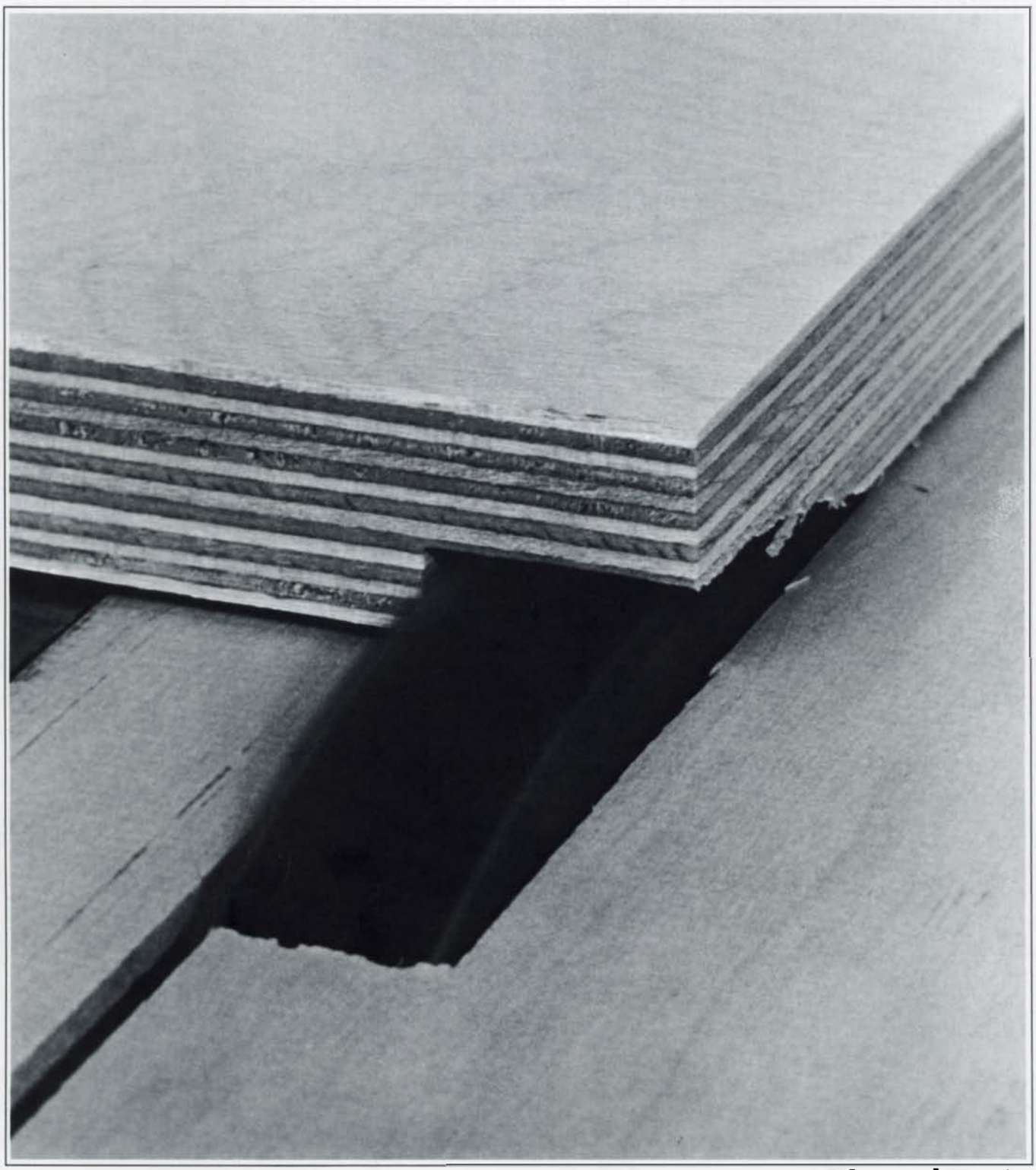
Fine WoodWorking

MAY/JUNE 1984, NO. 46, $3.50



Plywood Basics

Here's Front-Page News:

ANOTHER MR. SAWDUST BLADE ...FOR THE *TWO*-SAW SHOP!

We got fancy last Fall and did a survey.

Out of the hundreds who came to our shows, we hand-picked 358 *very* serious woodworkers and asked them to fill out a lengthy questionnaire. Here's part of what we learned:

Of the 358, table-saws are used by 242. Radial-arm saws by 212. And 124 own BOTH. So -- **35% have TWO-saw shops!** What's more, they convinced us: My original Mr. Sawdust blade is ideal for those "perfect, polished cuts" on *either* machine -- but they also want an all-purpose, fast-feed, planer blade *strictly* for their table saw. One that will give them a GLUE-LINE cut right off the blade.

They *least* enjoy ripping heavy stock and cutting up large sheets of material -- so they want to get the job done as *quick and clean* as possible. But more than that: Without changing blades, they want to crosscut and miter with an equally good cut.

So, for the TWO-saw shop, here's *another* Mr. Sawdust blade.

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This is my *original* Mr. Sawdust blade -- most desired by the American craftsman. Kerf: 3/32". 60 teeth. Modified triple-chip with micro-finish grind. Exclusive Forrest 400 carbide. **Perfect, polished cuts in every direction.** The one blade that does it all -- for as long as you'll cut wood or plastics.

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Generally, I recommend 40 teeth. However, if your ripping includes a lot of heavy hardwoods, specify 30 teeth. See dampener information (*) pertaining to table-saws.

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It's a vital part of the Forrest blade design -- to suppress harmonics caused by motor, belts, even change of grain in wood. For 10" blades, specify 6" dampener. This allows a 2" depth of cut. (For table-saws, if you cut a lot of full 2" stock, specify 5" dampener to expose blade above material.) For *maximum* 3" depth of cut -- table-saw or radial -- remove dampener. (For 8" and 9" blades, figure dampener size accordingly.) Want some expert advice? Our 800-number is toll free!

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LOUISVILLE, KENTUCKY
MAY 18 thru 20

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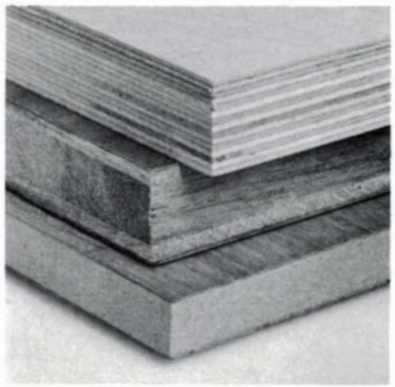


Cover: Tablesawing plywood. These wooden sandwiches come in a beguiling variety; shown above are Baltic birch, cherry lumbercore and walnut on fiberboard. Article begins on p. 48.

DEPARTMENTS

ARTICLES

Letters

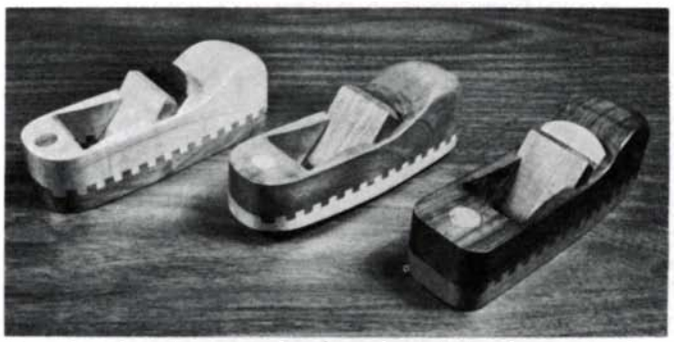
I am in the process of building the small highboy designed by Carlyle Lynch and featured in *FWW* #42. I'm using mahogany and I'm having difficulty bending the cock beading around the curves of the apron. I followed Mr. Lynch's instructions and boiled the strips for 10 to 15 minutes, but every time I apply pressure, the strips break. Mr. Lynch makes it sound very simple and routine.

—Thad W. Evans, Midlothian, Va.

CARLYLE LYNCH REPLIES: I made my highboy of cherry and had no trouble bending the cock beading. I mistakenly assumed that mahogany would be just as easy to bend, but when I steamed some mahogany strips for an hour in my wife's canner, I too found that they cracked when bent into the tight curves of the apron. The practical solution for builders working in mahogany is to use cherry or walnut for the cock beading and then stain it to match, as the old furnituremakers here in Virginia often did.

I might add that the cherry and walnut pieces I've bent so easily have been from "garret-seasoned" wood, which I prefer to use instead of kiln-dried lumber.

A couple of points about Tage Frid's article on drawers in *FWW* #45: He doesn't mention the possibility of gluing thin hardwood strips near the outside bottom of each drawer side. I have used this method on all sizes of drawers, from small trinket drawers to the nine-inchers in a chest. It permits most of the side to have easy clearance inside the carcase, and if the strips are rubbed with paraffin, it reduces friction to almost nothing. As regards lumber for drawer sides, Mr. Frid says that pine and poplar are too soft. I have used sugar pine on many drawers, with no problem. I do see that the wood is quartersawn, however, even if it means resawing the sides from heavier lumber.



'A palm plane is a very handy tool, as it is about 5 in. long. Here's a photo of three of the palm planes I've made. The fact that I have a Miller printers' saw with micrometer adjustments helps . . .' —Harry Erickson, South Norwalk, Conn.

Incidentally, I don't consider that a drawer fits unless it can be pulled out and pushed in with one finger when fully loaded.

—Stephen Miller, Essex, Conn.

I read with upsetting interest the article in issue #43 about shop-testing five jointer-planers. It was interesting because it was a needed article, but upsetting because with a few words it passed over two of this country's most nicely crafted and cost-effective machines: the Parks No. 11 combination jointer-planer and the Parks No. 95 planer.

Not to fly the flag too high in these days of esoteric imports, I'd like to say that these machines are crafted by American machinists in Cincinnati, Ohio, and have been since 1887. Perhaps Mr. Parks will need a cabinet someday and I can supply him because he is solvent. I doubt that any of my compatriots are expecting work from Mr. Hitachi or Mr. Makita.

But emotions are inconsequential when I run a 12-in. wide laminated board through my Parks for counter sections, planing off ⅛ in. in a single pass. I believe that your readers would appreciate adding the Parks machines to their list of choices when shopping for a tool that they can pass on to their children. *—Richard Raucina, Midpines, Calif.*

I appreciated the splinter-removal method of Dr. Tompkins (*FWW* #44, p. 6). While I can see the advantage of a flat versus circular-sectioned needle, I hope that none of your readers will find any doctor who would "give you a couple of used ones." I know of no better way to produce a full-blown case of hepatitis than to introduce a used needle into the skin.

—James R. Morrow, M.D., Anderson, S.C.

I have been able to make replacement blades for the Stanley #45 and #55 out of old-style can openers. The length, width and gauge as well as the quality of the steel are close enough to the originals to make rough-grinding and filing to size and shape fairly easy. The steel takes a good enough edge for soft woods, but can be made harder (and also more brittle) if heated to a cherry red and quenched in brine. Finish-sharpening can be done with appropriate slip stones, as for any molding cutters. *—Peter Birnbaum, Sebastopol, Calif.*

By and large, the article by Paul Bertorelli in the Notes and Comment section of issue #44 ("On equipping the small shop") is well written and gives some good tips for getting information. The elitist tone taken in the fifth paragraph, however, disturbs me greatly. The implication that "Harry Homeowner" would buy only poor equipment and that anything made by Sears falls into this category offends me. There are those of us who cannot afford some of the marvelous and generally expensive tools available today. Although I do not think anyone would compare Sears to Inca, there is no question that for those of us in small towns, Sears tools are available, generally reliable, and easy to get parts for.

