the heart). Proverbial wisdom has it that there are only two times when a patternmaker rushes—when he's making a mistake, or when he's fixing one.

Neither age nor gender is any real barrier to the trade, though I've never met a woman patternmaker. I trust that any determined woman cabinetmaker could open that door. When I began in our shop, I had the pleasure of working next to a 75-year-old retired master who had come in temporarily to help us through a heavy period. He was still a keen and productive tradesman, with a wonderfully light heart and an eagerness about his work. He made a point before he left to encourage each of the apprentices to stick with the trade, and expressed the undiminished sense of enjoyment that he still found in the work. →

Paul Suwijn, 30, is now a draftsman at the Gleason Works, Rochester, N.Y. He is currently studying machine design.

What Foundries Do

Wood patternmaking came into being in answer to the needs of Renaissance bell and ordnance founders, then further developed during the Industrial Revolution in response to the rapid growth in the demand for machinery castings. These days, we're surrounded by tools, machines and other objects made of cast metal, and each of them begins as a precise pattern, usually made of wood. Patternmaking has always reflected the state of foundry technology and makes sense only in light of casting practice. I'll discuss the basic concepts of shrinkage, draft, core boxes, core prints, patterns and parting lines with reference to sand-casting technique, the most common method of producing large metal castings.

A wooden pattern is used in the foundry to create a void in packed sand. The pattern is withdrawn and molten metal is poured into the void—the shape of the pattern thus translates directly into the shape of the casting. Many patterns are split into upper and lower halves. Sand cores are often secured within the mold cavity to define difficult features and to create chambers inside the casting. But since the pattern itself never contacts the molten metal, once made, it can be re-used indefinitely, though the time comes when it is cheaper to rebuild patterns than to refurbish them.

Casting sand is a fine, uniform sand mixed with water and clay or a resin-catalyst mixture; when packed against the pattern, it holds its shape, forming a **mold**. Initially brick hard, the mold is chemically constituted so that as the molten metal cools, its heat degrades the binders in the sand, making it easy to remove the mold from the cooled casting and to recycle the sand. Patterns are delivered to the foundry mounted on flat metal plates or wooden decks called **foundry boards**. An open-ended box, called a **flask**, is set down on the board, allowing room all around the pattern for the sand, which is mechanically cast down onto the pattern until the flask is full. Excess sand is raked off, and a sturdy metal plate is clamped atop the flask. The whole affair is now rolled over so that the foundry board, carrying the pattern with it, can be drawn off on a true perpendicular. This operation completes the lower half of the mold, known as the **drag**.

The upper half of the mold, the **cope**, is made in the same way, but without the heavy metal plate. The sand is secured in the cope flask by iron bars wedged across the width, and by twisted *L*-shaped rods of wrought iron, called **gaggers**, buried in the sand. This allows a pouring dish (connected by tunnels to the main mold cavity) to be built up on its top surface, along with the venting system. An overhead crane and a sand pit are required for rolling the larger variety.

Because the pattern must be pulled out of the sand, leaving its image intact behind, all its vertical walls must have taper, or **draft**. On a typical pattern the walls slope outward to the base, with the uppermost surface buried deepest in the sand. Because pattern features start at different levels, degrees of draft vary from point to point, and will have to be blended between high and low elements. Thanks to draft, most patterns may be drawn off cleanly, although some trowel repair is acceptable on non-critical mold surfaces.

Since the cope and the drag have to match exactly, the pattern halves must be precisely located when mounted on their foundry boards, but mirror-wise to one another. A locater frame is pinned to the first board; then blocks of wood that contact all the critical edges of the pattern half are dogged and glued to the frame. The pattern half is secured from below by screws, dowels and lags. Now the frame with blocks of wood attached is flipped over onto the companion board, where it will correctly locate the other pattern half. Split elements of the pouring system are mounted the same way.

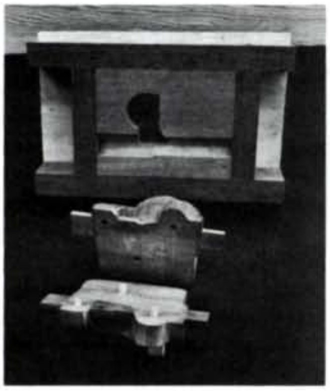
Foundryman pours a medium-size casting. Encased in a metal flask, the drag mold in the foreground is filled with cores that will form the internal ribwork of a machine frame.

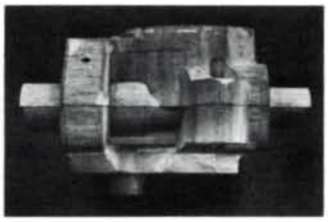
For short runs, patterns may be sent to the foundry unboarded. The two loose halves are doweled together with parting-line profiles matched exactly. They can be molded directly by first placing the drag pattern on a foundry board and filling its flask. When the flask is rolled over, the drag pattern is left in place. The alignment dowels allow the cope pattern to be placed on top, then a thin layer of washed sand, mixed with a parting agent, is spread on the parting line. Now a second flask is pinned on top of the first and filled with sand. The two mold halves are then separated at the parting line, and both pattern halves removed, leaving a complete mold.

A simple, unsplit pattern can be cast entirely in the drag by enclosing the cavity with a solid cope mold, unfeatured except for its pouring tunnel, called a **sprue**. But patterns, like their molds, are usually split along a horizontal parting line. And because a pattern half is molded on a foundry board, the parting line continues from the pattern's edges out to the rim of the flask. Although this parting plane is typically flat all across, it may be made irregular at the edges of the pattern in order to define recesses or projections that fall near the logical parting line. This device is a **sand match**.

A classic use of the sand match is seen in the cast-iron frying pan. The wooden form of the pan's exterior is mounted upside-down on one foundry board, while a recess routed in the other board is sized and located to cancel all of the mold impression but the uniform thickness of the pan itself. If the pan pattern were 2.25 in. high, the recess might be 2.13 in. deep, leaving a vacant .12-in. shell for the metal when the two mold halves are put together. If you check the one in your kitchen, you'll see that the pan's handle was split between the two boards and that it fits the hand better than if it were contoured on one side and flat on the other.

Parting-line orientation affects pattern costs and casting success, particularly when a casting has a number of external





Mahogany pattern, left, with projecting core prints is made in halves (cope and drag) split along a parting line. The accompanying core box, above, molds half of the sand core that will define the interior cavity in the casting.

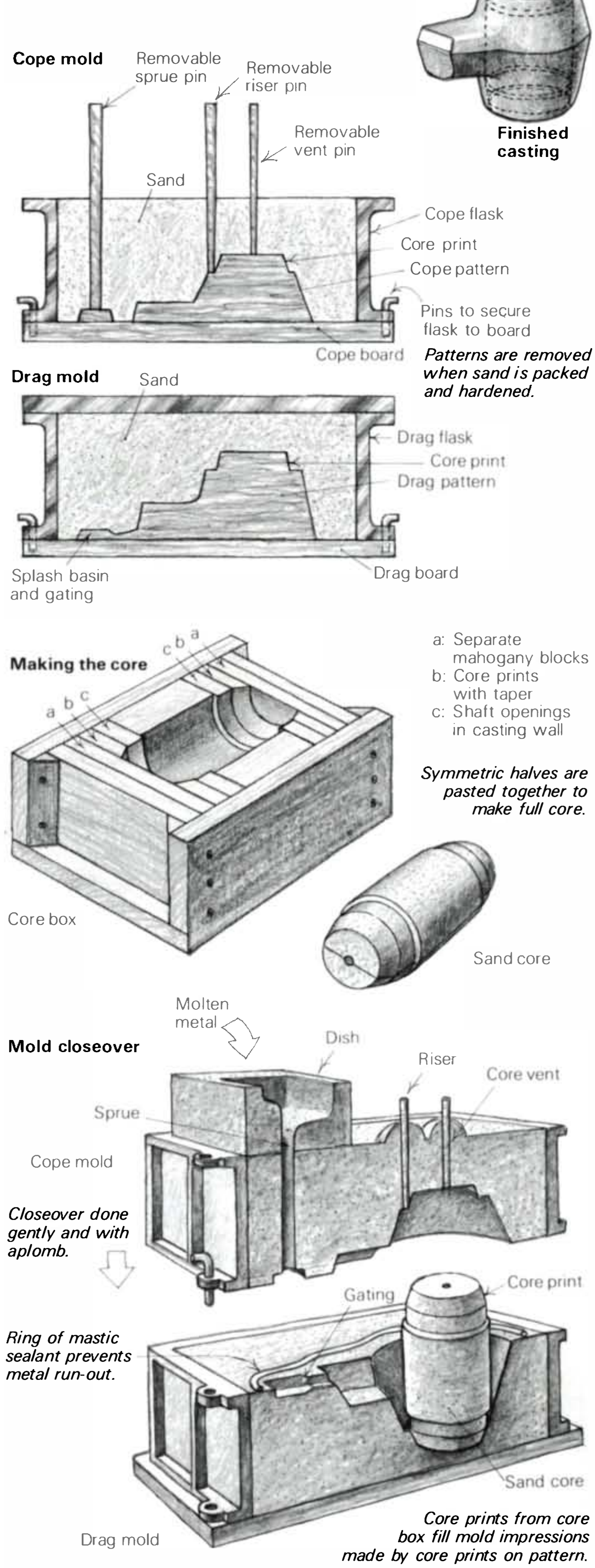
projections or recesses, or when its hollow and internal sand cores must be supported. Patterns are also split to minimize their height, and to locate in the drag half of the mold the most critical surfaces to be machine-finished. Sand inclusions and gas bubbles tend to migrate upward to the cope, so casting flaws are liable to be concentrated there. Because of this, a generous machine-finishing allowance will be added to cope finish surfaces. Finish allowances vary from ⅛ in. to 1 in., depending on scale and complexity. This excess is built onto the pattern to provide that excess metal.

Castings often call for projections or recesses on their outer walls that are too far up on the pattern half to be defined by the sand-match method. Pockets or undercuts in the outer cast walls would lock the pattern in the sand. Most interior cavities cannot be defined directly from the pattern. This problem is solved by providing the mold with a sand core, which when suspended from pockets in the mold wall defines a hollow in the casting. The core itself is molded in a core box, containing a specially shaped, tapered cavity into which casting sand is packed. The box is then inverted and drawn off. A block of wood, called a **core print**, is attached to the pattern covering the troublesome external area, or as an extension of an opening in the casting's wall. The core print leaves a pocket in the mold wall when the pattern is molded. Part of the sand core will fit exactly in the mold-wall pocket, cancelling that space. The rest of the core defines the difficult feature or cavity. Cores must be vented by a tunnel system leading to the upper mold surface. The intense heat of pouring that decomposes mold binders produces flammable gas, which is burned off at the top of the vents.

Pouring systems, called **gating**, are also built onto the patterns so they'll make an impression in the sand. They're designed to minimize sand inclusions, porosity and shrinkage voids in the cast metal, and thus the patternmaker finds himself in regular contact with the foundry metallurgist. Patternmaking apprentices in foundry-associated shops spend considerable time constructing foundry boards, mounting patterns and building gating systems. In addition to gas vents, the cope halves of large molds need vertical channels called flow-offs or risers to lead off excess metal and dross, and to shrink-feed thick sections of the casting. Running from the highest surface of the mold cavity to the uppermost mold surface, risers signal the foundry crew that the pour is complete.

After the mold cools—large work may take a day or two—the rough casting is shaken out of the mold. Extraneous parts (pouring channels, risers, fins around cored areas and along the parting line) must be cut or chipped off. The casting is washed, sand-blasted or shot-blasted clean, and the parting ridge and surface scale are ground away. If no defects turn up, it is painted and sent to the machine shop. —*P.S.*

Making molds from patterns



Woodworking Education

There are more schools than ever, each one a little different

So you're halfway to law school but you'd rather become a cabinetmaker? You can't stand your job, find solace working wood, and want to make that your living? Or maybe you'll always remain a hobbyist but you've gone as far as you can on your own and have to learn more? Whatever variation fits, you're not alone. And while it's not the only answer, going to school (or back to school) is among the best ways to get further along in woodworking. Self-taught craftsmen do become adept, but the way is hard and haphazard. Industry does train on the job, but usually for the assembly line, not for skilled craft. Apprenticeship is the avenue of choice, but those few craftsmen who can afford to take on an apprentice are awash in applications.

The list on p. 92 includes all the full-time woodworking programs we could uncover, plus a number of special short-term and part-time offerings, although you'll find more of the latter by investigating locally. Choosing among these dozens of schools is no easy matter. The basic question is whether or not a school teaches design as well as woodworking technique. If it's pure technique you want, you can probably find help close to home. If you yearn to design what you make, you'll probably have to travel to a school, and you'll want to be more choosy. Don't be confused, though, by what seems to be the design direction of the students you'll meet. A good instructor can help you along whether or not his taste meshes with yours, and some very fine traditional furniture has been designed and made at the most flamboyant of art schools. But, omitting some teacher-training courses and Colonial-village programs, there's only one place left—North Bennet Street Industrial School in Boston—that offers nothing but traditional furniture design.

This introduction is followed by a close look at an unusual school in Sweden by Scott Danielson, a second-year student there. While we don't expect many readers will want to move to Sweden, we found the author's description of life there strikingly similar to life at the better schools here. There's also an opinionated rundown by Larry Hunter on the eleven graduate progams offering a master of fine arts degree. If you already have a bachelor's degree, especially in art or industrial design, these schools probably are your best bets.

Besides what you can learn in the classroom, a good school offers less obvious benefits. In the first few weeks, you can expect your own standards and expectations of yourself to take a quantum jump. This is because you'll suddenly be surrounded by people who share your own passion for woodworking, all trying to do their very best without regard to cost or commercial pace. You see just how exacting good work can be, and to what lengths you'll have to go. You also meet dozens of craftsmen among fellow students and visitors as well as on field trips, and you see a range of technique and

Student work ranges from traditional to contemporary. Working almost entirely with traditional furniture, students at Boston's North Bennet Street School get thorough training in design and drafting, as well as in construction. The walnut lowboy shown below is being made by Richard Buck from full-scale measured drawings he prepared himself. Bruce Volz, at Leeds Workshops in Easthampton, Mass., designed and built the buffet at left from pear wood with laminated walnut door designs set on silk-covered panels. An unaffiliated academy, Leeds prepares students to become independent designer/craftsmen.

Scott Danielson

Writing pulpit and stool, in Italian cherry, made by Lars Rosenberg for his journeyman's test at Capellagården (see facing page). Inlaid veneers under writing surface include palisander, maple and satinwood.

style—successful and otherwise—that's hard to beat.

On the other hand, especially in woodworking, school may be no better than simply finding a job that offers a chance to learn, and supplementing that with visits to shops and galleries, night courses, books and magazines. For there's no substitute for sheer hours spent toiling at the bench, at the drawing board and at the table saw. Nor can schools do much to teach the difficult art of surviving at commercial pace.

Many would-be students can't see how to support a family while fitting into the lock-step of credit hours and degree requirements. Unless you plan to teach, a degree in woodworking is probably pointless. It's what you can make that counts. Most schools will tailor a course to suit the student's background, needs and plans, especially for an older student who is changing careers. Colleges can also advise you about scholarships, tuition assistance and part-time jobs. We know cabinetmakers who have learned what they needed by choosing courses intended to train teachers of industrial arts. We know one who did that while working nights and weekends in the local lumberyard. Now he owns a cabinet shop, and the lumberyard refers its challenging jobs to him. Determined students seem to find the necessary ways and means.

If you're already attending a college that has no woodworking program, don't neglect the non-credit craft shop that many schools maintain. Sometimes it's in the charge of a superior craftsman. Quite a few professional woodworkers have emerged through this back door at such unlikely schools as Dartmouth and Massachusetts Institute of Technology.

In recent years a number of colleges have simply abandoned degree requirements in their crafts programs, and several regional crafts centers have also developed excellent full-time courses. Notable here (see page 92 for details) are the Program in Artisanry at Boston University, the production crafts major at Hayward Technical Institute in Clyde, N.C., the Worcester (Mass.) Craft Center, the Appalachian Crafts Center (Gatlinburg, Tenn.) and the Oregon School of Arts and Crafts (Portland). By next year, College of the Redwoods hopes to have James Krenov teaching in new shops at Mendocino, Calif. In addition, a number of successful craftsmen have opened full-time woodworking academies in shops adjacent to their own studios. These include Ian Kirby's school in Bennington, Vt., Michael Coffey's in Poultney, Vt., Leeds Design Workshops in Easthampton, Mass., and Wendell Castle's school in Scottsville, N.Y. Most of the schools mentioned here expect a student to stay for two years, but shorter or longer programs can be arranged. *—J.K.*

Woodworking at Capellagården

by Scott Danielson

You're on the island of Öland off the southeast coast of Sweden, connected to the mainland by Europe's longest bridge. Öland's population of 20,000 is buffeted each summer by hordes of tourists, but most of the year the little town of Vickleby enjoys its solitude. Walking along the main street, you hear the rhythmic thunk of mallet and chisel competing with the roar of a large planing machine. You wonder where the sound is coming from, for the cluster of buildings looks like any other farm in the neighborhood—long barns of native limestone, two-storied board-and-batten houses with slate or tile shingles. The hand-carved sign reads *Capellagården, Sköla for Gestaltande Arbete*, which means school of creative crafts. Go down through the big basswood trees, turn into the long barn and you'll find a crowded woodworking shop—14 big benches; cabinets, tables and chairs in various stages of completion; lumber drying everywhere; working drawings hanging from walls and roof beams; bulging tool cabinets, and 13 or 14 students, most of them in their early twenties: in concentration if working, in a frenzy if gluing, or in despair if something went wrong.

The founder of Capellagården was Carl Malmsten, who became known throughout Europe for his opinionated (some say autocratic) view of furniture and interior design. He insisted that furniture fit people, both functionally and anatomically, and he was a major force behind the emergence of what we call Swedish Modern. From 1917, when his chairs were chosen for the new Stockholm city hall, until his death in 1972, he designed classic furniture, rethought traditional pieces and nearly always specified on his drawings, "All edges to be carefully rounded." Malmsten was a *formgivare*—a designer—for whom the problems of construction were secondary, to be worked out with the cabinetmaker. When a craftsman told him something was impossible, he would just ask for someone else. As a result, many of his designs demand perfect joints and special solutions, making them educational and challenging for student woodworkers.

His interest in education led first to a crafts school, opened in 1930. It developed into Malmsten's Verkstadsskola in Stockholm, a school where students concentrate on Malmsten's designs, but with an emphasis on cabinetmaking technique. For many years Malmsten also dreamed of a school where peaceful surroundings and collective work would lead to "creative cooperation between hand and soul." It wasn't until 1957 that he found the farm in Vickleby, and three more years after that to persuade a sugar-beet company to donate the adjoining lot with its two large houses. Malmsten was nothing if not persistent. In 1960 the present triad of courses—woodworking, weaving, pottery—got started.

At present Capellagården offers two three-week summer courses, which can be used as introductory trials for the nine-month winter session. Getting in for the winter requires prior skills, supposedly two years of technical schooling or equivalent, but the range of backgrounds and abilities is broad. The teachers look for diversity and the exchange of experience it provides, plus a commitment to earn one's living at the craft. They also value artistic leanings—students spend a day a week in art instruction. Competition for the half-dozen openings each year is stiff, and only 10% to 15% of the applicants get in. Foreign applications are quite common, and there is no formal entrance quota, but the group generally includes only one or two non-Swedes. Swedish is therefore the language of instruction.

Normally people stay two years at Capellagården, but you can go for just one year or, if taking the journeyman's test,

Cabinetmaker Scott Danielson is from Medford, Ore.

three or even four years. The woodworking course starts with two weeks of hand tools, then a series of progressively difficult projects. Students design their own pieces and work at their own paces. When all have completed an assignment, there is discussion and criticism. As each piece is finished it goes up to the exhibition area, and design work starts for the next. After the teachers comment on the sketches, blueprints and a cutting list are made, and the student heads out to the lumber storage area armed with a bucksaw, to pick his "perfect" planks from stacks of hardwood and pine. All the lumber is roughsawn, air-dried several years, dried further in a hot room, then stored indoors. Most of it is two or three inches thick, often two feet wide, ten to twelve feet long, local pine, birch, beech and basswood, plus elm, ash, oak and maple imported from central Europe, steamed pear and cherry from Italy. There are a few exotics and a variety of veneers. All wood is resawn in the shop, and its moisture content is closely monitored to make sure it has reached equilibrium with indoor air. Waiting for the wood to move can be exasperating, but it teaches a valuable lesson. We can never stop wood from shrinking and swelling, the major factor in designing furniture to last lifetimes. The lesson usually has to be learned the hard way before it takes root.

The crowded machine room is at least as imposing as the wood assortment: a 32-in. planer, an 18-in. jointer, a 30-in. band saw, a 15-in. sliding table saw, a 3-speed reversing shaper—all very heavy. There's also a 12-ft. panel sander, a lathe, a bench sander, a horizontal mortiser, a dovetail machine (used as an overhead router), a miter trimmer, a drill press, intermediate table and band saws, and a huge, hydraulic veneer press. Even with such extensive machinery, the use of hand tools is stressed. All dovetailing is hand-cut; likewise, individual parts are hand-shaped, although machined repetitions are no bad thing. The idea is that the possibilities of the machine must not limit the design of furniture, the diameter of a sanding roller should not determine the shape of a curve. This reflects Malmsten's insistence that designs should be fitted to people, not to ease of construction, and that they should be friendly to the touch.

Just the presence of a dozen similarly motivated people makes for an inspiring working situation. The shop stays clean, and there's always help for carrying planks or clamping. The only territoriality concerns carefully hoarded tools and secret stashes of lumber. The usual gripes are about machines that are dull or out of adjustment (students rotate sharpening and maintenance jobs) or about occasionally preoccupied teachers. Furniture built during class belongs to the school and is sold for operating income. But students can do their own work in the evenings and on weekends, and can buy back a large piece for about twice its materials cost.

Few schools in Sweden are not fully subsidized by the government; here, retaining a little of Malmsten's ideas about self-sufficiency, the subsidy is about half. Tuition is minuscule, about $100 per semester, and living expenses are reasonable, about $250 a month. Most students live at the school, the rest in small houses nearby.

The attraction of a school like Capellagården is that, for a while at least, you have the luxury of taking as much time as you want to build furniture as well as you can. There's no buyer wondering when it will be done, no employer looking over your shoulder, no accountant calculating cost effectiveness. You have a chance to find your own limits, satisfy your curiosity about what you're capable of creating with your own hands. And then at some point this selfishness must make room for the realities of surviving out in the real world. □

AUTHOR'S NOTE: To apply to Capellagården, write Rektor Eilert Sigvardsson, Capellagården, Vickleby, 38600 Färjestaden, Sweden. For information on Malmsten's Stockholm school, write Rektor P.O. Skotte, Malmsten's Verkstadsskola, Renstiernas Gata 12, 116 31 Stockholm, Sweden. Another crafts school with a four-year cabinetmaking program that Malmsten had a hand in starting is Stenebyskolan, Box 44, 660 10 Dals Långed, Sweden.

Eleven graduate schools

by Larry Hunter

About 150 colleges and universities around the country have woodworking programs. Of these, about half concentrate on furniture design and construction; of these, eleven have graduate degree programs with an art emphasis (master of fine arts). In the spring of 1979, I made a sabbatical trip to these eleven schools. What follows are my distilled observations and comments, but first, some general remarks.

I believe that you must have strong convictions if you are to make a significant contribution in furniture. Artistic conviction can be most rapidly and fully developed in a university art community, with its intense interactions. Every program has its own flavor, according to the current student mix and the strengths of the instructors, but all seem to offer ample scope for individual development too. What is important, beyond technical learning and the acquisition of skill, is that you learn to think, to question, to resolve. Otherwise, you remain a manipulator of material and not a creator of ideas.

Graduate school is not for everyone, and it's important when considering a school to visit it. If the program fits your needs and you feel comfortable, stay. If not, look elsewhere.

One can make some geographic generalizations about these eleven programs. On the East Coast, many of the faculty are former students of Tage Frid. Frid taught for many years at the School for American Craftsmen in Rochester, N.Y., and recently retired as professor at Rhode Island School of Design. His maxim is, "Design around the construction," and he emphasizes sound construction plus skillful woodworking technique. Schools on the West Coast have faculty from such varied backgrounds as sculpture, general crafts, painting and drawing. They put less emphasis on technique and advocate constructing around the design—that is, develop the visual concept first, then select the construction technique most appropriate. In the notes on the next page I've put in parentheses each instructor's special expertise. On the mundane level, East Coast schools generally enroll fewer students and provide a bench for each, while West Coast schools have larger classes and shared benches. Tuition is higher on the East Coast. →

Larry Hunter teaches furniture design in the art department at San Diego State.