I consider myself relatively well versed in woodworking, but I also consider myself a "Harry Homeowner" and resent the implication that I am some kind of second-rate woodworker because of the tools that I use.

—Douglas W. Lieuallen, M.D., Madras, Ore.

I'm an amateur woodworker and metallurgist, and presently I'm going through my back issues of *Fine Woodworking,* rereading articles of interest. I must admit that I have wondered about, and been amused by and sometimes horrified at the myths and misunderstandings that people have about the steel in their tools. There's nothing mysterious about fine cutting tools; quality is a matter of selecting the proper material, heat treatment and forming procedures.

Today's steels are better than those at any other time in history. Anybody who pines for toolmaking of bygone years is living in a make-believe world. Those *rare* tools that have survived for a hundred years are the product of good craftsmanship and exceptional care, or even lack of use. Never forget that for every hundred-year-old chisel that exists today, thousands probably went to the scrap heap. Anybody who doubts the advances in cutting-tool technology should throw away his carbide cutters and high-speed drills and go back to spokeshaves and splinters.

—Randall Anderson, Vallejo, Calif.

All of us in woodworking feel concerned for our safety in the shop. Usually we do try to take precautions. But sometimes we slip up under the pressures of production, or when taking those precautions seems inconvenient. There are simple remedies,

though. Safety glasses are a prime example. Sometimes the glasses are lost in the shop somewhere—in the rack behind the radial-arm saw, buried in bench clutter, or, for all we know, in a space-time warp (I know these exist where I work).

Anyway, a simple solution is to make the glasses more visible. One way is to put black and yellow stripes on the headband or the earpieces. You could use colored tape or the new opaque-paint pens to do this. You'd also be giving your glasses a more fashionable look; you could be the first in your shop with New Wave specs. *—Charles Dubman, Pikesville, Md.*

The two-part article on glues by George Mustoe (*FWW* #43 and #44) was informative, but there is one type of glue that is little known yet deserves to be added to the list. It's EPI (emulsion polymer isocyanate), a relatively new adhesive developed by Ashland Chemical Co. and available from them at Box 2219, Columbus, Ohio 43216. It's an interior/exterior glue similar to resorcinol, being at least as water-resistant but having a much lighter color (about like white oak when cured).

EPI is prepared by mixing two liquids, the resin (water-based) and the crosslinker, in variable proportions, depending on how much water-resistance and strength are desired. The glue has a pot life of several hours after mixing, and the recommended clamp time is 30 minutes at 70°F. EPI gives good results at temperatures as low as 40°F, and it doesn't release any formaldehyde, as do the other glues.

All in all, I've found EPI to be the most versatile glue in my shop, and although I don't use it for everything (it's not practical to mix just a dab), I certainly feel that it should be recognized as a very important woodworking adhesive.

—Paul A. Geiger, Gaithersburg, Md.

In 1937, my wife and I bought a house for $50. We knew that it had been standing in 1740. Despite its dilapidated condition, the inside trim was worn but in restorable condition. Making measured drawings and setting up a catalog was the prelude to carefully ripping out the trim, producing bundles of numbered sticks, panels, doors, etc. We moved this collection some 15 miles in an old touring car. Even the mortised-and-tenoned staircase came along whole on a flatbed truck and was reassembled in my shop, where it sat, leading to nowhere, while we rebuilt the house from the inside out.

Preparing the old trim for installation was a big job, so I bought a 10-in. tablesaw. My father, a devotee of the old-fashioned hand methods which he had carefully taught me, wanted to know what I had bought "that thing" for. He predicted all sorts of lost fingers and blinded eyes, not to mention ill-fitting joints. Twenty years before, I had been trained to use power tools by a high school teacher who would have none of the safety devices he was sure were dangerous because they were always in the way. He even hated push sticks, allowing us to use them only when absolutely necessary. His insistence that students relax and never hurry comprised a goodly portion of the flow of excellent advice.

I have followed the teachings of this man for 65 years with great success. I have all my fingers, even though I use a tablesaw with all its attachments for all sorts of cuts, some forbidden. The point is this: in the comments on safety stimulated by the article in *FWW* #36, there is hardly any mention of the need to relax, plan every cut and learn to keep one's fingers away from the blade. This simple habit of relaxing is surely as important as putting the guard back on the saw.

—Frederick Johnson, Andover, Mass.

Simon Watts' two-stage router/tablesaw method for cutting raised panels (*FWW* #44, p. 56) is too prone to error, as

well as being difficult and time-consuming. Here is a simpler, fool-proof method using a router table:

Buy a 1-in. dia. straight steel router bit and have a radius ground on the corners. Don't try to grind these radii yourself unless you're an expert—take them to the local precision grinder. Also, relieve the top center of the bit to give a flat cut. Except for heavy production work, carbide bits are unnecessary and steel bits are easily honed by hand on a stone. I keep two bits on hand—one with a $\frac{3}{32}$-in. radius for fine panels and one with $\frac{5}{32}$-in. radius for larger panels.

To use the bit, set the table's fence to the final width of cut and the router to less than the final depth of cut. If you creep up on the final depth, you'll get a tight sliding fit in the frame groove. Make end-grain cuts first, backed up with a block to prevent tearout. Then do the long-grain cuts.

—James Clifton, Green Bay, Wis.

After the usual delay in the mails, my July/August issue of *FWW* arrived. It was worth the wait, and wooden spectacle frames have now been added to my list of forthcoming projects.

I'm writing to comment on David Papke's letter concerning Belizean bee boxes (p. 4). Mahogany is not a suitable wood—it is too heavy for easy working with the hive and is not particularly termite-proof. Ask any termite here and it will tell you that mahogany (*Swietenia macrophylla*) is one of its favorite foods. Now, what that termite really doesn't like is the bitter taste of cedar (*Cedrela odorata*). . . and that, not mahogany, is what we use for the majority of our bee boxes. *—R.A. Jarrah, Belmopan, Belize*

I'm very upset with my recently purchased 10-in. Inca tablesaw, and I would like to share my observations with other woodworkers so that they can more accurately assess this machine.

Inca's claim that this is a 10-in. tablesaw is technically correct, but misleading and dishonest. The saw is really an 8-in. saw with the capacity for a 10-in. blade. With the 10-in. blade on the arbor, the least amount of possible blade exposure still leaves the blade $1\frac{1}{4}$ in. above the table. Tablesaw safety recommendations say that for cutting, the blade should extend no more that $\frac{1}{4}$ in. above the stock, yet this is not possible with the Inca with any stock less than 1 in. thick. This makes the saw inherently unsafe, and also incapable of performing tasks that other 10-in. saws can do, such as grooving and rabbeting in thinner stock.

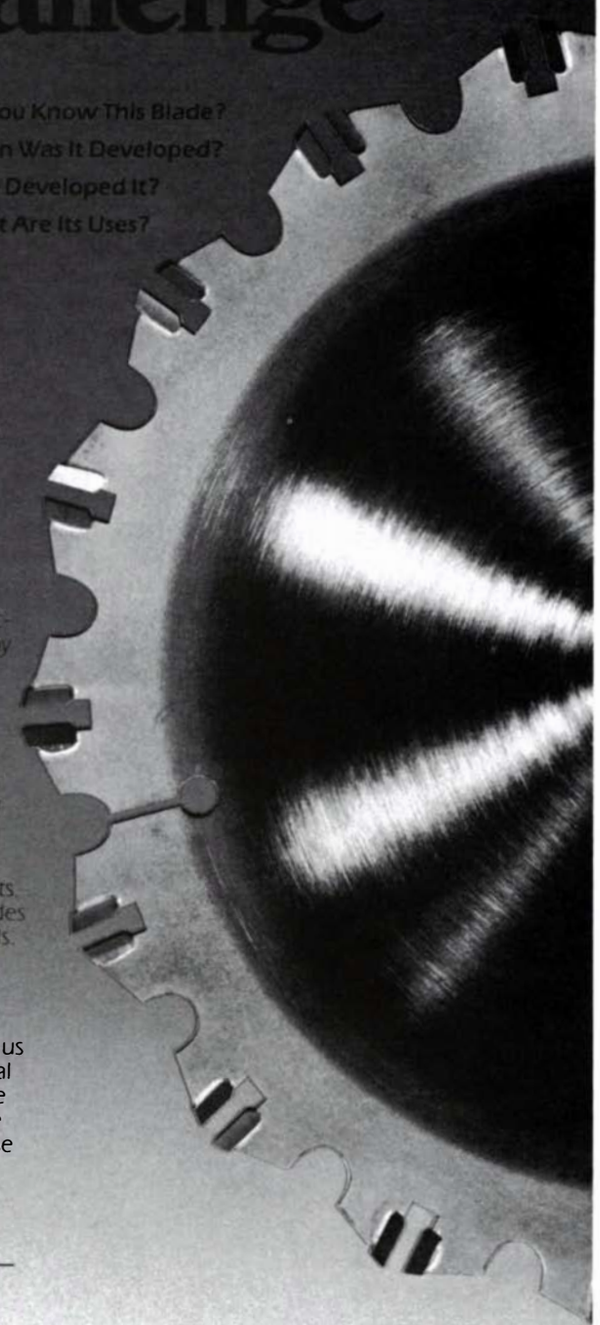
My first thought upon discovering this unusual feature was that I had been given Inca's smaller saw by mistake. When I called the local dealer, I was informed that it was the correct saw, but that they recommend an 8-in. blade for general sawing and the use of a larger blade for heavier stock. By all standards, and by Inca's own admission, this is definitely an 8-in. tablesaw.

I don't know how Inca has gotten away with this deception for so long. I feel certain that my own reaction and the reactions of knowledgeable people in the trade constitute warranted complaints. It will be interesting to see if other woodworkers who have used this saw share my dissatisfaction.

—Lou Irion, Paoli, Pa.

EDITOR'S NOTE: Garrett Wade Co., Inc., the importer of Inca tools, told us that other buyers have complained about some of the Inca's features, but that the company insists that its advertising is not deceptive. Henry Lanz, Garrett Wade's vice-president, pointed out that a recent catalog described the Inca's capabilities thusly: ". . . the minimum depth of cut with a 10-in. blade is 1 in. This trade-off, we feel, is more than compensated for by the added precision. An 8-in. blade (or a 6-in. industrial groover) will cut the shallowest grooves when necessary." Lanz also says that tablesaws are sized by the maximum diameter blade they will accept.

Take The Challenge



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Who Developed It?
What Are Its Uses?

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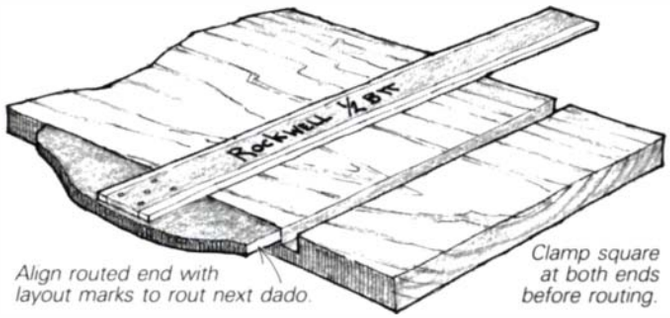
T-square router guide



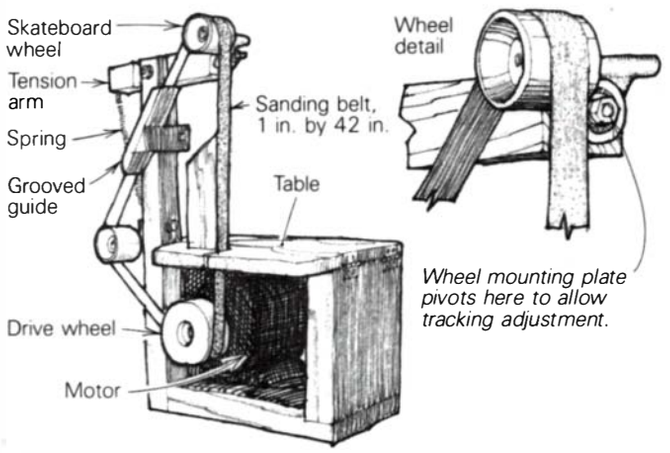
A couple of years back, I grabbed an old drafting T-square for a woodworking student to use as a guide for routing a dado. When he approached the end of the cut, he stopped and told me that if he continued to the edge of the board, he would rout through the head of the square. Since I had a few spares around, I told him to go ahead. When he was finished, we were surprised to find that we had produced, by routing off the tip of the head, a very useful dado guide. The head of the square, now perfectly sized, could be used to align subsequent cuts with the same router and bit.