Comments on the schools:

Arizona State University (Tempe)—New, large shops, good machines, separate bench room. Steam bending.
Faculty: Tom Eckert (sculpture, painting), Ray Fink (sculpture).
Comment: A new and dynamic program. There's also a course in production woodworking, so one can range from fine arts to hard realities.

California State University, Long Beach—Limited space, equipment; separate rooms for benches, machines. Grad students have their own bench room.
Faculty: John Snidecor (crafts), Frank Cummings (crafts). Students also can work with Tracy Dukes, an industrial designer, and John Nyquist, a well-established cabinetmaker whose shop is nearby.
Comment: Emphasis is on design and the development of an individual's aesthetic. "I cannot separate technique from concepts" (Cummings). Los Angeles has many furniture designers and showrooms as well as industry to draw upon.

California State University, Northridge—Well-equipped power shop, smaller bench room, large outdoor work space for sanding and grinding.
Faculty: Tom Tramel (metal), Ralph Evans.
Comment: A well-established program that has given rise to an organization for recent graduates (Guild of Designer Craftsmen) to ease the transition from school to working shop. "Creative ideas are of prime importance, techniques are secondary" (Tramel).

Central Washington University (Ellensburg)—A small program in a small school, good machines and benches in one large room, steam-bending.
Faculty: Gary Galbraith (sculpture, glass).
Comment: For those who wish to make furniture as an art form, excellent for those who already have strong technical background and wish to develop aesthetically. "The human-use function is secondary to the visual" (Galbraith).

Indiana State University (Terre Haute)—One room (3,000 sq. ft.) for benches and machines, separate studio for grad students.
Faculty: Jack Gates (sculpture, kinetic art).
Comment: Gates, a self-taught sculptor, has just taken over, and the program is in transition. Lots of walnut trees grow in Indiana.

Program in Artisanry (Boston University)—Machine room, two bench rooms, all somewhat crowded. A bench for each student.
Faculty: Jere Osgood, Alphonse Mattia.
Comment: This is a new program designed for the established craftsman who wants additional technical knowledge, plus development in aesthetics and design. "It is not intended to be a passport to teaching; focus is on the working craftsman" (Osgood). Boston overflows with museums and galleries, and many fine craftsmen work in the area.

Rhode Island School of Design (Providence)—Good facilities; machinery and undergraduate benches share one large room, with graduate benches in an adjoining room. Equipped for large-scale veneer work.
Faculty: Tage Frid (emeritus); Seth Stem.
Comment: This has been the best place to learn woodworking technique, and Frid will continue to teach one day a week.

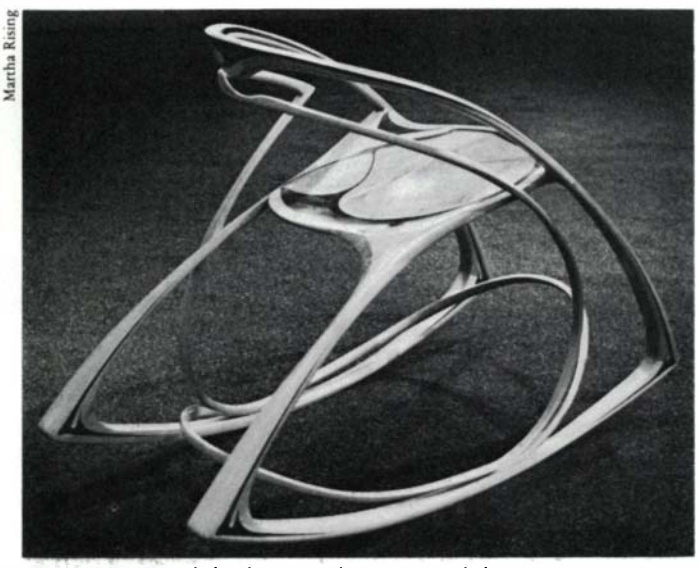
San Diego State University—New shops; machines and benches in one large room; equipment for steam bending, vacuum forming; drawing room, library.
Faculty: Larry Hunter (metal, ceramics), Jack Rogers Hopkins (painting, sculpture, ceramics, metal).
Emphasis: Construct around the design, strong on sculpture and contemporary techniques. "Techniques are a vehicle whereby the concept is brought to reality" (Hunter). San Diego has good museums and galleries, moderate climate. Wood doesn't move much here.

School for American Craftsmen (Rochester Institute of Technology)—The best facilities—a large, well-equipped machine room, two bench rooms, a bench for each student. Big spray-booth, steam bending, drafting room. As close to ideal as I've seen.
Faculty: W. A. Keyser, Douglas Sigler.
Comment: Emphasizes techniques and sound construction; student work ranges from sculptural and fantasy through traditional. "If I had ten students, I'd like them to be going in ten different directions—then I'd be doing my job" (Keyser).

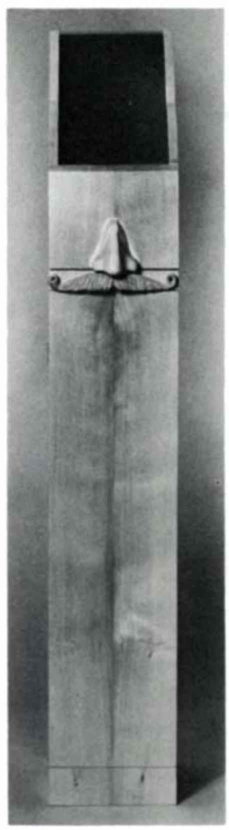
University of Wisconsin (Madison)—Graduate students have separate, better and larger facilities than undergraduates; adequate machinery, experimental ammonia-bending apparatus.
Faculty: Skip Johnson.
Comment: Johnson has a close working relationship with his students and brings to them his own playful sculptural bent. Students emerge well-trained both technically and aesthetically.

Virginia Commonwealth University (Richmond)—Large, one-room shop with good machines and individual benches for graduates and advanced undergraduates. Steam bending.
Faculty: Bill Hammersley (sculpture).
Comment: A program that makes students think; ranges from fine art furniture to practical cabinet work. The Richmond area is steeped in Colonial traditions. □

Brian Gulick



Martha Rising



Maggie Ellis

Construct around the design or design around the construction? Bentwood rocking chair, above, was made by Martha Rising at California State University, Northridge; she's now teaching woodworking and furniture design at De Anza College in Cupertino. A more traditional rocker with woven seat, top, was made by Clark Peasley at Rhode Island School of Design; he's now working as shop manager at RISD. But geographical generalities don't stand close scrutiny. Nose cabinet in sycamore and beech, right, was made by Jonathan Davis at the London College of Furniture (41 Commercial Road, London E1 1LA), the principal trade school for British industry. Davis, a Canadian, plans to return to his native Winnipeg to set up shop.

Woodworking schools

This survey was compiled from questionnaires mailed to woodworking instructors at more than 600 schools across North America. We obtained the addresses from past surveys (*FWW* #6 and #11), from reader advice and from standard educational directories. If you are a student or a teacher of woodworking at a school that's not included, please let us know—we'll be revising the listings periodically.

Following the school names and addresses, we've indicated the times at which instruction is offered, the basic tuition rate and the degrees graduates can receive. Daytime (days) courses are generally for full-time students, evening (eves.) programs are usually part time. Regarding tuition, unfortunately there's no way to compare dollars per credit hour with dollars per quarter or semester. Furthermore, most state schools have two fee schedules—lower for state residents, higher for out-of-state students.

Junior colleges confer associate's certificates after two years of study (abbreviated A.A., A.S., etc.) Four-year colleges usually offer bachelor's degrees (B.A., B.S., B.F.A., B.Ed., etc.), and universities confer, after five or six years of study, master's degrees (M.A., M.S., M.F.A., M.Ed., etc.).

Next in each listing comes alphabet soup. We asked the schools to check the courses they teach on the following list. To find the program you might want, you'll have to note its abbreviation here and scan the listings for it.

A&R, antiques & reproductions
BB, boatbuilding
cab., cabinetmaking
car., carving
D, design
F, finishing
FD&C, furniture design & construction
FM, furniture manufacturing
HTW, hand-tool woodworking
IA, industrial arts
IAE, industrial arts education
ID, industrial design
IP, industrial processes
J, joinery
M, millwork
MI, musical instrument making
M&I, marquetry & inlay
MW, machine woodworking
P, wood patternmaking
PW, production woodworking
RC, residential construction
R&R, furniture repair & restoration
S, sculpture
T, turning
TM, toolmaking
U, upholstery
V, veneering
WS&T, wood science & technology

Finally, as space permits, we've included quotations from the instructors about the program or the type of student they hope to attract. If a school attracts you, it's wise to begin inquiries with a letter to the admissions officer, who will be able to tell about tuition as well as about grants, scholarships and loans, and to advise you about whom to see next—be sure to visit a school before you enroll as a student.

Because there are so few of them, we extracted from the state-by-state listings those schools specializing in stringed musical instruments, boatbuilding, and carving or sculpture. You'll find them grouped together in boxes.

ALABAMA

Wallace State Community College, Box 250, Hanceville 35077. Days, eves., $100/quarter. Cab., RC, D, F, R&R, J, M&I, T, U.

ARIZONA

University of Arizona, Art Dept., Tucson 85721. B.A., B.F.A., days. Crafts, S, D. "...solving aesthetic problems using wood."

Arizona State University, Art Dept., Tempe 85281. B.F.A., M.F.A. Crafts, FD&C, S. Program stresses "functional sculpture, one-of-a-kind objects with concern for the aesthetic as well as utilitarian function."

Northern Arizona University, Flagstaff 86001. B.S., IAE, IP, cab., RC, crafts, FD&C, P, WS&T.

Eastern Arizona College, 616 Church St., Thatcher 85552. A.S., days, $89/semester. Cab., RC, IAE, U.

Yavapai College, 1100 E. Sheldon, Prescott 86301. A.A., days, eves., $96/semester credit hour. Cab., crafts, FD&D, M, S, D, J.

ARKANSAS

University of Central Arkansas, Conway 72032. B.S.E., M.S.E., days, $30/hr. IAE, IP, cab., car., F, HTW.

Arkansas Art Center, Box 2137, Little Rock 72203. Part time. Cab., car., D, HTW, J, T, FD&C. "...woodworking from an art or creative viewpoint."

CALIFORNIA

California Polytechnic State University, San Luis Obispo 93407. B.S., M.S., days, about $80 for 6 units. IAE, IP, BB, cab., D, RC.

California State University, Dept. of Art, Fullerton 92634. B.A. and M.A. (5 yrs.), about $100/semester. Crafts, FD&C. "Emphasis on one-of-a-kind with limited production as option/supplement."

California State University, 5500 State College Pkwy., San Bernardino 92404. B.A., days, $75/quarter. Crafts, D, FD&C, D, T.

California State University, Chico 95929. B.S., days. Cab., RC, ID, IP, WS&T, IA.

San Francisco State University, 1600 Holloway Ave., San Francisco 94132. B.A., B.S., M.A. Days, eves., extension. IAE, cab., D, HTW.

California State University, 18111 Nordhoff, Northridge 91324. B.A., M.A., days. Crafts, FS&C, ID, S, T.

California State University, 5151 State University Dr., Los Angeles 90032. B.A., M.A., days, eves., $62/2 courses. IAE, IP, cab., car., D, F, HTW, RC, J, T, U.

California College of Arts and Crafts, 5212 Broadway, Oakland 94618. B.F.A., days, also part time; $1,895/semester, $465/course. FD&C, IAE, ID, S, RC. "Emphasis on furniture designs that reflect the designer, the function of the piece and the person that will use it."

California State University, Fresno 93740. B.A., M.A, days. Cab., crafts, FM, IAE, ID, IP, WS&T, RC, car., F, R&R, HTW, M&I, T, U.

Orange Coast College, 2701 Fairview Rd., Costa Mesa 92626. A.A., days, also eves. RC, cab., IA.

Cuesta College, Box J, San Luis Obispo 93406. A.A., days, free to residents. Cab., RC, FD&C. Emphasizes the "building trades; for people who want to build their own homes."

Laney College, 900 Fallon St., Oakland 94607. A.A., days, eves., wknds. Free to residents. Cab., RC, FM, ID, M, S, car., D, F, HTW, J, T.

Long Beach City College, 1305 E. Pacific Coast Hwy., Long Beach 90806. A.A., certificate, days. Cab., RC, U, M.

Merritt College, 12500 Campus Drive, Oakland 94619. A.A., days. RC, cab., HTW.

Southwestern College, 900 Otay Lakes Rd., Chula Vista 92010. A.A. Crafts, FD&C. "...an introduction to design in wood...through an understanding of the nature of the material, processes and purpose."