Now we have eight T-squares with lopped-off heads, each clearly marked as to the router and bit they go with. Four go with different size dados (¼-in., ⅜-in., ½-in. and ¾-in.) on a Sears router; the other four go with a Rockwell router.

The T-squares are handy for other operations as well. We use them with a ½-in. carbide bit in the router to "saw" wide or long boards to length if the operation is awkward on the tablesaw. Nothing could be squarer.

—Jeff Sherman, Finn Rock, Ore.

Homebuilt vertical sander



This homebuilt vertical belt sander performs well and is easy on the tool budget. All you need to drive a standard 1-in. by 42-in. belt the proper 1500 to 2,000 FPM (surface feet per minute) is a small 1725-RPM motor, a 3-in. to 4-in. drive pulley, and two slave wheels installed on a frame with a tensioning device.

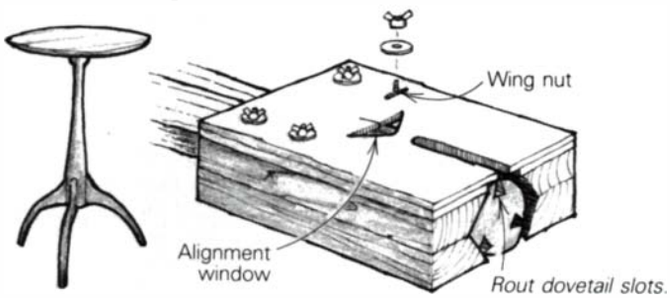
A satisfactory drive wheel can be turned from wood, or fabricated from a tuna can with both ends cut out. Take a small pulley that fits your motor shaft and epoxy it in the center of the can, being careful not to cover the setscrew on the pulley. For greater traction, wrap the circumference of the drive wheel with duct tape.

For weight and strength, construct the frame from 2-in. thick hardwood. Plywood will suffice for the table. The tensioning arm should fit the vertical support with a pivoting bridal-joint arrangement.

Scavenge the slave wheels from an old skateboard and, using the existing hardware if possible, fasten one wheel to the tensioning arm 12 in. to 15 in. above the drive wheel. Fasten the other slave wheel to the back of the vertical support. Make sure the wheels are attached so that they can pivot to allow the small adjustments needed for alignment and perfect belt-tracking. Other construction details are shown in the sketch. *—Leon O. Beasley, Lafayette, La.*

Routing dovetail slots for Shaker tablelegs

Although the Shaker pedestal table design has been around for 150 years, its clean lines have a contemporary feel. Inexpensive to build, the table requires only six wooden parts and a handful of screws. The only construction problem is cutting the sliding-dovetail housings for the legs. The jig shown below solves this problem.



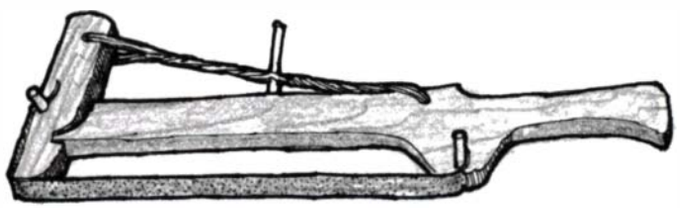
To use the jig, first build up a hexagonal turning blank for the table's stem, chuck it in the lathe and turn the lower 5 in. of the stem to size, leaving the remainder of the blank hexagonal. Now remove the blank from the lathe, mark out the centerlines for the dovetail cuts on three sides of the stem, and mount the jig in place on the workpiece.

The jig has two halves that mate with the hexagonal part of the workpiece, thereby positioning the turned section under the router guide slot. Be sure that the marked centerline on the blank is correctly positioned in the alignment window.

A bench vise holds the entire setup. Start by hogging out all three dovetail slots with a ⅜-in. straight bit. Use your router's guide bushing to guide the cut. Next, clean out the slots with a dovetail bit. After the dovetail slots have been cut, return the stem to the lathe to complete the turning.

—Bernie Maas, Cambridge Springs, Pa.

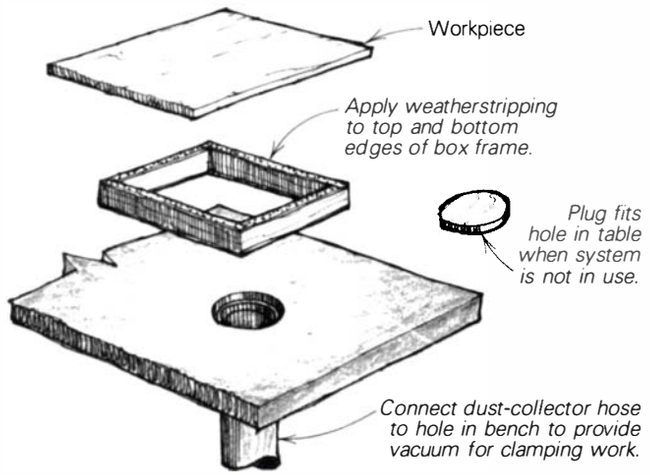
Contour sander



This shopmade sander for lathe work and curves uses a length of abrasive cloth tensioned, bowsaw fashion, by a twisted cord. The abrasive cloth, which can be purchased in ¾-in. or 1½-in. width rolls, is clamped into the sander with tight-fitting dowel pegs. *—Richard Tolzman, Excelsior, Minn.*

Vacuum clamping system

If you have a central dust-collection system in your shop, a simple addition to it will provide a useful clamping system. Cut a 5-in. hole through the top of your bench, rabbet the

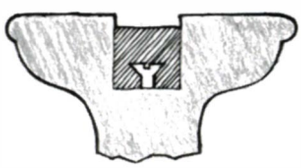


edge of the hole with a router, and cut a hardwood plug to fit flush—it will leave the bench smooth when you're not using the clamp. Connect your dust-collection system to the bottom of the hole with whatever piping is necessary.

To use the clamp, make a box frame, and cover the top and bottom edges with self-adhesive foam weatherstripping. Place the box on the bench over the hole, place the workpiece on top of the box, and turn the vacuum on. The workpiece will be held firmly for edge-routing, sanding and other operations, with nothing to obstruct work on all four edges. Because of the padding offered by the weatherstripping, this is an ideal way to hold flat panels for sanding between coats of finish. The hole in the bench has a side benefit: it makes cleaning shavings off the bench easier and faster.

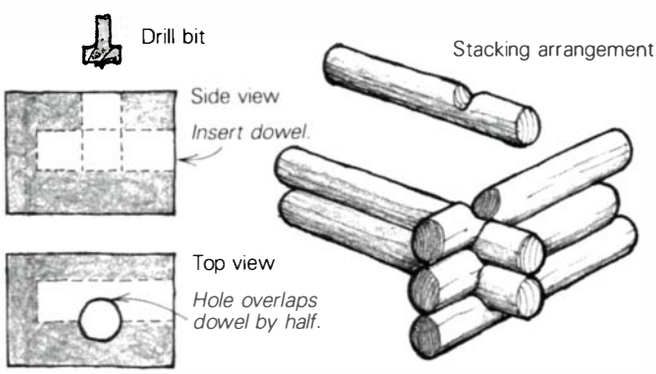
—Mac Campbell, Harvey Station, N.B.

Stabilizing tall candlesticks



To stabilize tall wooden candlesticks, I pour molten lead into a ¾-in. by 1-in. hole bored in the bottom. If you start a screw in the hole and pour the metal around it, the lead will stay in position. To avoid burning the wood, I cut the lead into small ingots that I can heat with a propane torch and I drip the lead into the hole one drop at a time. Old wheel-balancing weights from a gas station are good raw material. *—Eric Schramm, Los Gatos, Calif.*

Miniature log-house joint



This simple little jig makes joints on dowels or short tree branches for a miniature log house. Choose a drill bit the same size as the dowels or sticks to be used in the house, then drill a block of wood from two sides, with the second hole overlapping half of the first. To use, insert a dowel in the first hole and use the other as a guide for the drill bit. Note that the distance between the overlap and the end of the first hole will determine the overhang of the miniature logs, which assemble as shown in the sketch.

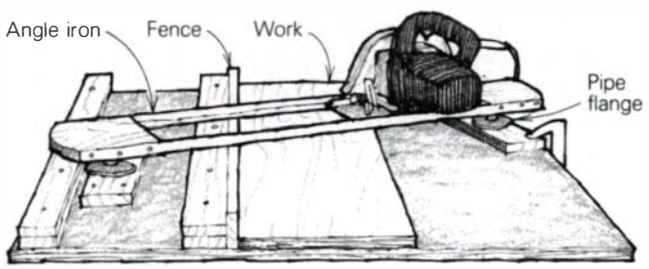
—Gerald Robertson, Angus, Ont.

"Poor boy" radial-arm saw

For crosscutting long boards and making miter cuts, this shopmade saw guide is accurate, portable, easy to use and economical to build.

The guide is simply an angle-iron and plywood track sized to fit the base of a portable circular saw. The guide is perched atop legs at each end. Each leg is made from a pair of 3½-in. pipe flanges connected by a ¾-in. by 1½-in. pipe nipple. The legs provide clearance for the work and allow the track to pivot for making angle cuts.

To use, clamp the guide at the proper angle in relation to the fence on the plywood base. Before cutting, secure the saw's blade guard up out of the way with a screw threaded through a hole in the blade housing. Make sure you remove the screw before the saw is used in the conventional manner.

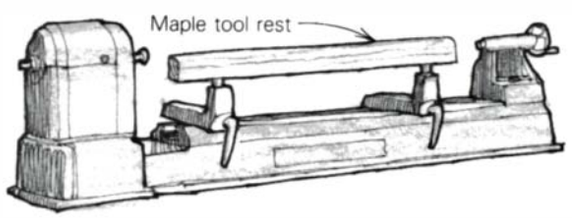


Another note of caution: The direction of blade rotation tends to lift the work from the table, so make sure the work is tight against the fence and can't shift. Otherwise, the work might pinch the sawblade and cause the saw to lift out of the guide rails.

On my 7¼-in. saw, the depth of cut is limited to 1¾ in., but this covers most of the crosscutting work I do.

—Jack Fisher, Dayton, Ohio

Shopmade tool rests



Roughing down a whole turning at once is such a pleasure that I've made a series of hard-maple tool rests in various lengths. I use them instead of the skimpy metal rest that came with my lathe. Support the wooden rest with a metal post that fits your current tool rest's base. For long tool rests, you'll need more than one base.

—Jim Ryerson, Guelph, Ont.