San Joaquin Delta College, 5151 Pacific Ave., Stockton 95207. A.A., days. Cab., RC, M, F, R&R, J, HTW, T. Apprenticeship program in industry. "Trains construction workers and cabinetmakers; some transfer to four-year colleges and become teachers or contractors."

College of the Redwoods, 542-B N. Main St., Ft. Bragg 95437. A.A., days, eves, Cab., D, MI, S.

Sierra Community College, 5000 Rocklin Rd., Rocklin 95677. Certificate, A.S., days, eves, Cab., FD&C, F.

Grew-Sheridan Woodworking Studio, 500 Treat Ave., San Francisco 94110. Private academy, part time. FD&C, cab., D, HTW, J, S, T, student-developed projects.

Baulines Craftsmans Guild, Box 305, Bolinas 94924. Short-term apprenticeships in furniture design & construction with working craftsmen, days, about $400/month.

Ganahl Lumber, Box 31, 1220 E. Ball Rd., Anaheim 92805. Private academy, Saturday classes, also summers. Car., D, J., sharpening.

The Cutting Edge Workshop, 3871 Grand View, Los Angeles 90066. Private academy, part-time. Cab., car., D, F, HTW, J, M&I, S, T, special sessions with prominent woodworkers. Emphasis on "hand-tool instruction in fine furniture-making. Program geared to amateur at various levels."

The Cutting Edge Workshop, 1836 4th St., Berkeley 94710. Private academy. Eves., Saturdays. Car., F, FR&R, HTW, J.

COLORADO

Metropolitan State College, 1006 11th St., Denver 80204. B.S., $300/semester. IAE, IA, F, HTW, T, U.

Western State College of Colorado, Gunnison 81230. B.A., M.A., days, eves., $363/semester. IAE, cab., RC, crafts, U, WS&T, car., R&R, T.

University of Southern Colorado, 2200 Bonforte Ave., Pueblo 81001. B.A., B.S., M.A., days, eves., $390/semester. IAE, cab., RC, P.

University of Northern Colorado, Greeley 80639. B.A., BS., M.A., days, $20/credit hour. IAE, IA, IP, cab., crafts, F, R&R, HTW, A&R, T, U.

Anderson Ranch Arts Center, Box 2406, Aspen 81611. Workshops in wood and other crafts, $100 to $400/course. Cab., D, F, HTW, J, S, T.

CONNECTICUT

Brookfield Craft Center, Rt. 25, Box 122, Brookfield 06804. Workshops with guest instructors: BB, cab., car., crafts, R&R, HTW, J, M&I, MI, S, T.

Craftsmanship in Wood, 27K Commerce St., Glastonbury 06033. Private academy, short courses. FD&C, cab., F, HT, A&R, T.

FLORIDA

Florida A & M University, Box 433 FAMU, Tallahassee 32307. B.S., days. IAE, IA, F, R&R, HTW, T.

University of West Florida, Pensacola 32504. B.S., part time. IAE.

Brevard Community College, 1519 Clearlake Rd., Cocoa 32922. Two-years, certificate, days, $122/semester. Cab., IP, M.

GEORGIA

University of Georgia, Athens 30602. B.S.Ed., M.Ed., $303/quarter. IAE, cab., D, HTW, RC, T.

Atlanta College of Art, 1280 Peachtree St. N.E., Atlanta 30309. B.F.A. $125/semester. S,D. "Shop courses are part of continuing education program."

Berry College, Mt. Berry 30149. B.A., days, $800/quarter. IAE, IA, cab., D, F, R&R, HTW, RC, J, M&I, A&R, T.

HAWAII

University of Hawaii, 1776 U. Ave., Honolulu 96822. B.Ed., days, $240/semester. IAE.

Hawaii Community College, 1175 Manono St., Hilo 96720. A.S., days, $40/semester. RC, apprenticeship. "Students should be able to build a house after two years."

IDAHO

Ricks College, Rexburg 83440. A.A., days, $425/semester. RC, IAE.

ILLINOIS

University of Illinois, Urbana 61801. B.S., M.S., M.Ed., days, $423 IAE.

Northern Illinois University, DeKalb 60115. B.S., M.S., days, eves., $25/semester hour. IAE, IP, cab., HTW, chairmaking workshop.

Chicago State University, 95th at King Drive, Chicago 60628. B.S., days, $22/credit hour. Cab., RC, crafts, FD&C, IAE, ID, IP, P, WS&T.

John Wood Community College, 1919 N. 18th St., Quincy 62301. A.A., eves., $12/semester credit hour. Cab., D, F, HTW, U.

Chicago Academy for Fine Woodworking, 1633 W. Fullerton, Chicago 60614. Two-year college, beginning Sept. 1981; certificate, A.A., days, eves., $295/course. A&R, cab., RC, FD&C, FM, S, car., WS&T, BB, J, T.

INDIANA

Indiana State University, 8600 University Blvd., Evansville 47712. B.S., days, $84/course. Crafts, FD&C, S.

Ball State University, Muncie 47306. B.S., M.S., $325/quarter. IAE, IP, cab., D.

Herron School of Art, 1701 N. Pennsylvania Ave., Indianapolis 46202. B.A., M.A.E., days, eves., $30/credit hour. Cab., FD&C, S.

IOWA

Iowa State University, Ames 50010. B.S., M.S., days. IAE, IP.

William Penn College, Oskaloosa 52577. B.A., days. $2,740/semester (incl. room & board). IAE, IA, IP, cab., car., F, HTW, RC, J, A&R, T.

Des Moines Area Community College, 2006 Ankeny Blvd., Des Moines 50021. days, $165/qtr. RC.

Muscatine Community College, 152 Colorado St., Muscatine 52761. 1-yr. degree, days, $350/sem. RC.

Southeastern Community College, Messenger Rd., Keokuk 52632. 2-yr. college, days, $169/quarter. RC.

Waldorf College, Forest City 50436. A.A., days, $1,447/semester. IAE, cab., F, HTW, J, T.

KANSAS

Bethel College, North Newton 67117. A.A., B.S., days. $1,183/semester. IAE.

Fort Hays State University, Hays 67601. B.S., M.S., days, $23/credit hour. IAE, IA, cab., RC, FD&C, U, F, HTW, J, T.

Pittsburgh State University, Pittsburg 66762. A.A., B.S., M.S., days, $280/semester. Cab., RC, FD&C, FM, IAE, IP, M, U, P, WS&T, F.

Wichita State University, 17th & Fairmount, Box 77, Wichita 67208. B.S., part time, $26/semester hour. IAE, IA, cab., HTW, RC.

Independence Community College, Continuing Education, College Ave. and Brookside Dr., Independence 67301. A.A., eves., $14/credit hour. Woodworking courses for hobbyists: cab., car, R&R, U.

Neosho County Community College, 1000 S. Allen, Chanute 66720. A.A., part time, $10/credit hour. Cab., FD&C, IAE.

KENTUCKY

Eastern Kentucky University, Richmond 40475. A.A., B.S., M.S., days, eves., $290/semester. IAE, WS&T, IA, cab., D, L, V..

Western Kentucky University, Bowling Green 42101. A.A., B.S., M.S., days, eves., wknds,, $25/course hour. IAE, IA, BB, cab., crafts, D, F, R&R, HTW, A&R, T, clocks.

LOUISIANA

Louisiana State University, Baton Rouge 70803. B.S., M.S., days. IAE.

MAINE

University of Southern Maine, College Ave., Gorham 04038. B.S., M.S., days, $990/year. IAE, IA.

Southern Maine Vocational Technical Institution, Fort Rd., South Portland 04106. A.A., days, eves. RC, cab.

MARYLAND

University of Maryland, College Park 20705. B.S., M.S., days, eves., $70/sem. IAE, IP, cab., HTW.

University of Maryland, Eastern Shore, Princess Anne 21853. B.S., days, $1,656/semester. IAE, IP, RC, WS&T, cab., D, F, HTW, J, T.

Maryland Institute College of Art, 1300 W. Mt. Royal Ave., Baltimore 21215. B.F.A., days, $3,750/year. Crafts. "Students pursue utilitarian and/or sculptural forms."

Chesapeake College, Wye Mills 21679. A.A., days, $23/credit hour/semester. D, F, R&R, HTW, S, U, woodblock printing.

Catonsville Community College, 800 S. Rolling Rd., Catonsville 21228. A.A., days, eves., $20/credit. Car., D, F, R&R, HTW, J, S, T.

MASSACHUSETTS

Boston Center for Adult Education, 5 Commonwealth Ave., Boston 02116. Non-credit, part time, $52/quarter. Cab., D, F, R&R, HTW, T, U.

Boston University Program in Artisanry, 620 Commonwealth Ave., Boston 02125. A.A., B.A., Certificate of Mastery (6 yrs.), $5,795/year. FD&C, MI. "Emphasis is on making a person self-sufficient as a designer/craftsman and competent tc run a small business."

Leeds Design Workshops, One Cottage St., Easthampton 01027. Private academy, days, $3,900/year. FD&C, cab., drafting, perspective drawing.

North Bennet Street Industrial School, 39 North Bennet St., Boston 02113. Trade school for adults, days, diploma (1½ yrs.), $300/month. Students accepted on a rotating basis. A&R, cab., FD&C, FM, ID, WS&T, HTW.

The Worcester Craft Center, 25 Sagamore Rd., Worcester 01605. Certificate (2 yrs.), $900/semester, days. Cab., crafts, FD&C, FM, S, U, car., F, HTW, J, M&I, T. Program teaches the "techniques and design skills needed to produce furniture and options for earning a living with these skills."

MICHIGAN

Western Michigan University, Kalamazoo 49001. B.S., M.A., days, $33/sem. Cab., RC, FM, IAE, IA.

University of Michigan, 2000 Bonisteel Blvd., Ann Arbor 48109. B.F.A., M.F.A., days. S, ID, IA, FD&C.

Lake Superior State College, Sault Ste. Marie 49783. B.S., days, $26/quarter hour. IAE, IA.

Andrews University, Berrien Springs 49104. B.S., days, $1,325/quarter. RC, IAE, F, HTW, J, T, U.

Delta College, University Center 48710. A.A. (1½ yrs.), days, eves., $24/credit hour/semester. RC, cab., HTW.

Southwestern Michigan College, Cherry Grove Rd., Dowagiac 49047. A.A., days. IP, F, R&R.

MINNESOTA

University of Minnesota, 159 Pillsbury Dr., 125 Peik Hall, Minneapolis 55455. B.S., M.S., days, $346/quarter. IAE.

University of Minnesota, 2400 Oakland Ave., Duluth 55812. B.A., B.S., days, $27/credit. IAE, IP, RC, F, R&R, HTW, U.

Moorhead State University, Moorhead 56560. B.A., B.S., M.A., M.S., days, $10/credit hour/quarter. IAE, IP, RC, F, R&R, HTW, U.

St. Cloud State University, St. Cloud 56301. B.S., M.S., days. IAE, IA, cab., RC, FD&C, ID, IP, U, P, WS&T, D.

Winona State University, Winona 55987. B.S., M.S., days, $12/credit hour. IAE, IP, RC, cab.

Mankato State University, Mankato 56001. B.A., B.S., M.A., M.S., days, $12/credit hour. IAE, IP, RC, cab., D, F, R&R, HTW, J, T, U.

Dakota County Area Vocational Technical Institute, 145th St. E. at Akron Ave., Rosemount 55068. 1-yr. F.

The Wood Carving School, 3056 Excelsior Blvd. Minneapolis 55416. Certificate, cooperative credit, intensive courses, beginners' class, $75. Car. D, HTW, M&I, S, MI, P.

MISSISSIPPI

Mississippi State University, Drawer NU, Mississippi State 39762. B.A., M.A., M.S., D.Ed., days. IAE, IP.

Mississippi Valley State University, Itta Bena 38941. A.A., B.A., days, $24/semester hour. Cab., RC, F, HTW.

MISSOURI

Northeast Missouri State University, Kirksville 63501. B.A., days, $170/semester. Cab., RC, IAE, WS&T, U.

Northwest Missouri State University, Maryville 64468. B.S., M.S., days, $270/semester. IAE, IA, cab., HTW, T.

Southwest Missouri State University, 901 S. National, Springfield 65802. B.S., B.S.Ed., M.S.Ed., days, eves., $210/semester. RC, IAE, ID, IP, WS&T, F, R&R.

Missouri Southern State College, Newman and Duquesne Rd., Joplin 64801. A.A., B.S., days. IAE, F, R&R.

The School of the Ozarks, Point Lookout 65726. B.A., B.S., days, $42/semester hour. IAE, IP, WS&T, cab., F, HTW, RC, J, A&R, T.

MONTANA

Montana State University, Bozeman 59717. B.A., days, $650/quarter. IAE, cab., D, HTW, RC, J, T.

Northern Montana College, Brockman Center, Havre 59501. B.S., M.S., days, $160/quarter. Cab., RC, FD&C, IAE, ID, IP, P, WS&T.

Western Montana College, Dillon 59725. B.S., days, eves., $160/quarter. Crafts, IAE.

Primrose Center for Fine Woodworking and Furniture Design, 401½ Railroad (West), Missoula 59801. Private academy, days, $1,400/semester. FD&C, T, BB. Program strives to "give individuals ability and confidence to produce furniture of their own design."

NEBRASKA

University of Nebraska, Teachers College, Lincoln 68588. B.S., days, $27/credit hour. IAE, IA.

Peru State College, Peru 68421. B.A., days, $285/semester. IA, IAE, IP, cab., RC, WS&T, D, F, R&R, HTW, J, A&R, T, S.

Southeast Community College, Beatrice Campus, Highway 136, Beatrice 68310. A.A., days, $135/qtr. RC.

NEVADA

Northern Nevada Community College, T & I, Elko 89801. B.S., eves., $45/course. Cab.

NEW HAMPSHIRE

University of New Hampshire, Durham 03824. B.A., B.F.A., days, part time, $50/credit. Cab., FD&C, S. Violinmaking, summer only.

Keene State College, Keene 03431. B.S., days, $40/semester hour. IAE.

NEW JERSEY

Trenton State College, Armstrong Hall, Trenton 08625. B.S., days, eves., $30/sem. hr. IAE, BB, cab., D, RC.

Montclair State College, Valley Rd. & Normal Ave., Upper Montclair 07043. B.A., days, eves., $25/credit. IAE, A&R, cab., RC, FD&C, FM, MI, WS&T, J, M&I, T.

William Paterson College, Pompton Rd., Wayne 07042. B.F.A., days, $29/cr. D, FD&C, S.

Mr. Sawdust, Box 4, Schooley's Mountain 07870. Private woodworking academy, eves. Cab., car., HTW, MI, A&R.

Peters Valley, Layton 07851. Summer associate, internship, residency. Cab., WS&T, ID, D, HTW, MI, TM, lumbering. Emphasis on contemporary design. Most of the students are college graduates with a fine arts degree and out of school a few years. "Residency program is very competitive."

Kean College, Morris Ave., Union 07083. B.A., days, eves., $23/semester hour. IAE.

NEW MEXICO

Eastern New Mexico University, Station #11, ENMU, Portales 88130. A.A., B.S., days, $310/semester. IAE, IP, cab., car., crafts, F, R&R, HTW, J, S, T, U.

Boatbuilding

The Apprenticeshop of the Maine Maritime Museum, 375 Front St., Bath, Maine 04530. Two-year apprenticeships in traditional wooden-boatbuilding. Also, 6-week boatbuilding internship, $600.

Norfolk School of Boatbuilding, Box 371, Norfolk, Va. 23501. Apprenticeship, days, $250/month. Traditional & contemporary boatbuilding, wood science & technology. "In-depth training in yacht maintenance and new construction as preparation to enter the commercial and pleasure-boat industry."

Prothero School of Wooden Boatbuilding, Box 401, Port Townsend, Wash. 98368. Days, six-month course, $1,800.

New Mexico Highlands University, Las Vegas 87701. B.S., $227/sem. IAE, RC, FD&C, WS&T, IP, Spanish colonial furniture.

NEW YORK

Rochester Institute of Technology, School for American Craftsmen, One Lomb Memorial Dr., Rochester 14623. B.F.A., M.F.A., M.S.T., days, eves., $3,921/year. Cab., FD&C, ID, S, HTW, J, T.

State University of New York, Visual Arts, Lincoln Ave., Purchase 10577. B.S., M.S., days, $450/semester. Cab., FD&C, S.

State University of New York, Oswego 13126. B.S., M.S., days, $900/year. IAE.

State University College at Buffalo, 1300 Elmwood, Buffalo 14222. B.S., days, $450/semester. IAE.

State University College, New Paltz 12561. B.A., B.F.A., B.S. $700/sem. Cab., FD&C, FM, IAE, ID, IP, M, MI, S, U, P, WS&T.

Knowhow Workshop, New School, 17 W. 17th St., New York 10011. Adult ed., B.A., $185/course. Cab., D, R&R, HTW, RC, T, U.

Hartwick College, Oneonta 13820. B.A., days, $4,900/year. FD&C, cab., car., D, R&R, J, A&R, T, S.

John Harra, 511 W. 25th St., New York 10001. Private school, part time. Cab., D, F, J, A&R, T.

Woodsmith's Studio, 142 E. 32nd St., New York 10016. Private school, part time. Cab., car., F, HTW, T, picture-frame making.

Craft Students' League, YWCA Bldg., 610 Lexington Ave., New York 10022. Arts and crafts center. Cab., car., F, HTW, J, T, toymaking.

Emanu-El Midtown YM-YWHA, 344 E. 14th St., New York 10003. Arts and crafts center, eves. Cab., car., R&R, HT.

Wendell Castle Workshop, 18 Maple St., Scottsville 14546. Private academy, A.A., B.A. granted cooperatively, $4,000/year. Cab., FD&C, S.

National Trust for Historic Preservation, 635 S. Broadway, Tarrytown 10591. Apprenticeship, days, 1 to 3 yrs. "Program trains artisans in architectural preservation and restoration."

Thousand Islands Museum Craft School, 314 John St., Clayton 13624. Credits granted cooperatively, A.A., days, $115/2-week course. BB, car., crafts, D, HTW, S.

NORTH CAROLINA

University of North Carolina, Charlotte 28223. B.A., B.Arch., $200/sem., days. Cab., D, J, S, ID. Emphasis on development of sensitivity toward the design process, particularly in the applied sense.

North Carolina State University, Box 5488, Raleigh 27650. B.S., days, $279/semester. WS&T.

East Carolina University, Greenville 27834. B.S., days, $279/semester. IAE, IA, cab., HTW, RC, J, T.

Appalachian State University, Boone 28608. B.S., M.A., days, $307/semester. A&R, FD&C, IAE, IP, cab., D, F, R&R, HTW, J, M&I, T.

Brevard College, Brevard 28712. A.F.A., days, $162/course. Crafts, S.

The John C. Campbell Folk School, Rt. 1, Brasstown 28902. B.A. granted cooperatively. One and two-week courses, days, $75/week. Crafts, FD&C, MI, car., HTW, J, T.

Pitt Community College, Box 7007, Greenville 27834. A.A., days, $39/quarter. Cab., RC, M.

Cleveland Technical College, 137 S. Post Rd., Shelby 28150. A.A., days, $49/quarter. R&R, RC, U.

Bladen Technical College, Box 266, Dublin, N.C. 28332. A.A., days, $43/quarter. RC.

Asheville-Buncombe Technical College, 340 Victoria Rd., Asheville 28801. Diploma, part time, $39/quarter. Cab., RC, R&R.

Guilford Technical Institute, Jamestown 27282. Days, also part time. Cab., RC, FM, M, U, WS&T, IAE.

Haywood Technical College, Box 457, Clyde 28721. Certificate, days, $40/qtr. Cab., FD&C. Wood Products Dept. has a sawmill, dry kiln.

Country Workshops, Rt. 3, Box 221, Marshall 28753. Private academy, days, $175/1-wk. workshop includes use of tools, materials, campsites and three meals/day. Car., HTW, log-house building, white-oak basketry, chairmaking, traditional rural crafts.

Penland School of Crafts, Penland 38765. Cooperative credit, summers.

NORTH DAKOTA

University of North Dakota, Grand Forks 58202. B.S., M.S., days, $29/semester hour. IAE, IA.

OHIO

Ohio University, 69 W. Union St. Athens 45701. B.S., days, $452/qtr. IAE, IA.

Ohio State University, Rt. 250, Wooster 44691. A.A., days, eves., $358/qtr. WS&T, cab., HTW, RC.

Bowling Green University, Bowling Green 45405. B.S., M.S., days, $402/qtr. RC, IAE, ID, IP, P, WS&T.

Ohio Northern University, S. Main St., Ada 45810. B.A., B.S., days, $1,217/quarter. IAE, IA.

OMI College of Applied Science, 100 E. Central Pky., Cincinnati 45221. Eves. Cab., F, R&R, HTW, A&R, T.

OKLAHOMA

Oklahoma State University, 104 Industrial Bldg., Stillwater 74074. B.S., M.S., Ed.D., days, $15/sem. hr. IAE, cab., FD&C, WS&T, car., F, HTW, T.

Northeastern State University, Tahlequah 74464. Certificate, B.A., B.S., M.A., M.S., days, eves., $13/semester hour. IAE, IA, cab., RC, FD&C, FM, ID, IP, M, U, P, WS&T, R&R, HTW, J, M&I, A&R, S, T.

Northwestern Oklahoma State University, Alva 73717. Certificate, B.A., B.S., M.S., days, $14/cr. hr. IA, cab., RC, FD&C, ID, IP, U, P.

Southeastern Oklahoma State University, Durant 74701. B.A., days, $15/semester hour. IAE, cab., F, HTW.

Southwestern Oklahoma State University, Weatherford 73096. B.S., M.S., days, $15/hour. IAE, IA, cab., F, RC, T.

East Central Oklahoma State University, Ada 74820. B.S. IAE, cab., U.

Oklahoma Baptist University, 500 W. University, Shawnee 74801. B.A., B.F.A., B.S., days, $800/semester. D, S.

Panhandle State University, Goodwell 73939. B.S., days, $38/semester hour. IAE, cab., car., D, F, HTW, RC, J, T, U.

Central State University, Edmond 73034. B.S., M.T., days, eves., about $16/semester. IAE, cab., FD&C, FM, U, P, clocks, R&R, T.

OREGON

Oregon State University, Corvallis 97331. B.S., IAE.

Oregon School of Arts & Crafts, 8425 S.W. Barnes Rd., Portland 97225. B.F.A. granted cooperatively. part time, Cab., car., D, HTW, J, S.

PENNSYLVANIA

Temple University, Philadelphia 19122. B.S., M.S., Ed.D., days, eves. IAE, ID, IP, RC, F, T.

Edinboro State College, Edinboro 16444. B.S., B.F.A., M.F.A., M.S.Ed, days, $565/semester. FD&C, S.D. "Woodworking program is an adjunct to our art education and fine arts program."

Millersville State College, Millersville 17551. B.S., M.S., $475/sem. IAE.

Kutztown State College, Kutztown 19530. B.F.A., days, $1,920/year. FD&C, crafts.

Philadelphia College of Art, Broad & Spruce Sts., Philadelphia 19103. B.F.A., days, eves., $5,000/year. FD&C, S, ID, cab., D, U, WS&T, J, car., M&I, T.

Indiana University of Pennsylvania, Sprowls Hall, Indiana 15705. B.A., B.S., days. FD&C, HTW.

Amaranth Gallery and Workshop, 2500 N. Lawrence St., Philadelphia 19133. Private academy, cooperative credit. Cab., F, R&R, HTW, J, T.

RHODE ISLAND

Rhode Island School of Design, 2 College St., Providence 02903. B.F.A., M.F.A., days, $5,000/year. FD&C, ID, S.

New England Institute of Technology, 184 Early St., Providence 02907. A.A., days, eves. RC, cab.

SOUTH CAROLINA

Piedmont Technical College, Box 1467, Greenwood 29646. A.A., days, eves., $120/qtr. RC, cab., HTW.

SOUTH DAKOTA

University of South Dakota, Springfield 57062. A.A.S., B.S.T., B.S.E., days, $21/semester. RC, IAE.

Black Hills State College, 1200 University, Spearfish 57783. B.A., B.S., days, $19/sem. hour. IAE, RC.

Dakota State College, Madison 57042. A.A., B.S. granted cooperatively, days, $19/semester. IAE, IA.

Freeman Junior College and Freeman Academy, 748 S. Main St., Freeman 57029. A.A., days, $80/cr./sem. IA.

TENNESSEE

East Tennessee State University, Wilson-Wallis Hall, Johnson City 37601. B.S., days, $246/semester. IAE, cab., RC, T.

Austin Peay State University, Clarksville 37040. B.S., days, $170/qtr. IAE, IP, IA, R&R, HT, U.

Middle Tennessee State University, Murfreesboro 37132. B.A., B.S., M.A., M.S., days, about $300/semester. IA, cab., car., R&R, J, A&R, T.