Keeping padauk's color

Many woods that have brilliant color when freshly cut, padauk for example, will darken and turn brown in time. Bruce Hoadley points out that the major culprit in this color change is ultraviolet light. To shield the wood from ultraviolet light and thus effectively slow the darkening process, I use a product called Armor-All, a spray-on protective liquid for auto

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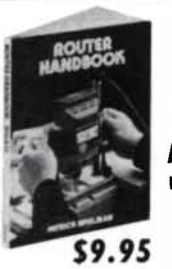

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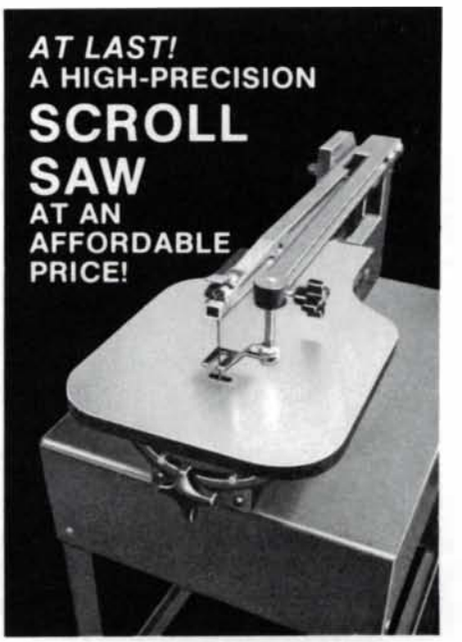

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vinyl. This product, available at auto supply stores, is quite effective—I have yet to see the color of padauk change, even after four years. To use, spray three or four coats of Armor-All on the wood before you apply the finish. I use an oil finish, which is compatible with Armor-All, but other finishes such as lacquer or varnish may not be. You'd best test the particular finish you plan to use.

—David Lewis, Phoenix, Ariz.

Masking-tape drill stop

The best depth stop for a portable electric drill is a masking-tape flag around the bit stem, as shown in the drawing. Masking tape works on all kinds of bits, is easy to set to the right depth, and never mars the workpiece. The advantage of the flag is that you don't have to strain your eyes to tell when the tape reaches the surface—you simply stop drilling when the flag sweeps the chips away.

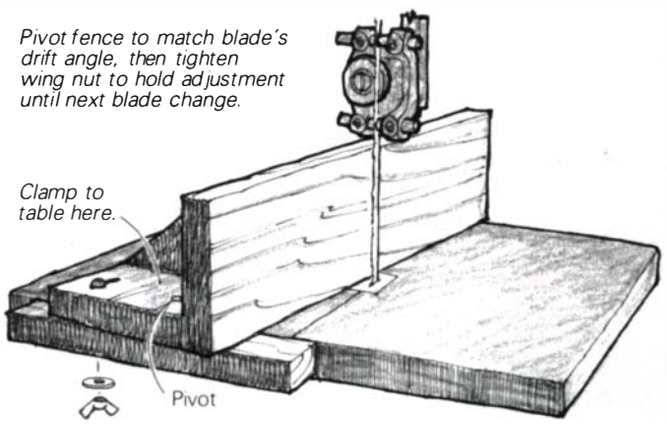
—Richard R. Krueger, Seattle, Wash., and Norman Crowfoot, Pinetop, Ariz.

Stopping sandpaper gumming

If your sandpaper loads up with residue when you're sanding wood that has been stripped, for example, throw some pumice-stone powder on the work. The paper will keep working and won't load up, and the abrasive will stay sharp longer. Add more pumice as needed.

—Jon Gullett, Washington, Ill.

Bandsaw rip fence adjusts for drift



Those who use the bandsaw for ripping and resawing know that each blade has its own line of cut, which is rarely parallel to the fence. This shopmade rip fence reduces the time-consuming chore of redetermining the drift angle every time you move the fence. The base clamps to the front of the table, and the fence itself pivots and locks as shown in the sketch, allowing you to set the drift angle into the fence.

To set the guide, first determine the drift angle by freehand ripping a piece of waste stock. Feed the board, angling it until the blade tracks straight down its center. Transfer the drift angle from the board to the adjustable rip fence with a T-bevel. Tighten the guide at the angle, and the drift is set into the fence until the next blade change.

—Richard Farwell, San Luis Obispo, Calif.

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. We'll acknowledge contributions when the final decision has been made, and return those with an SASE.*

Broken rocker legs—*All four legs on my antique rocker have broken, been glued, and have broken again. The grain runs across the legs at about a 45° angle, and the breaks occur where the legs are drilled for the rungs. I softened the old glue with white vinegar and removed it by wire-brushing and scraping down to the wood. Is further cleaning necessary? I plan to inlay splines across the breaks and shape them to match the leg. Is aliphatic glue okay for this repair?*

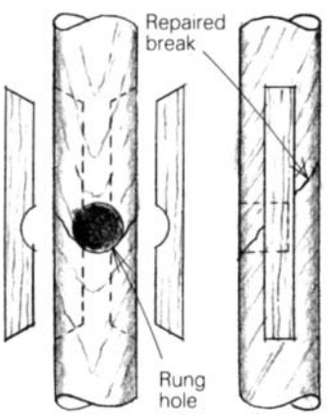
—John Ramsay, Pollock Pines, Calif.

DALE BOYCE REPLIES: Ideally, a repair on an antique should restore structural integrity but disturb as little of the original material as possible. People often use wood screws to reinforce this type of break, but adding unnecessary foreign material is not very sympathetic to wood movement or to the piece's value.

It sounds like you've cleaned the joints sufficiently. I, too, would use aliphatic glue. Be sure that it's fresh. An extremely strong glue joint here is not as important as good alignment of the repair, because the problem is in the construction: the grain runout in the legs. If you use epoxy to glue the legs, chances are the wood will break somewhere else.

The glue-up can be difficult. To align the parts, use firm gluing blocks (I like ½-in. Baltic birch) on all four sides of the leg, and clamp lightly in each direction. Be sure to use plastic, waxed paper or silicone release paper under each block. I prefer silicone release paper (available from Conservation Materials Ltd., Box 2884, 340 Freeport Blvd., Sparks, N.Y. 89431) because it seems to allow moisture vapor through, so the glue dries more quickly. Apply light pressure to align the joint, then, using another clamp from end to end of the leg, bring the joint tight. Let the leg dry for at least 24 hours before you start to work with it again.

On each side of the leg, inlay a spline made from wood that matches. The spline should be approximately one-third the diameter of the leg in both width and thickness, and 2 in. to 3 in. long, depending on the length of the split. The grain should run parallel to the length of the leg. Either pre-cut the splines for the rung hole or re-drill the hole after the splines are in place. Lay out the mortises and carefully chisel out by hand. Unless you have a *flawless* jigging system, stay away from the router. Don't glue the splines in while the rung is in place, or you may lock the rung in the leg. This could cause problems with wood movement and make future repairs difficult.



Leave the splines slightly proud and shave them down, trying not to disturb any of the surrounding surface. Then stain and finish the splines to match the adjacent area.

This method is, of course, a compromise between saving all of the original material, and being able to use the chair. I feel it's worth it to be able to use the chair.

[Dale Boyce is a furniture conservator and boatbuilder in Bristol, R.I.]

Dye or stain?—*I stripped a heavily carved, late-Victorian, white oak bookcase with a methylene-chloride-based stripper. Then I washed it with water and bleached it with a warm solution of oxalic acid (4 oz. to 1 qt. of water). The wood appears to have been colored with a red stain that resists bleach. I repeated the bleaching process twice more, with no success. I also tried both Clorox and a mixture of potassium permangenate and sodium thiosulfate. How can I remove this stain?* *—Gerard Ferretti, Brooklyn, N.Y.*

GEORGE FRANK REPLIES: Your bookcase was dyed, not stained. As the French say, "Au grand maux, grand remedies" ("Grave illnesses need strong medicine").

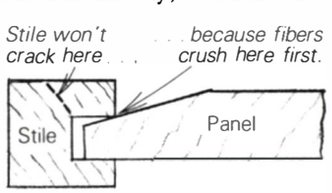
Here's how to solve your problem. To a quart of water, add enough lye to make a strong solution. Stir in 2 oz. of wallpaper paste to thicken the solution (don't use an aluminum container, because lye ruins aluminum). Heat this mixture until it's warm, put on rubber gloves, and spread the creamy solution on the wood with a rag. Keep the wood wet for 10 to 15 minutes. Next, wash off this lye solution with lots of water and a scrubbing brush, preferably one with stainless-steel bristles. Let the wood dry, then bleach it with Clorox. Neutralize the Clorox with vinegar, and when dry your bookcase can be dyed any color, and finished any way you wish.

[George Frank, a retired European master wood finisher, lives in South Venice, Fla.]

Fit between frame and panel—*I made a sugar pine cabinet with raised-panel doors, my first attempt at making this type of door. I didn't want a gap to show between the panel and the frame, so I made the panels fit tightly in their grooves. Is there a potential problem that the stiles will crack if the panel expands? Is it really that important to allow for expansion?*

—George Fitzgerald, Detroit, Mich.

SIMON WATTS REPLIES: If you made your frame and panel as in the drawing, the stiles won't crack. Fortunately, wood is relatively compressible, and the fibers will just crush slightly as the panel swells.



You need make no allowance for expansion along the length of the grain because wood moves scarcely at all in that direction. But across the grain is another story, and you ignore it at your peril. For each foot of panel width in a red oak panel, you should allow about ⅜ in. for expansion (3/16 in. on each side); for a mahogany panel, only about ¼ in. White oak moves even more than red oak, but sugar pine is almost as stable as mahogany.

I usually pin my panels to the rails at the center, top and bottom, so that any movement has to take place equally on both sides of the centerline. This also stops the panel from sliding around in the wintertime.

[Simon Watts is a boatbuilder and furnituremaker in Berkeley, Calif.]

Telegraphing gluelines—*About a year ago, I made a red-oak coffee table with 4-in. square legs glued up from thinner stock. I used Titebond glue. The table is finished with an oil stain followed by three coats of tung oil. Since then, it's occasionally been dusted with lemon oil.*

Traces of the glue have begun to ooze from between the laminations. This glue ooze is not very conspicuous, just visible. Since I discovered this, I've found it has also occurred in some of the joints on a piece of furniture that I brought from Germany to New Mexico. Can you offer an explanation and a solution to prevent this from occurring in future projects?

—George A. Hays, Holloman AFB, N.Mex.