Appalachian Center for Crafts, University P.O. Box 347-A1, Smithville 37166. B.S., M.S. degrees granted cooperatively, days, $1,187/quarter, includes room & board. Crafts, FD&C, S, HTW, D; also Appalachian folk craft workshops.

Arrowmont School of Arts and Crafts, Box 567, Gatlinburg 37738. Credits granted cooperatively, One and two-week workshops, $80/course. D, F, HTW, J, S.

Sculpture/carving

City College of San Francisco, 50 Phelan Ave., San Francisco, Calif. 94112. Days, eves. All courses are free to residents of San Francisco. Sculpture.

Florida State University, 123 Education St., Tallahassee, Fla. 32306. B.A., M.F.A., Sculpture.

Evanston Art Center, 2603 Sheridan Rd., Evanston, Ill. 60201. Days, part time, $45 to $95. Sculpture.

Louisville School of Art, 100 Park Rd., Anchorage 40223. B.F.A., days, eves. $975/semester. Sculpture.

The College of St. Catherine, 2004 Randolph Ave., St. Paul, Minn. 55105. B.A., days. Sculpture.

Delta State University, Cleveland, Miss. 38733. B.F.A., days, $325/semester. Sculpture.

Webster College, 470 Lockwood, St. Louis, Mo. 63119, B.A., B.F.A., M.A.T., M.A.I., days, $1,700/semester. Sculpture.

The American Carving School, 21 Pompton Plains Crossroad, Wayne, N.J. 07470. Private academy, part time. Carving, sculpture.

Art Life Studios, 1384 3rd Ave., New York, N.Y. 10021. Arts and crafts studio, $95/3 months. Sculpture.

Haber School of Sculpture, 1170 Old Northern Blvd., Roslyn, N.Y. 11576. $165/12 sessions. Sculpture.

University of Akron, Akron, Ohio 44325. B.A., days, $75/semester. Sculpture.

River Bend Art Center, 142 Riverbend Dr., Dayton, Ohio 45405. Part time, $40/course. Carving.

Wooster Art Center, E. University St., Wooster, Ohio 44691. Part time, summers. Carving, sculpture.

University of Tennessee, Chattanooga, Tenn. 37402. B.F.A., days, $285/semester.

Hardin-Simmons University, Hickory & Ambler Sts., Abilene, Tex. 79698. B.A., part time, $65/semester hour.

Ethan Allen Community College, Box 905, Manchester Center 05255. A.A., $120/course. Carving, sculpture.

Cambrian College of Applied Arts & Technology, 1400 Barrydowne, Sudbury, Ont. P3A 3V8. Eves., $30/12-week course. Carving.

TEXAS

North Texas State University, Denton 76203. B.S., M.S., days, eves., $4/semester hour, $50 minimum. IAE, IP, WS&T, cab., D, F, J, T, U.

Texas A & I University, Box 2185 TAIU, Kingsville 78363. B.S., M.S., $78/course. IAE, cab., D, R&R.

University of Texas, 3900 University Blvd., Tyler 75701. B.S., M.S., days, eves., $162/semester. Cab., RC, FD&D, FM, IAE, ID, IP, WS&T.

Texas A & M University, College Station 77843. B.S., M.S., M.Ed., Ph.D., Ed.D., days, $4/credit hour. IAE, cab., D, HTW, RC, T, crafts.

East Texas State University, Commerce 75428. B.S., M.S., days, eves., wknds., $86/course. Cab., RC, FD&C, IP, M, U, F, R&R.

West Texas State University, Box 767 W.T., Canyon 79015. B.S., days, $60/sem. IAE, cab., F, HTW, RC, J.

Southwestern Adventist College, Keene 76059. B.S., days, $120/semester. Cab., RC, FD&C, U.

Abilene Christian University, ACU Box 8107, Abilene 79699. A.A., B.S., M.S., days, $225/semester hour. IP, IA.

Tarleton State University, Box T489, Tarleton Station, Stephenville 76402. B.S., days, $4/semester hour, $50 minimum. IA, IAE, IP.

Sul Ross State University, Alpine 79830. B.A., B.S., M.S., days, $4/semester hour. IAE.

UTAH

Brigham Young University, 230 SNLB, Provo 84602. B.S., M.S., days, evens.. IAE, IP, ID, cab., M, S, U, F, RC, T.

VERMONT

Marlboro College, Marlboro 05344. B.A., $4,970/year. FD&C, MI. "An advanced woodworker may do a two-year plan of concentration in woodworking leading to a B.A. Courses for beginners as well."

Kirby Studios, B.C.I.C. Building, North Bennington 05257. Private academy, days, wknds., summers, $1,500/sem. Cab., FD&C, FM, IP, U, WS&T.

Michael Coffey School of Fine Woodworking, RD 2, Poultney 05764. Private academy, days, $3,400/year. Cab., FD&C, S, WS&T. "Learning by making fine furniture, coupled with relevant classes."

VIRGINIA

Virginia Commonwealth University, 221 Shafer Ct., Richmond 23284. B.F.A., M.A., M.F.A., days, $820/year. Crafts, FD&C.

Southside Virginia Community College, Keysville 23947. days, $114/quarter. Cab., RC, R&R, U.

WASHINGTON

Eastern Washington University, Cheney 99004. B.S., M.S., days, $206/quarter. IAE, IP, RC, D, cab., F, R&R, HTW, J, T.

Central Washington University, Ellensburg 98926. B.A., B.S., days, eves. RC, FD&C, IP, WS&T.

Western Washington University, Bellingham 98225. B.S., days, $206/quarter. IAE, IP, D, F, T.

Walla Walla College, College Place 99324. B.S., days, $1,325/qtr. IAE.

Evergreen State College, Olympia 98505. B.A., days, $206/quarter. "Students and faculty draw up a contract on a particular subject for credit. Three years ago we had a wood furniture/sculpture design contract; other past programs include a 38-ft. wooden research ship."

Cornish Institute, 710 E. Roy, Seattle 98102. Degrees in general and interior design, days, $90/credit hour/sem. "School offers good background in furniture design."

Spokane Community College, N. 1810 Greene St., Spokane 99207. A.A., days, $109/quarter. Cab., RC.

WEST VIRGINIA

West Virginia University, Morgantown 26506. B.S., M.S., days, $241/semester. WS&T.

Fairmont State College, Fairmont 26554. A.S., B.A., B.S., days. Cab., RC, FD&C, S, WS&T, F.

Augusta Heritage Arts Workshop, Box 1725, Elkins 26241. Cooperative credit, days, about $75/wk. Workshops in car., cab., FD&C, white oak basketry, making hammered dulcimers and banjos, woodcrafting, shingle splitting.

Huntington Galleries, Park Hills, Huntington 25701. Credit granted cooperatively, M.S., part time. Miniatures, crafts.

WISCONSIN

University of Wisconsin, 455 N. Park St., Madison 53706. B.F.A., B.S., M.F.A., M.S. FDC.

University of Wisconsin, River Falls 54022. A.A., B.S., M.S., days, $92/quarter hour. IAE, F, HTW, WS&T, farm buildings.

Cardinal Stritch College, 6801 N. Yates Rd., Milwaukee 53217. A.A., B.A., B.F.A., B.S., days, eves., $90/credit. Car., FD, S.

Northeast Wisconsin Technical Institute, 2740 W. Mason St., Green Bay 54303. Diploma (1 yr.), days, $13/credit. Cab., RC, F, R&R.

Blackhawk Technical Institute, Rt. 3, Prairie Rd., Janesville 53545. Diploma, days. Cab., RC.

District One Technical Institute, 620 W. Clairemont Ave., Eau Claire 54701. Credit granted cooperatively, diploma (1 yr.), $200/semester. Cab., RC.

Mid-State Technical Institute, 500 32nd St. North, Wisconsin Rapids 54494. A.A., days, $12/credit/semester. Cab., RC.

Madison Area Technical College, 211 N. Carroll St., Madison 53703. A.A., days, $307/semester. Cab., RC, D, F, R&R, HTW.

WYOMING

University of Wyoming, Box 3374 University Station, Laramie 82071. B.S., M.S., $296/semester. IAE, IP.

Canada

ALBERTA

Northern Alberta Institute of Technology, 11762 106th St., Edmonton T5G 2R1. Days, $320/year. Apprenticeship cab., RC; also M, cab., F, R&R, T.

Red Deer College, Technical & Apprenticeship Div., Box 5005, Red Deer T4N 5H5. Days, apprenticeship in RC.

Fairview College, Trades Div., Box 3000, Fairview T0H 1L0. Days, government pays costs. Apprenticeship in cab.; evening courses in cab., R&R.

Southern Alberta Institute of Technology, 1301 16 Ave. N.W., Calgary T2M 0L4. Apprenticeship in cab., RC; also cab., F, R&R, HTW.

BRITISH COLUMBIA

Vancouver Vocational Institute, 250 W. Pender St., Vancouver V6V 1S9. Pre-apprenticeship, $36/mo. RC, M.

British Columbia Institute of Technology, 3700 Willingdon Ave., Burnaby V5G 3H2. Diploma of technology, days, $550/year. WS&T, lumber & plywood manufacturing, lumber grading.

Douglas College, Box 2503, New Westminster V3L 5B2. One-year degree, days, $32/month. RC, HTW.

Northern Lights College, 11401 8th St., Dawson Creek VIG 4G2. Apprenticeship, days. RC.

NEW BRUNSWICK

New Brunswick Craft School & Centre, Box 6000, Fredericton E3B 5C3. 3-year diploma in crafts, days, $500/year. Cab., FD&C, MI, car., HTW, J, S, T.

New Brunswick Community College, Box 70, Power Rd., Edmundston E3V 3K7. Apprenticeship, days, eves. RC, cab., FM, M, HTW.

New Brunswick Community College, Campus de Grand-Sault, 160 Reservoir St., Box 1270, Grand Falls E0J 1M0. Trade school, free to residents. RC, U.

NEWFOUNDLAND

District Vocational School, Box 550, St. Anthony A0K 4S0. Apprenticeship, days, $150/course. Cab., RC, M, WS&T, blueprint reading & sketching. Program "trains students for the construction industry."

District Vocational School, Clarenville A0E 1J0. Apprenticeship, pre-employment, $23/semester. Cab., RC, HTW, J.

District Vocational School, Grand Falls A0H 2H0. Pre-employment, $1,250/semester. RC

District Vocational School, Premier Dr., Lewisporte A0G 3A0. Pre-employment, days. RC.

ONTARIO

Conestoga College, Doon Campus, 299 Doon Valley Dr., Kitchener N2G 4M4. A.A., days, $462/year. A&R, cab., FD&C, FM, IP, M, U, P, WS&T, F, car., R&R, M&I.

Georgian College of Applied Arts & Technology, One Georgian Dr., Barrie L4M 3X9. Apprenticeship, days, $13/week. Cab., RC, FD&C, FM, M, F, R&R, HTW, J.

Niagara College, Welland Vale Rd., St. Catharines. 1-yr. apprenticeship, $20/week. Cab., RC, FD&C, ID, M, P, WS&T, F, R&R, HTW, J, T.

Humber College of Applied Arts & Technology, 56 Queen Elizabeth Blvd., Toronto M8Z 1IM. 1-yr. degree, days, eves., $12/wk. Cab., FD&C, FM.

Humber College, 205 Humber College Blvd., Rexdale M9W 5L7. 3-year program, days, $240/semester. FD&C, ID, HTW, cab., J.

Sheridan College of Applied Art & Technology, 1460 S. Sheridan Way, Mississauga L5H 1Z7. 3-year program, days, $500/year. Cab., FD&C.

Algonquin College, 1385 Woodroffe Ave., Ottawa K2G 1V8. Certificate, days, $222/semester. Cab., FD&C.

Northern College of Applied Arts & Technology, Box 970, Kirkland Lake P2N 3L8. 3 yrs. days, $500/40-wks. RC, R&R, pre-apprenticeship.

PRINCE EDWARD ISLAND

Holland College, Enman Crescent, West Royalty C1A 7N9. Days, $300/year. Cab., crafts, FD&C.

SASKATCHEWAN

Wascana Institute of Applied Arts & Science, Box 556, Maxwell Campus, Regina S4P 3A3. Days, eves., $23/wk. Farm-related construction. □

Stringed instruments

Roberto-Venn School of Luthiery, 5445 E. Washington St., Phoenix, Ariz. 85034. Accredited, 4-month course, certificate. Days, $2,100. Construction & repair of fretted acoustic & electric instruments. Also guitar painting & finishing, guitar electronics, business history.