R. BRUCE HOADLEY REPLIES: "Telegraphing" of gluelines is the result of moisture-related dimensional change in the wood, and subsequent stress on the glueline. It's caused either by a

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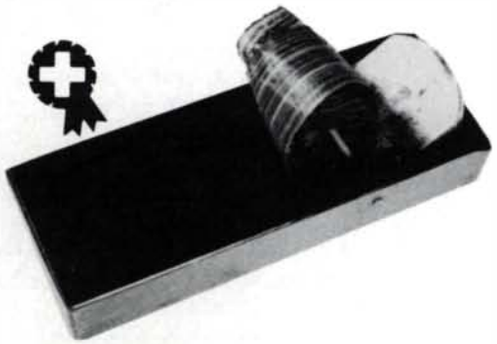

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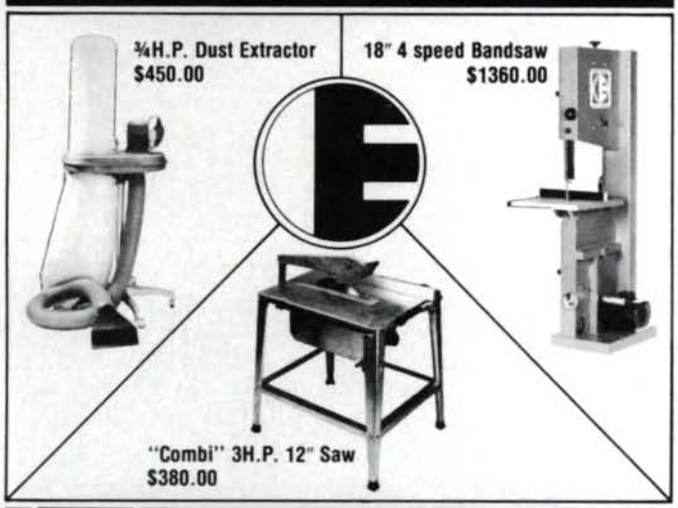

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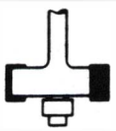	#11	3/8" RABBETING	Deep 3/8"	1¼"	1/2"	14.00
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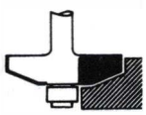	#15	RAISED PANEL	20° Angle	1-5/8"	1/2"	25.00
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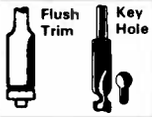 Flush Trim / Key Hole	#13	1/2" FLUSH TRIM		1/2"	1"	8.50
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slight shifting of the laminations, or, as in your case, by beading of the adhesive layer along the glueline. The flexibility of PVA and aliphatic glues enables them to retain a bond in conditions of dimensional conflicts, such as in mortise-and-tenon joints, but the same flexibility also results in flow or creep, and causes telegraphing. For side-grain to side-grain gluelines, such as in laminations, the more rigid urea resin glues are a better choice.

[R. Bruce Hoadley teaches wood technology at the University of Massachusetts at Amherst.]

Hide-glue preservative—*I'd sure like to know what my pipe-organ-building boss put in his hot gluepot to keep the stuff from rotting. He's dead now, so I can't ask him why his glue would last for months in the pot, whether or not the pot was kept going, but my glue turns into rotten soup in three days.* —*D.R. Lane, Jr., Vallejo, Calif.*

GEORGE MUSTOE REPLIES: Probably the best way to keep hide glue from spoiling is to add a tiny pinch of thymol crystals. Thymol, a disinfectant, is available from chemical suppliers and some pharmacies. I've heard of people using phenol (carbolic acid) crystals instead, but phenol is potentially more hazardous to handle. The final dilute solution is safe, but concentrated phenol is poisonous, and corrosive to the skin.

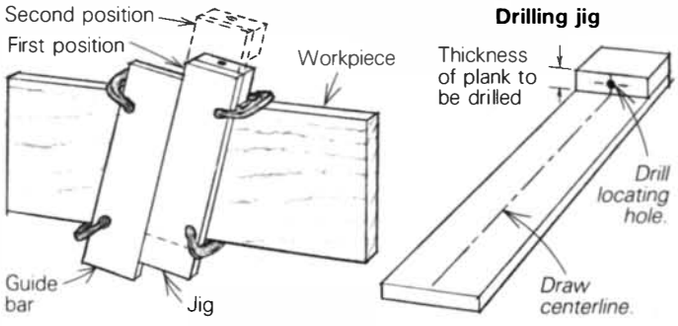
If you can't get thymol, try adding a few drops of some water-soluble household disinfectant such as Lysol.

[George Mustoe is a geochemistry research technician at Western Washington University in Bellingham, Wash. He wrote about adhesives in *FWW* #43 and #44.]

Drilling long holes—*I sometimes need to drill long, accurate, ⅜-in. holes from edge to edge across the width of a board. With a brad-point drill, I drill halfway in from each side, but the holes never meet in the center of the board. Is there a way to drill these holes accurately without a drill press?* —*Lazlo Spectrum, Tucson, Ariz.*

MIKE PODMANICZKY REPLIES: Drilling a long, accurate hole is one of the few procedures in woodworking that really require assistance from jigs and guides.

To bore an accurate hole through the width of a plank, I make a jig. If the drill-locating hole in the jig is accurately bored (a drill press helps), I can't miss. For this job, I prefer "aircraft bits," which are long twist drills with a shank that has the same diameter as the bit.



On the plank, mark the line you want the hole to follow and clamp the guide bar parallel to it. Then clamp the jig against the guide bar as shown, with the drill-bit holder against the edge of the plank, and bore a shallow hole in the edge of the plank. Unclamp the jig, slide it along the guide bar so that the drill-locating end moves away from the edge of the board, and reclamp, keeping the jig against the guide bar. Now the drill bit will be supported farther back along its shank. Bore halfway through the plank, then flip the jig end-for-end without changing the position of the guide bar, and

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repeat the procedure on the other edge of the board.
[Mike Podmaniczky is a boatbuilder and period furniture-maker in Thomaston, Maine.]

Clearing a multi-spur bit—*When using multi-spur bits an inch or more in diameter, I have to stop my drill press after each hole to pick out the disc of wood that stays inside the bit. This is particularly annoying when drilling plywood. I've tried backing up the stock with various materials, and varying the drill speed and depth. So far, success has been spotty and unpredictable. Is there a cure for this, or is this something which just has to be lived with?*
—Robert M. Vaughan, Roanoke, Va.

TAGE FRID REPLIES: To remove the disc without stopping, I usually use a blast of air from my compressor. Another trick: Drill one side first until the spur comes through, then flip the board over and finish the hole.
[Tage Frid is a cabinetmaker, and professor emeritus at the Rhode Island School of Design.]

Fire-hardened tool handles—*Will you please give me a few pointers on how to fire-harden the hickory tool handles I make?* *—William Hood, Ebberton, Ga.*

DREW LANGSNER REPLIES: Some years ago, the USDA Forest Products Laboratory ran tests on fire-hardened tool handles. The results demonstrated that this practice doesn't improve strength or durability. The FPL concluded that fire-hardening is purely cosmetic—a gimmick to sell tool handles.

I don't fire-harden handles anymore, but until I learned better, I fire-hardened tool handles with a propane torch by simply scorching the wood surface for the desired effect.
[Drew Langsner is the director of the Country Workshops in Marshall, N.C.]

Follow up:

Peter Koch's reply to Steve Ketch on planing crosscut slabs (*FWW* #44, p. 16) doesn't mention the potential danger involved. I once tried to surface-plane the end-grain face of some cutting boards glued up from oak blocks. The cuts were so thin that I could hardly hear the knives cut. After a couple of passes, I felt less nervous about what I sensed was a dangerous practice. Then one of the cutting boards came apart. Fortunately, I was standing to one side of the planer, as I usually do. The piece that hit me only lacerated my thumb, but a few other pieces went through the garage door. I couldn't find any failed gluelines, but I did find an abrasive planer to finish the job. *—M. Felix Marti, Monroe, Ore.*

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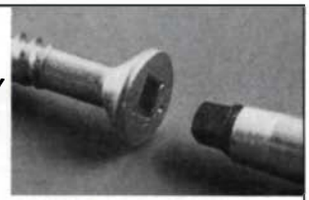

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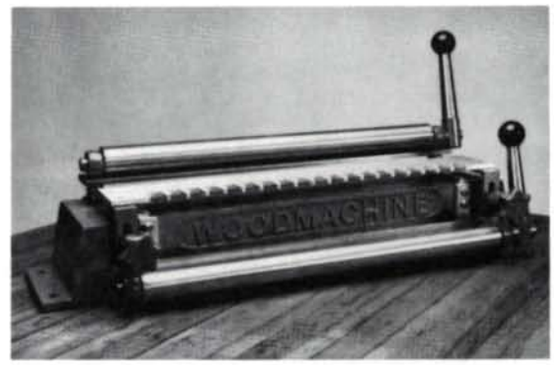

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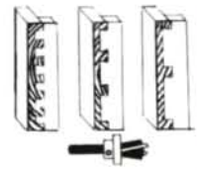

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Books

Three Centuries of American Furniture by Oscar P. Fitzgerald. *Prentice-Hall, Inc., Englewood Cliffs, N.J. 07632, 1982. $34.95, hardcover; $16.95, paperback; 323 pp.*

American Furniture, 1620 to the Present by Jonathan L. Fairbanks and Elizabeth Bidwell Bates. *Distributed by Arts Americana, PO Box 464, Dedham, Mass. 02026, 1981. $19.50, hardcover; 561 pp.*

While possession of these two recent volumes would not render unnecessary the owning of Wallace Nutting's *Furniture Treasury* (1928), for the student of American furniture they present a considerable amount of new material organized on quite different lines, and a great deal of informed commentary almost entirely absent from the earlier work. Nutting's book is a typology of American furniture built before 1850, with commentary kept as brief and elliptical as possible (save that on construction); the present works are socioeconomic histories, arranged chronologically and by region, which take us to about 1910 in one case, and in the other to the present day.

Fitzgerald is a lecturer for the Smithsonian Institution and the Associate Director of the U.S. Navy Memorial Museum in Washington, D.C. Sure of his taste and not hesitant to judge a piece successful or otherwise, he maintains a scholarly decorum for the most part. But Fairbanks, curator of American decorative arts at the Boston Museum of Fine Arts, and Bates, a cultural historian, regularly adopt the stance of art critics, explicating and appreciating the internal life of each piece. This difference affects the diction of the two books—such phrases as "enormous visual excitement" are common in *American Furniture,* rare in *Three Centuries*—and their graphic design as well.

Three Centuries uses a dense three-column layout, and the legends, text and small photographs often comprise a thicket. One does eventually get used to it all, and the thickets are well worth penetrating. *American Furniture* uses a comfortable two-column layout for plain text, and around the illustrations as much white space as anyone could wish; many pages show but a single piece. Both books contain hundreds of excellent photographs (fourteen hundred in *American Furniture*) and a number of line drawings (of consistently fair quality in *Three Centuries,* but of uneven quality in *American Furniture*). Fairbanks and Bates regularly feature opulent color work, but Fitzgerald restricts it to a four-page insert showing selected period interiors.

Fitzgerald's survey ranges from the Jacobean period through the Arts and Crafts movement, with regional excursions into the countryside, the South and the West, and a special chapter on the Pennsylvania Germans and the Shakers. Each chapter begins with a detailed sketch of the salient events and ideas of the time, then advances to a series of discrete subjects which vary from chapter to chapter but normally include architecture, the new style, and influences. The furniture is then discussed by type or room location. Although this system requires a patient reader, it is nonetheless well suited to displaying the author's considerable erudition. The final chapter, on connoisseurship, is useful on most points, yet inadequate on others (drawer construction, for example). But the body of the work is so strewn with pearls of observation concerning design, ornament and construction that inadequacies here do not weigh decisively.

Fairbanks and Bates cover comparable historical and regional ground, opening each chapter with a polished essay on relevant social, economic and intellectual matters, followed directly by examination of the furniture, usually by type. From time to time, pictorial evidence is introduced and thoughtfully analyzed. Two chapters, "Away from the Mainstream" and "The Frontier and Vernacular Traditions," survey by major subject what was being built away from the eastern seaboard, but also present examples of such unexpected work as American Indian and Norwegian-American, together with a fair sampling of pieces from Texas and Utah.

It is on the Victorian period (after 1830), however, that Fairbanks and Bates concentrate a major effort. Their discussion is a sympathetic effort to convey the high seriousness of Victorian aesthetics, advancing beyond Nutting, who had declared at the outset of his 1928 *Treasury:* "The limit of styles has been fixed at the end of the Empire period, which indeed brings us to the beginning of the degraded styles." Since 1970, when the New York Metropolitan Museum showed the exhibit "Nineteenth-Century America," Nutting's view has been officially discredited, and the two volumes reviewed here signify above all that the Victorian era has been rehabilitated, not soon again to be ignored or condemned.