Ervin Somogyi School of Lutherie, 3052 Telegraph Ave., Berkeley, Calif. 94705. 1 eve./wk., $800/14 weeks. Guitar & lute-making.

Kenneth Warren & Son School of Violin Making, 28 E. Jackson Blvd., Chicago, Ill. 60604. 3½-year program, days, $990/semester.

Maine Guitarmakers' School, Box 168, Main St., Tenants Harbor, Maine 04860. Days, $275/week, semi-private instruction.

La Gitana Instruments, 83 Riverside Ave., Concord, Mass. 01742. Full time for one apprentice, 4 hrs./wk. for students. $10/week. Guitar and dulcimer-making; repair of all stringed instruments except keyboard.

Stringfellow Guitars, 121 Union St., North Adams, Mass. 01247. Six-week courses, days, $1,000. Course provides "supervision, tools, materials and supplies necessary for the construction of one guitar."

Bob Zatzman Guitar Studio, 6655 McCallum St., Philadelphia, Pa. 19119. Apprenticeship, guitar repair course, once a week, $15.

The Apprentice Shop, Box 267 N. Main, Spring Hill, Tenn. 37174. Certificate, days, $1,000/guitar construction course; $600 guitar repair course. Also lacquer finishing.

School of the Guitar Research & Design Center, Rt. 132, South Strafford, Vt. 05070. Private academy, days, $1,400/six-week course. "Principles and methods of guitar construction and design."

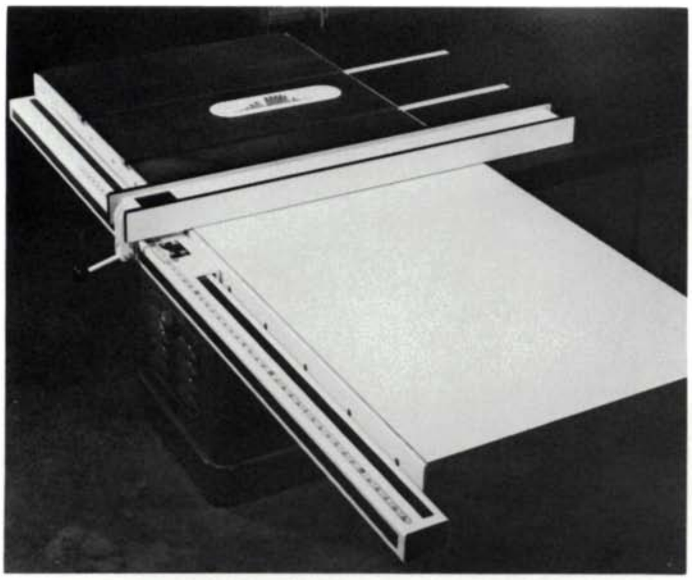
Northwest School of Instrument Design, Box 220, Skykomish, Wash. 98288. Apprenticeship, one year, $7,500; independent study tutorial, 30 weeks, $1,100. Design & construction of guitars, lutes, historical reproductions, replicas; also repair & restoration.

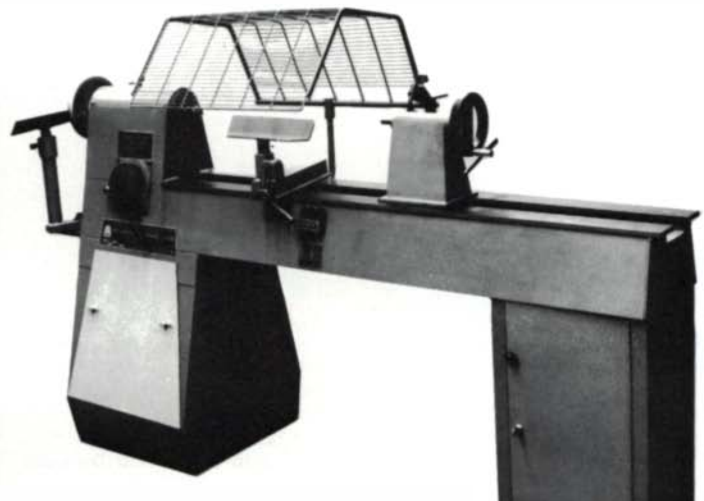
EDITORS' NOTEBOOK

Fairs and Expositions: Louisville, Atlanta and Chicago

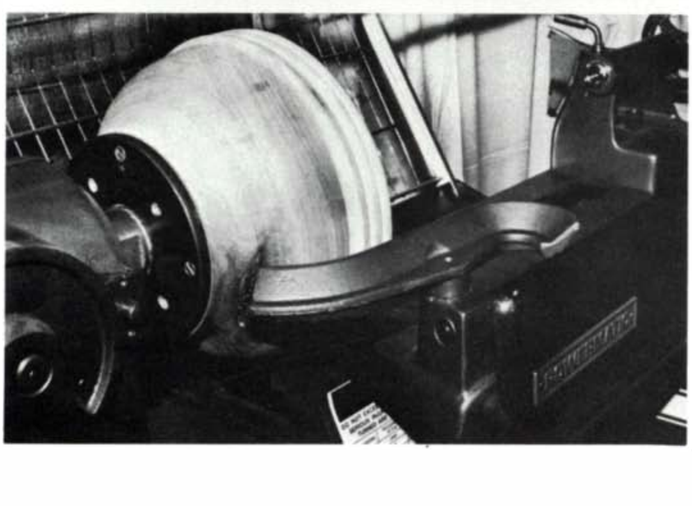
Every two years thousands of furniture manufacturers migrate to Louisville, Ky., to take in the International Woodworking Machinery and Furniture Supply Fair. Last summer they also flocked to Atlanta, Ga., where the Woodworking Machinery Importers Association staged a show to compete with Louisville. Some 263 firms exhibited in Atlanta; at Louisville there were more than 700. Most of these were suppliers to the furniture industry. You could buy four-sided molding/framing machines to turn out finished frame-and-panel doors from rough stock, web laminating presses to make infinitely long plastic-covered wood or computer-programmed multi-spindle carving machines—if you could afford prices running into six figures, that is. If that were all there was at these fairs, there'd be reason enough for the craftsman to go take a look-see. Many exhibitors demonstrate state-of-the-art equipment. DeVilbiss, of Toledo, Ohio, had a $95,000 spray robot with arm and wrist action on six axes that performs "like your best painter, on his best day, every day, all day." At the Atlanta show was Italpresse's monstrous hydraulic press that takes ordinary wood panels and with a set of dies squashes detailed relief "carvings" onto their faces with 300,000 lb. of pressure. And Goodspeed, of Wichendon, Mass., showed a hopper-fed hydraulic backknife lathe that turned 30-in. long walking sticks, one every 10 seconds. By the second day hundreds of Louisville fair-goers sported one. It may be trepidation that accompanies the feelings of awe and amusement at how stretched ingenuity can become, but it's good to know what the beast is up to. "Why, that machine's worth three men," said one businessman.

But there's much at these fairs for the reader of this magazine besides technical prodigies. There are sources of supply for all kinds of specialty hardware and tooling services, like the Jack Sigrist Co. (324 19th St. S.E., Hickory, N.C. 28601), which supplies small quantities of Tantung, a non-ferrous cast alloy for tool bits that falls between high-speed steel and carbide in hardness, toughness, and workability. Companies like Stanley, Bosch, Rockwell and Powermatic offer discount prices on fair-bought items. You can see in one day and under one roof more kinds and brands of equipment than you can in weeks of driving around to distributors. While most of the people you will talk to in the booths at these fairs are salespeople rather than engineers and you may know more about what you're looking at than they do, there is no substitute for seeing the real thing. It doesn't take studied examination to

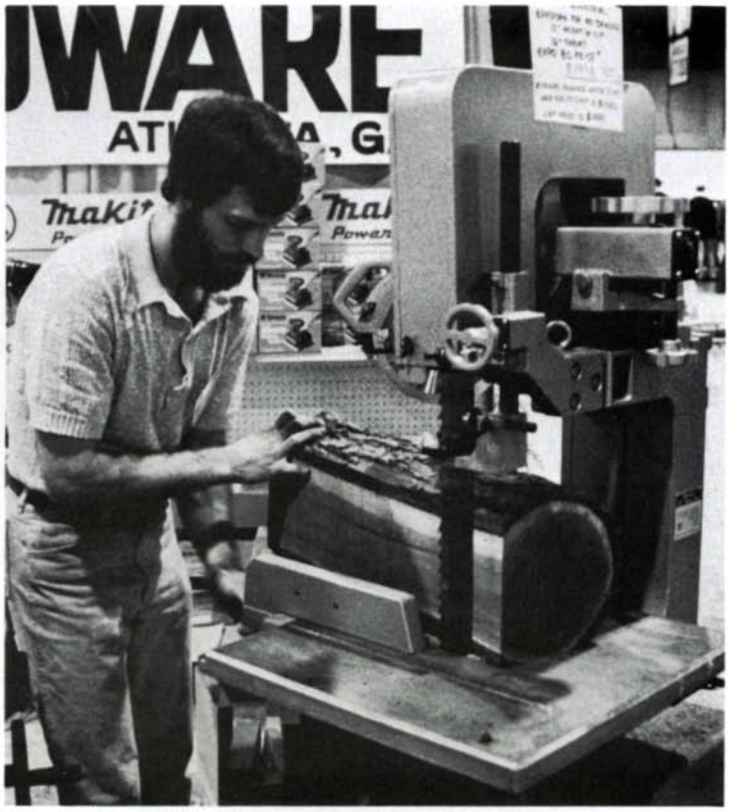




Made by Vega Enterprises, R.R. #3, Box 300 B, Decatur, Ill. 62526, this 48-in. lathe with 15-in. swing reflects the thoughtful designs of all of the woodworking machinery this company is introducing. Its tailstock and tool rest slide smoothly on machine-ground steel ways, and it has an outboard tool rest that bolts directly to the headstock casting. With its long, 17-lb. spindle and wide speed range (350 RPM to 3,450 RPM), this is an impressive machine for its $1,900 price. Photo: Vega Enterprises.



The T-Square Saw Fence System, above left, made by Biesemeyer Tools, Inc., 216 S. Alma School Rd., Suite 3, Mesa, Ariz. 85202, includes graduated front guide rail, fence and extension table; it can be adapted to fit all table saws. The rip fence automatically squares itself when locked in place with a single lever, and can be set with exceptional accuracy, eliminating the need to measure blade-to-fence distance with a rule or tape when setting up for a new cut. The cost is about $300, with a 36-in. extension table. (Photo: Mallory's.) Powermatic introduced a concave/convex bowl-turning tool rest, left. It has a 1⅛-in. diameter mounting shaft, and they'll sell it separate from the lathe for $21.50.



For more than 20 years craftsmen at the Artistic Manufacturing Co., 13821 Progress Pkwy., North Royalton, Ohio 44133, specialists in picture frames, have used Ulmia table saws. They recently designed and Ulmia is manufacturing a 10-in. saw, above, especially suited for short, precise cuts; the entire table top, with its 5-ft. long fences and elongated slot, slides on steel bearings and automatically returns after the cut. The table can be locked and used with a conventional rip fence and miter gauge. With a 1-HP motor it costs $4,000. Chris Bagby, right, of Highland Hardware Co., 1034 N. Highland Ave. N.E., Atlanta, Ga. 30306, demonstrates Makita's new band saw. Specially built for resawing, it can handle blades up to 2⅜ in. wide. Its table is 21⅛ in. by 20⅝ in., its depth of cut 12⅜ in., and it costs $1,900. Equipped with factory-supplied tires, it can be used as an ordinary band saw, accepting blades as narrow as ¼ in.

tell the higher quality of a casting on an Oliver table saw when you compare it to some of the other saws you'll see. And there's another reason to go. You'll learn what's new on the market, for many items (some shown here among the more interesting things we saw), are unveiled at these fairs. Look forward then (notices will appear in the Events column) to the next couple of shows in 1982—admission is free if you register in advance. —*R.M. and J.L.*

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Another spinoff of the Louisville fair was the Excellence in Woodworking exhibition, held last October at Chicago's Hyatt Hotel. An experiment in fusion, it was half trade show, aimed at professional and amateur woodworkers, and half wood craft fair, aimed at gallery owners, interior decorators and the buying public, with technical seminars in joinery, design and woodturning thrown in. It attracted exhibitors and woodworking enthusiasts from as far away as Alaska, Florida and England, bringing to a city not well exposed to craft fairs a more-than-regional display of woodworking and woodworking supplies. There were machinery and tool distributors, wood and hardware suppliers, craft-school representatives and craft-book publishers, along with the work of some 50 woodworkers. Almost 9,000 people came, and 1,000 of them attended the technical seminars. Everyone I met there felt the show's organization left something to be desired.

The organizers—Marvin Park, who also assembles the Louisville fair, and the brothers LeCoff, responsible for the Philadelphia woodturning symposiums—attributed the problems to the inevitable snags of a first run-through. The seminars, for example, were merely curtained off from the main hall—the noise interfered with the speakers, and the lights couldn't be turned off for viewing slides. Machinery on which to demonstrate, first lost in shipping, worked poorly when it finally arrived. Picture Bob Stocksdale without a lathe, Tage Frid without a bench and Sam Maloof without a band saw. The good feelings of instructors and audience alike were sorely taxed.

Woodworkers who came to sell their work were also dissatisfied. Some covered expenses and a few did well, but most said their half of the show was inadequately promoted—instead of wholesale buyers and a craft-hungry public, the browsers were other woodworkers wanting to compare notes. They'd paid $4 admission, mainly to take in the trade show. To the guy who had paid $150 for booth space, plus transportation and shop down-time, the arrangement wasn't fair. "This isn't a buying public," said one woodturner. "Everybody wants to know what kind of chuck I use."

The best part was the trade show. Many exhibitors expressed surprise at the crowd's enthusiasm for high-quality equipment. Besides connecting buyer and seller, here was another opportunity to see demonstrated what you've seen only in pictures, and to offer the distributor your opinion of its quality. These shows could be the best forum for improving the tools we use.

Park and the LeCoffs figure the experiment was a qualified success, and they're already planning two more, one on the East Coast, the other on the West, in addition to a second Chicago show this year. The trade show promises to grow; whether the wood show will happen along with it remains to be seen. It's worth questioning whether the two, their different audiences and atmospheres, belong under one roof. Are gallery owners and interior decorators, who really do need a place to see fine wood furnishings, attracted by screaming band saws? Are pieces of furniture shown to advantage in 10-ft. by 10-ft booths? Boxes and toys and other small items can look good displayed on shelves or from racks—it has the atmosphere of the carnival. But an executive desk in rosewood and inlaid brass is out of scale and out of taste in a carnival booth. The Chicago show was particularly indecorous; in a basement, on a cement floor, under fluorescent lights, the wood just didn't look good. The booths were uncomfortably stark, one reason being the show's location—a luxury hotel in a big-union city where everything had to be moved in and assembled by labor that charged by the pound and by the hour. Shouldn't a show called Excellence in Woodworking be presented to make the wood look best? Then woodworkers and interior decorators alike would do well to attend it, whether or not they came also for the trade fair. —*R.M.*

by John Lively

AN AFTERNOON WITH CHARLES RIORDAN

"Read all the experts you want, and you still can't cut better dovetails than these." Charles Riordan looms over me like a big old bear, holding a tiny dovetailed tray for a jewelry box. Its pins are barely ⅛ in. wide, uniformly spaced with no gaps anywhere. I wonder how he does such precise work with such huge hands. He walks over to his bench, sweeps aside some of the clutter and deals out several dovetail templates he's cut from sheet brass. "Really, there's no sense in wasting time trying to lay out dovetails with a sliding bevel. Templates are more accurate, and they're faster. Here, I'll show you." He shows me. He's right. His method is fast and it's accurate, and the results seem faultless.

Riordan, 70, of Dansville, N.Y., reproduces and interprets 18th-century Philadelphia and New England-style furniture. He takes on work in other areas, occasionally doing a Sheridan or Hepplewhite piece, but he seems most comfortable working in the rococo mode, carving acanthus leaves, shells and ball-and-claw feet and incising relieved scrolls around the edges of piecrust tables. Impeccable in their detail and definition, his carvings exhibit the restraint of virtuosity, that intuition for what is enough and what is too much.

He lumbers over to his lathe and points to a partially turned bowl that's mounted on a faceplate. "I don't like to turn outboard. I can't get into the inside of a bowl as well and don't get the control I want. I have to turn these piecrust tabletops outboard, but when I do, I bolt a long 2x6 between the ceiling posts and use it for a tool rest." Leaning against the wall at the headstock end of the lathe are three such tops, in different stages of completion. He picks one up. Its diameter is over 36 in. "This was made from one mahogany board. It's not glued up. I really like it when I get stock that's good and wide, and I save it for pieces like this."

"During the war I was a tool and die maker. I learned lots of tricks. Look over here at this." He walks over to his table saw and tries to wiggle the miter gauge back and forth. It doesn't budge in the slot. "Know how much slop there usually is in a miter gauge?" I nod yes. He picks up his tenoning jig from the floor, blows the dust off it, and pushes it in the miter-gauge slot. It doesn't wiggle either. Then he shows me where he's dimpled the sides of the steel guide bars with a punch. The metal displaced by the point of the punch rises like a little ripple around the hole, increasing the effective width of the bar. He dimples the bar several places front and rear until it's tight and then files it a little until it slides snugly in the slot.

I ask him what finish he likes. He gives me one of those wide-eyed, quizzical looks of his and then says that people make too much fuss about finishes. He uses a polymerizing tung oil on solid-wood furniture, but generally he shellacs high-style veneered pieces. He's not the alchemist I expected him to be and has no arcane formulas, only direct, reliable methods for getting the looks he wants.

He goes over to the grinder on his bench. "It really gets my goat how people make such a big deal about sharpening tools." He gives me another one of those looks. "You don't need a bunch of oilstones to get a razor edge, or even a fine-grit wheel." The secret to getting a good, clean edge with a coarse grinding wheel, he says, is in properly dressing it down. "Those star dressers aren't worth a quarter. I use a diamond dresser and use it pretty often." He flips on his grinder and makes several deft passes across the edge of the wheel with the diamond dresser. Then he reaches above his bench and plucks down what looks to be a 25-mm, #8 gouge. Thumbing its edge, he says he'll get it sharp enough to shave his arm in a couple of minutes, using only his 36-grit wheel and buffer.

Riordan's grinder has a tool rest with a *V*-block held out from the wheel by an adjustable bracket. The handle of the chisel rests in the *V*-block, whose distance from the wheel and relation to the axis of rotation determine the angle of the bevel on the tool. He begins grinding the edge of his gouge, turning it back and forth in the *V*-block so that the entire face of the bevel makes uniform contact with the wheel. He uses light pressure and goes slowly so the steel won't heat up. "But I can lean on it if I'm in a hurry. Then I just spray it with water as I go along."

To polish the edge he loads some grey buffing compound on his hard felt buffing wheel and strops the gouge. He rolls up his sleeve and begins to shave his arm. "You can't do good carving," he says, "unless your tools are kept absolutely sharp. And you can't carve if you spend all your time honing your tools. That's why I don't fool around with oilstone sets." He hands me the gouge again. The bevel is surprisingly smooth and polished, showing none of the grinding lines you'd expect. "You've got to keep the wheel clean," he reminds me. "The coarseness of the grit doesn't matter."

It's getting late. He says dinner's about ready so we leave the shop and walk across his yard to the house. Inside I get to look around at some of the many pieces of furniture he's made. In the dining room there's a nice Massachusetts-style lowboy he built 35 years ago. There are several piecrust tables placed in corners here and there, and a Philadelphia footstool in the living room that epitomizes Riordan's work. Like the man himself, it combines certain contradictory qualities, the forceful presence of its muscular legs and sinuous claws being balanced by its harmonious proportions and its look of aristocratic repose.

We eat an excellent meal of chicken and broccoli. Between bites I can't resist the temptation to rock back and forth in the chair just a bit to get a feel for the strength and flexibility of this Philadelphia dining chair that he made over 30 years ago. All the chairs have fretted splats and scrolled ears, and the angle made by the rear legs as they sweep up to form the back seems overly sharp to me. But the chair is comfortable, and there's plenty of spring and flex to the splat, but no play at all in the rail-and-leg joints.

After dinner we look at some photographs of commissioned works, and Riordan tells several stories about unusual jobs and eccentric clients. He recounts how one old dame, after having had him make a card table for her sitting room, put it behind a chair, out of view, until a museum curator who was a guest at one of her soirees remarked on the excellence of its design and construction. After that she moved the table to the center of the room. "Can you imagine that?" He shakes his head, chuckling at how the merit of one man's work can depend on the weight of another man's words. □

Right, one of a pair of Flemish armchairs made in oak to match a set of side chairs. These two chairs were commissioned to complete an antique dining-room suite.

Queen Anne drop-leaf table is of mahogany. Its graceful legs and delicate ankles terminate in unusually massive ball-and-claw feet and show Riordan's penchant for combining incongruous elements in pleasing ways.

The design of the mahogany jewelry case, below, was influenced by a Quaker Bible box. The inside is lined with felt and contains a sliding tray with four divisions. The inlaid monogram is in holly, and the floral marquetry design inlaid in the lid is by Jason French.

This secretary of mahogany and tulipwood, above, was inspired by a similar piece made by Samuel Prince, which is on display at the Winterthur (Del.) Museum. The silver chest at left, photographed in its unfinished state, was built to complement a client's existing dining-room furniture. The molding on the outside corners of the top has been carved so that a gentle cleavage separates the intersecting planes. Riordan embellishes many of his tabletops in this manner.

Photos: Don Sylor, Trinity Galleries

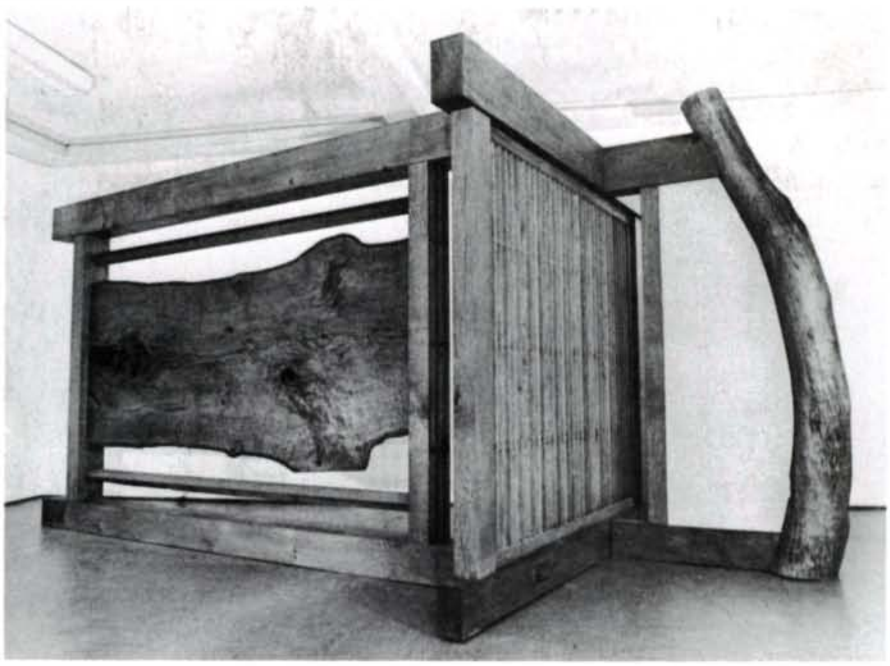
Odate (shirtless) commands one of the top members into place, above. More help was required to upright the 3-in. thick white oak flitch mounted in mortise-and-tenon timber frame, right. Screen frame, center right, was drawn to flitch frame with clamps.

A Sculpture-Raising in Connecticut

Though it didn't quite require pikes and a derrick, the opening last September at the Washington Art Association Gallery of a show of work by sculptor Toshio Odate did resemble a New England barn raising. He brought his largest piece, shown here, unassembled. A commander and some neighborly help eased its timber-frame mortise-and-tenon joints into place.

Odate, 50, was a cabinetmaker's apprentice for five years in his native Japan before studying interior design at National Chiba University. His current work, constructed using mainly traditional Japanese techniques and tools, is a tribute to his heritage. It is also an image of his present surroundings in Woodbury, Conn. His pieces, neither furniture nor architecture, are comfortable objects whose familiar architectural elements evoke various environments. This piece in particular, with a crooked cherry log framing a cement partition perpendicular to a classical Japanese screen, suggests both interior and exterior spaces. The mix of local materials and modern technology (that 48-in. wide white oak flitch was chainsawn freehand) with imported traditions is designed to engender the sort of pride in craftsmanship that transcends times and nationalities. "I am trying," Odate says, "to produce a solid sense of heritage, pride, trust and peace."

Cement wing with cherry log is slid into place.



Odate's 'Homage to Professor Shinji Koike,' incorporating Western and Eastern elements, measures 15 ft. long, 7½ ft. wide and 7 ft. tall, and is mainly of white oak. Construction took about a month, entirely without working drawings or model.