Those who approve of the resurrection will doubtless enjoy the extensive illustrations and the detailed expositions of the various stylistic periods between 1830 and 1890. Those who disapprove, or who have not yet caught on to the new dogma, will find much to think about, and may be converted. There is a full-page portrait in Fitzgerald of a superb writing desk built about 1875 by Herter Brothers in New York, and Fairbanks and Bates show a large and equally graceful wardrobe by the same firm. These two pieces (and there are others to be seen), by their utter clarity of form and careful organization of surface, demonstrate that the ability to design serene and lucid furniture did not lie dormant for fifty or sixty years.

The remarkable diversity of Victorian work may also strike the reader as a fitting prelude to the diversity of our own century. In the final chapter of *American Furniture,* "Moderne to Contemporary," there are photos on facing pages of work by Wendell Castle, William Keyser and Judy McKie. That such different kinds of work should appear simultaneously proves no peculiarity of our time; rather, it is the continuation of a habit at least a hundred years old. There is an instructive voyage here for the reader curious to know what of modern work is thought essential. Fairbanks and Bates sail rapidly and confidently from Frank Lloyd Wright through de Stijl, the Bauhaus and Art Deco (with appropriate comment on changing industrial design as well as furniture styles), to Cranbrook and Rochester (nothing about Denmark, but Tage Frid is here), identifying finally a "generation of artist-craftsmen" (Nakashima, Maloof, Carpenter) whom they see following from Wharton Esherick, and whose work they propose is "a sought-after remedy to the inner losses experienced through mechanization and depersonalization." It may be so.

Dr. Johnson once said that the dancing dog must be praised not for doing it well, but for doing it at all. The achievement of these books—the gathering, organization and successful display of an immensity of data—must thus be admired, though not on these grounds alone. Fitzgerald we must praise for his sense of order, and to Fairbanks and Bates we can be grateful for their inclusion of the modern era. May we then fairly ask for some general expression, missing in these volumes, of what is American about American furniture, and for some thoughtful speculation, beyond the socioeconomic, on the springs of design? —*Kenneth Rower*

Kenneth Rower is a joiner in Newbury, Vt.

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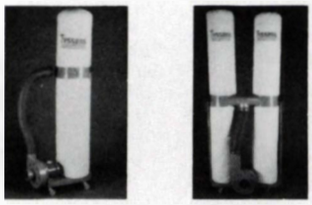

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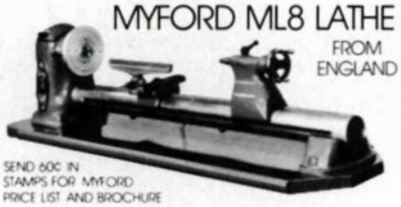

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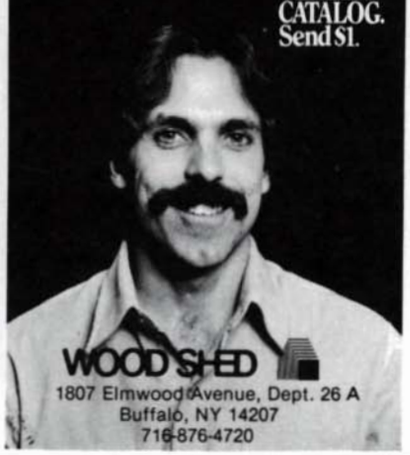

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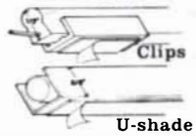

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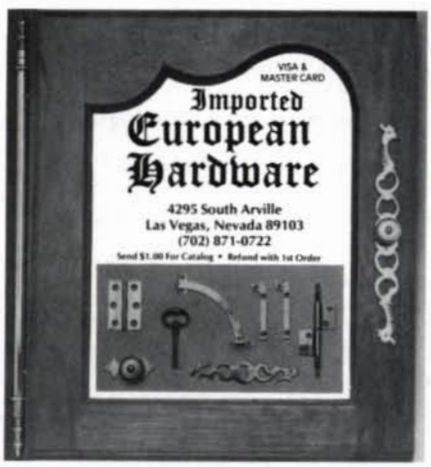

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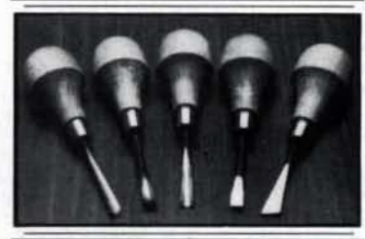

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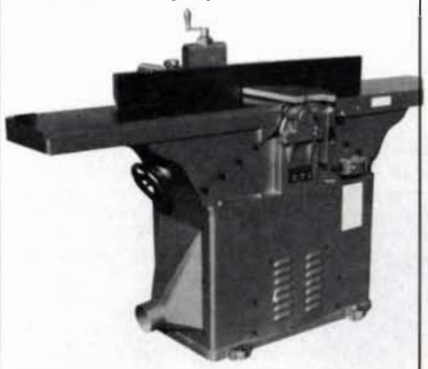

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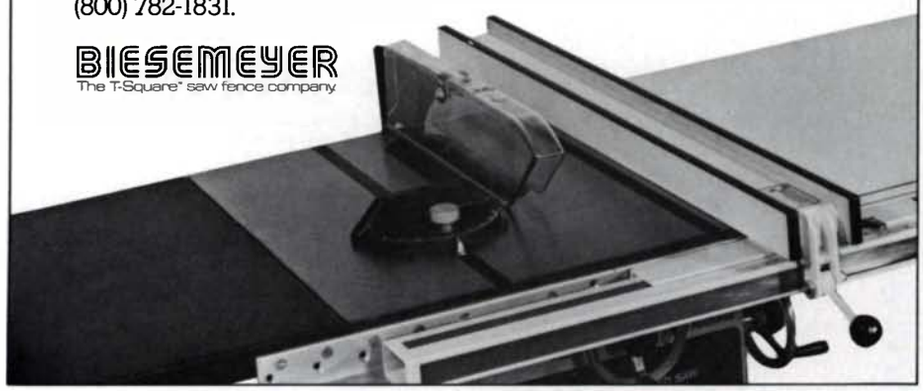

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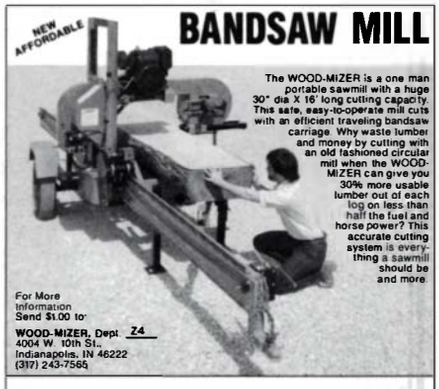

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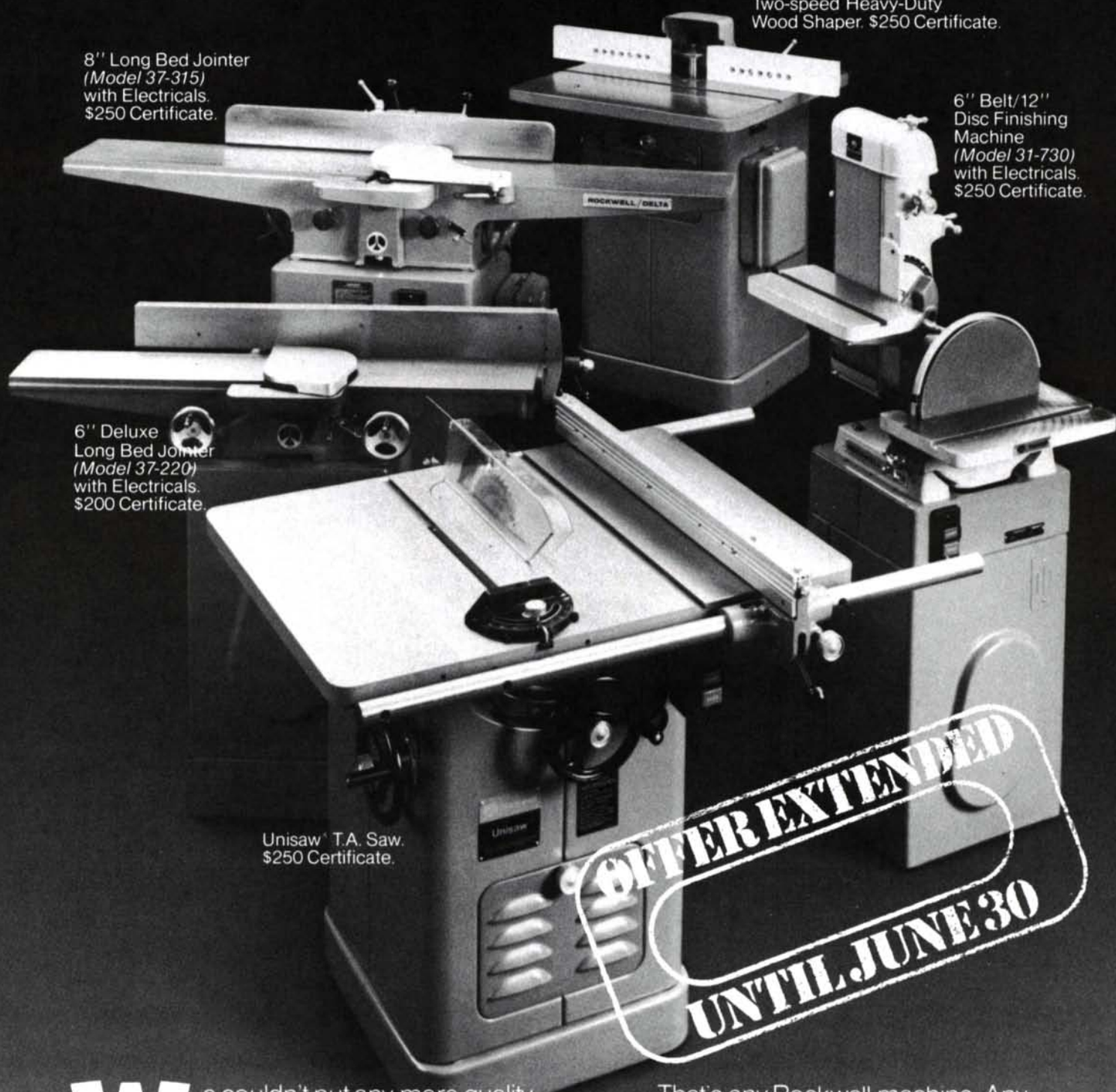

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Fine WoodWorking

Veneering

Preparing substrates is the first step

by Ian J. Kirby

Polished veneers: apple (top), padauk, maple burl, curly koa.

Veneering can lead to furniture designs that just aren't possible with solid wood. Lots of furniture has the shape it does because of wood's hygroscopic nature—you have to allow wood to expand and contract. Once you master veneering, however, you don't have that restriction. You can turn particleboard and fiberboard into dimensionally stable panels that are as attractive as any piece of solid wood, opening up a whole new world of design possibilities.

A veneer is simply a thin layer of wood, which can be glued on top of another material. At its best, veneering produces superb results. Done badly, it's a mess. You must plan every step before you begin. Unlike other woodworking, you don't start with a large plank and carve it down; you begin with a small piece and build it up to the size you want.

Veneering allows you to use woods that would be too expensive (rosewood or ebony) or just too unstable (burls or crotches) to be worked in solid form. Veneers have been available for centuries, of course, but what has now brought veneer into the small-shop woodworker's province is the advent of man-made substrates, the material onto which the veneer is glued. Particleboard and medium-density fiberboard have changed the whole nature of veneering.

In this article, the first in a series on veneering, I'll discuss veneers (p. 39), substrates and how to prepare them for veneering. Future articles will deal with the application of veneers, and with design considerations when using veneered boards.

• • •

Until the turn of this century, woodworkers had to make their own solid-wood substrates for veneering, and that was a real problem. If you veneer solid wood, laying the grain of the veneer at right angles to the grain of the solid wood, the veneer will come under tremendous stress as the substrate shrinks and expands, and can crack or delaminate. Even if you orient the grain of both materials in the same direction, you'll just have ordinary wood with a different wood glued onto it—with all of solid wood's moisture-related problems.

The traditional solution was to make large panels out of many small panels within frames, the assumption being that each little panel would shrink and expand less than one large panel would. It seems to have solved the problem in many cases, yet it shouldn't. Lots of little bits of wood will expand and contract collectively as much as one big piece of wood.

Today you can sidestep all of these problems by using particleboard or fiberboard as the substrate. These materials are so stable that seasonal movement is negligible. Probably the best substrate is medium-density fiberboard (MDF). It is made by breaking down wood into its fibrous form, then pressing the fibers back together again with an adhesive. All MDF is basically the same: it has no grain, is square-edged and uniform throughout, and weighs about 48 lb. per cubic foot. It's a material that is very stable, but so boring that it cries out for the application of something with a little more life. Veneering both sides of a ⅝-in. thick MDF board produces a board thick enough for most furniture designs. You may have trouble finding MDF, since it is made primarily for industrial use. Some large lumber companies do carry it, although they may require a substantial minimum order. Professional woodworkers in your area may be able to recommend a local source of supply. Allied Plywood Corp. (which has seven warehouses along the East Coast) and Paxton Lumber Co. (which is headquartered in Kansas City, Mo., but has warehouses in several states) handle both MDF and furniture-quality particleboard. These materials are also available through some Georgia-Pacific Corp. service centers.

Plywood isn't a good substrate for veneering. Since it's made by gluing together layers of wood at right angles to each other, it has decent dimensional stability, but it can warp and twist. Particleboard, which is made by gluing wood particles together, is dimensionally stable, but some people get into an awful mess because they veneer onto building boards, not furniture-quality boards, which are multilayered boards with very smooth surfaces. Surface irregularities of the coarser building boards are liable to telegraph through the veneer. You can recognize furniture-quality boards (sometimes called industrial-grade) because they are oversize—a 4x8 sheet really measures 4 ft. 1 in. by 8 ft. 1 in. Building board is always 4x8, because builders commonly work to a 16-in. module.

The edges of man-made boards are just as boring as their surfaces. If the edges are going to show, you have to cover them in some way, as shown in figure 1. The usual technique is to glue a lipping of solid wood or veneer onto the edge of the substrate, clean it off, and glue veneer on both surfaces of the entire panel, including the lipping. Veneering the edges has one disadvantage: the edges will remain square after they're veneered. The only thing you can do to improve the ap-

pearance and to help prevent chipping is to soften the veneered edges with sandpaper. You could make a softer edge by applying two or three layers of veneer so that you'd have more material to radius. One of the nice things you can do with veneer lipping, however, is to accent the edge treatment. If you wanted a five-veneer lipping, you could glue on three layers of the surface veneer and two layers of a different color veneer. This colored border picks out the edge and gives the job a lot of life.

For more shape on the edges, or what in woodworking terms is called molding, use solid-wood lipping. Other edge treatments include gluing on strips of leather, Naugahyde or even metal, such as fine copper foil.

In any case, decide what the lipping's width will be before you cut your substrate to size. The procedure is to first determine the size of the finished veneered panel, including the lipping. Then determine the width of the edge treatment, and subtract twice that from the length and width of the finished panel to get the dimensions of the substrate.

I prefer to glue the solid-wood lipping around the edge of the substrate before it's veneered. This gives enough material to mold the edges, and the surface veneer blends into the lipping, making the whole piece seem more cohesive. It's common to make the lipping of the same material as the surface veneer, but don't sacrifice a rare, exotic hardwood like ebony for lippings. Use a multilayer veneer lipping instead.

Lippings can be either mitered or butt-jointed at the corners, depending on the quality of the piece and the effect you want. With thin lippings, you can just about eliminate the visual effect of the butt joint by radiusing the corner. If you wish to miter the lipping, it's best to miter the lippings for the long edges before gluing them to the panel. If you do it this way, the lipping must be glued on very accurately, with no slippage along its length. On the short edges, when you're filling in, you have to cut the miter correctly at each end, and the length must be dead-accurate. Alternatively, you can glue the lipping on first and then cut the miters, but then you've got only one shot at getting them right.

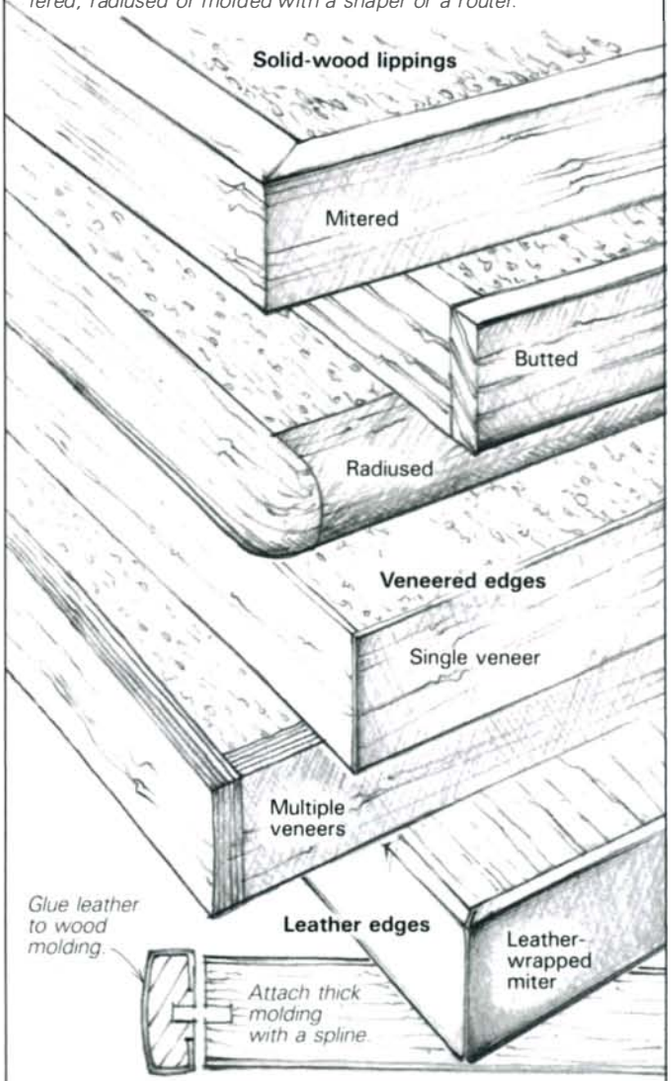
The most common fault in making lippings is to have them too wide. The lipping should be the width needed to accommodate the molding on the edge, plus a safety margin of no more than $\frac{1}{8}$ in. So, if you want a $\frac{3}{4}$-in. thick edge rounded to a semicircle, all you need for lipping is $\frac{3}{8}$ in. plus a little, since $\frac{3}{8}$ in. is the radius of a $\frac{3}{4}$-in. circle.

The main reason for keeping lippings as narrow as possible is the shrinkage differential between the stable man-made substrate and the solid-wood lipping. After a few months, a wide lipping may shrink and show through the veneer, a condition known as telegraphing. Cost is also a consideration—you'd be surprised how much material goes into the lipping.

The simplest way to apply lipping is to keep the wood for the lipping wider than necessary until after it's glued onto the substrate. It will serve as its own clamping block, so you don't need a lot of clamps and battens, as you would if you

Fig. 1: Edge treatments

Choose lippings to suit your design. To minimize chipped edges, ease the arris of a veneer-lipped panel with sandpaper or a hand plane after adding surface veneers. Thicker lippings can be chamfered, radiused or molded with a shaper or a router.

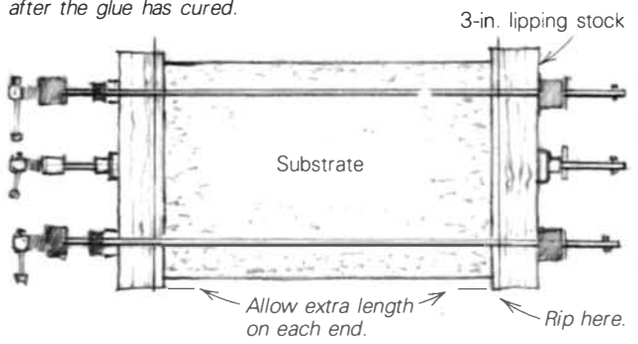


Glue leather-covered moldings to veneered substrates.

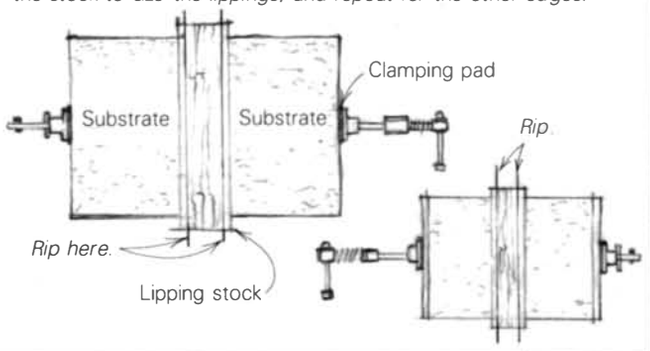
With the mitered lipping glued to the panel sides, use a marking knife to scribe the miters on the end lipping.

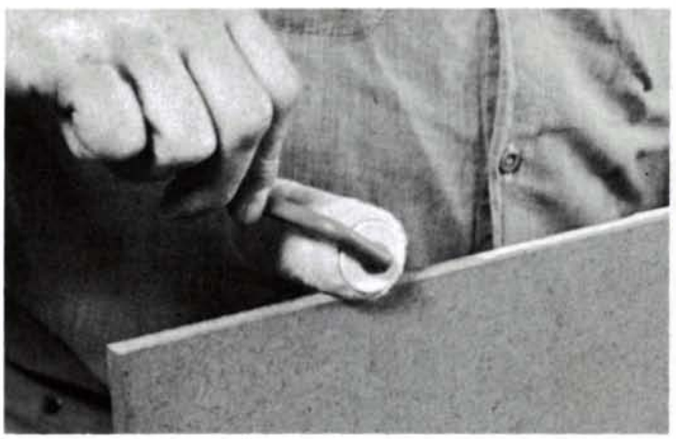
Fig. 2: Two ways to apply solid-wood lippings

A. *Wide lipping stock serves as its own clamping block. Rip to size after the glue has cured.*

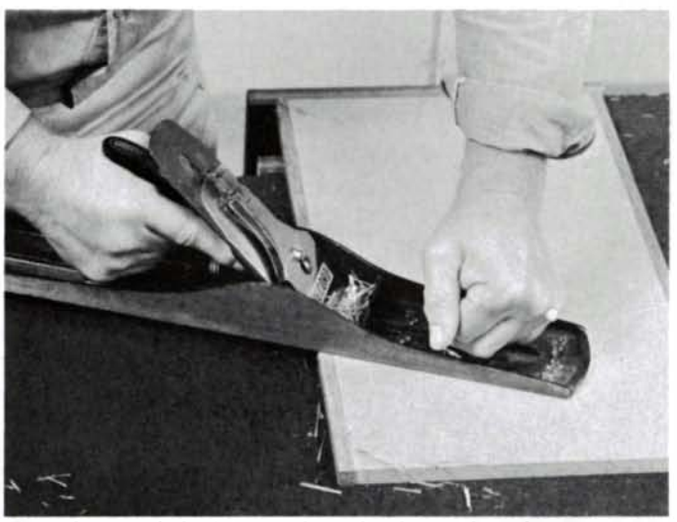


B. *Put stock wide enough to make two lippings between two panels, glue, and clamp them together. When the glue has dried, rip the stock to size the lippings, and repeat for the other edges.*





Spread an even coat of white glue on the substrate edge with a small paint roller before applying the lipping.



Rest the toe of the jointer plane firmly on the substrate to prevent tapering the lipping.

tried to glue on thin lipping (figure 2). After the lipping is glued onto the panel, you can quickly cut it to width. The lipping stock should be just slightly thicker than the substrate, at most $\frac{1}{16}$ in. more on each side. You could make it the same thickness as the panel if you could position it exactly when you glue it on, but this is difficult. Leave a small amount on each face and plane it flush after glue-up. The lipping need be only $\frac{1}{16}$ in. or so overlong at each end. Don't try to buy insurance by leaving excessive amounts of wood everywhere. It's tough to remove before you glue on the veneer.

The key to spreading a thin, even coat of glue on the substrate edges and the lipping is to use a narrow paint roller (the bubble pack it comes in makes a good reusable glue tray). You don't need any exotic joinery to secure the lipping: once the lipping is glued on, it's never going to come off in conventional use. In fact, I once put lipping on without glue—I just pinned it, leaving the pins proud so that I could remove them. I veneered the top and bottom, then took the pins out. Try as I might, I couldn't break the lipping off.

White PVA glue is fine for both veneer and lipping. Don't put excessive amounts of glue on either surface. Remember, you're going to have to deal with the accrued amount from both of them coming together. All you've got to do is wet the surface with glue. If the surface has dry patches, it won't adhere. If you put on too much glue, you'll get dribbles and they'll be a problem when you trim the lipping, whether with a router or a plane. All you want visible are little beads of glue. If you trim this lipping with a router trimming bit, the bit's pilot needs to travel on an absolutely clean surface, otherwise it will hit glue bumps and won't flush the lipping. If the pilot has a clear path, you can set the bit to no tolerance and clean the lipping perfectly.

The alternative is to plane off the excess lipping by hand, using a jointer plane. Clamp the panel to the bench. Put the toe of the plane on the surface and plane in a circular motion across the grain, with the substrate acting as a register for the toe. Careful, though—once the plane gets down to the substrate, stop. Don't remove lipping by planing straight along the grain. It's too easy to tip the plane and taper the lipping. Planing across, rather than with, the grain gives you a slightly less smooth surface, but that doesn't interfere with the gluing on of veneer. The thing you've got to guard against is lifting the plane's toe off the substrate, else you'll lose the absolutely flat surface. Keep a straightedge handy to check your work. Clearly, it's bad practice to glue on the lipping with $\frac{1}{4}$ in. of excess on each side, or to put it on high at one point and down at another. It's easy to get it on, but you pay the price when you have to remove the excess. Nothing other than care and accuracy will do. Cleaning up the lipping is not done rapidly. You can't do it accurately with a belt sander.

Once the lipping is absolutely level with the substrate, the panel is ready for veneering. If you're not going to veneer right away, cover the panel to keep off dust and contamination. Contrary to an old popular practice, there's no need to scuff the surface with a toothing plane; glue doesn't need a rough surface to work. The surface is now as flat as it's ever going to be—scuffing will only ruin it. □

Ian J. Kirby is an educator, designer and cabinetmaker. He recently moved his woodworking school from Vermont to Cumming, Ga. Drawings by the author. For more on particleboard and fiberboard, see FWW *#29, pp. 76-81.*

Getting on the good side of veneer

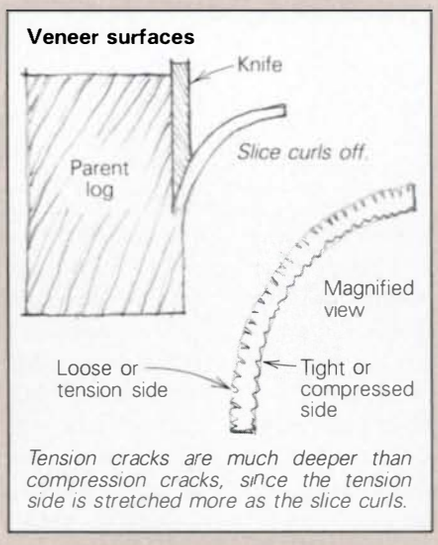
Veneers come in three types: sawn, sliced and rotary-cut. Sawn veneer is the oldest form, and was very common in Europe in the 1700s. It's simply a piece of wood, any thickness up to ⅛ in., sawn from a log or a board and then planed. Sawn veneer hasn't been used much in recent years, though modern band resaws offer a good chance for its revival, especially since any wood can be sawn into veneer. Modern resaws saw wood thinly and accurately, and because they make a very fine kerf, thus minimizing waste, they're economical, too.

Rotary-cut veneer, which generally is confined to the manufacture of plywood, is made by mounting a whole log on a giant lathe and peeling off veneer as if it were wallpaper. It's rarely used as a surface, show-wood veneer in furniture, although it can look nice, as in some birch plywoods used for drawer bottoms and carcase backs. Rotary-cut veneer can be very thick (⅛ in.) or very thin. Only diffuse-porous woods that grow abundantly in plywood-manufacturing areas, such as lauan in Southeast Asia and birch in Europe, are rotary-cut.

Woodworkers are most concerned with sliced veneer. Any wood can be sliced: hard, soft, ring-porous, diffuse-porous, fast-grown, slow-grown—it doesn't matter. Essentially, a guillotine-type knife is brought down through a block of wood to slice off thin pieces, usually 1/32 in. to 1/28 in. thick. The veneer doesn't lose any measurable thickness during drying. Veneers can be sliced thinner, but I find that 1/40 in. is about the thinnest that can be handled easily in a small shop.

Sliced veneers are most commonly available in 6-ft. to 8-ft. lengths, the size of most slicing machines, but lengths of up to 16 ft. can sometimes be found. Widths of up to 30 in. are possible, but getting a wide piece of veneer doesn't have the same attraction as getting a wide piece of wood does. It's easy to cut, match and join veneers together to create the widths and grain patterns needed for any job. Wide veneers frequently are rougher and coarser in the center than on the edge, so they can be difficult to smooth and finish.

Veneer-cutting technology is complicated, and the only thing that most woodworkers need to understand is that there is considerable cracking of wood tissue during the slicing process



Tension cracks are much deeper than compression cracks, since the tension side is stretched more as the slice curls.

Bookmatching shows the difference between compression and tension surfaces. Compression side, right, has more sheen and is smoother than tension side.

Veneer bent along its grain with the tension side up will bend a great deal without audible cracking. With the compression side up, the radius of the curve will be greater and you'll hear cracking before the piece actually breaks.

and the two sides of each veneer piece will have very different characteristics. Two different surfaces are created as each new slice curls off the parent log, as shown in the drawing (for more about knife checks, see *FWW* #12, pp. 83-85).

This difference is important when you're deciding which side to glue to the substrate. By putting the smoother compression side up (the tight side), you'll have the more cohesive side of the veneer on the outside, with the deeper cracks of the tension (loose) side against the substrate. Smooth-side-up is best for hand-woodworking, because when you clean and sand you will go through the small compression cracks and get to the solid part of the veneer much more easily.

These two surfaces also affect bookmatching. If you have a highly figured veneer 6 in. wide and you want a 12-in. panel, you might be tempted to open two consecutive pieces like a book and put them together so that the pattern matches down the center (you can do this since veneers are stored in bundles or swatches in the order in which they were sliced). This works in solid wood, but with veneer you expose one tight side and one loose side. The visual effect when finish is applied to bookmatched veneers can be quite poor. A surface that looks fine all through the process suddenly takes on a different feel, because the tight and loose sides will absorb the finish differently and that makes the surfaces reflect light differently.

There are several ways to tell which side is which. You can rub the surfaces with your hand—the loose or tension side will be rougher. Or you can look at the stuff, and generally the side that looks smoother is the tight or compression side, and it will have more sheen than the loose side. Neither of these methods is reliable, though. The best way to differentiate between the two sides is to bend the veneer and imitate what was happening to it when it came off the machine. With the tension side up, it will bend sharply without any audible or visible cracking. If you turn it over and do the same thing on the other side, you'll feel greater resistance and hear cracking. Thus the side that is less prone to bending is the compression side; the other is the tension side. —*I.J.K.*

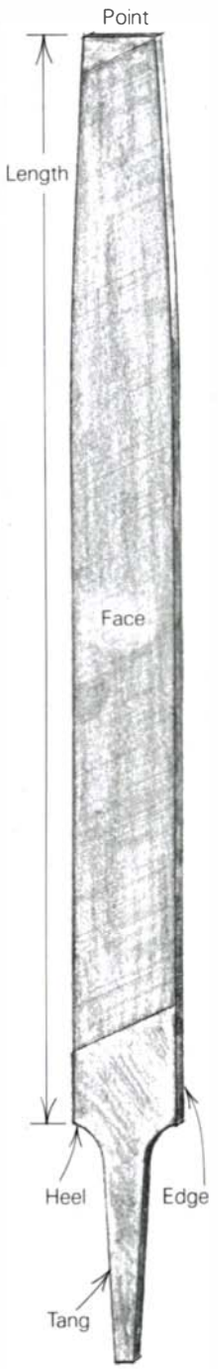


Fig. 1: Parts of a file

Files in the Woodshop

They're often a good alternative to abrasives

by Henry T. Kramer

Files seem to be poor country cousins in a typical woodworker's shop, often neglected by even skilled craftsmen. But it's wrong to ignore a tool that can be so useful and that frequently is the best tool for shaping, smoothing or sharpening.

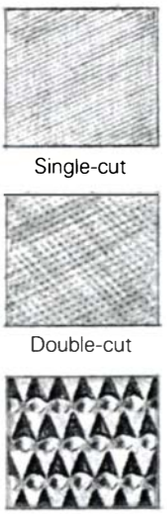
Files can true up all kinds of tools, especially new planes and spokeshaves. They sharpen saws, scrapers, cold chisels, axes and screwdrivers. Files can also smooth knicks and dents in everything from drill bits to drive shafts. They're efficient and economical alternatives to abrasives for shaping both wood and metal—they last a long time, and there's a size, shape and cutting grade for almost any carving or smoothing job you might encounter.

You may not consider a file a precision tool, but I've brought the badly hogged sole of a 22-in. jointer plane to within ±0.00125 in. of dead flat with only three files. And it doesn't take as much time or experience as you might think. As in any woodworking or metalworking, the slogan is "Measure twice, cut once." Stress the word "cut": you'll never learn how to use a file properly until you realize it's a cutting tool, not one that abrades the work.

More than 650 types of files are available today, but I'll discuss only 10 groups of "American Pattern" files that include about 170 files useful to woodworkers. The American Pattern designation is a traditional one stemming from post-Civil War days when Americans first began manufacturing files on a large scale, instead of importing them from Europe. These American Pattern files usually are coarser than their European or "Swiss Pattern" counterparts. I won't consider Swiss Patterns here, since they are finishing tools used by jewelers and modelmakers and too fine for most woodshop jobs, or circular-tooth files designed for soft, ductile metals such as copper, brass and aluminum.

The terms commonly used to describe files are fairly self-explanatory and probably already part of your vocabulary (figure 1). Most files have cutting teeth on both faces and both edges, but some have one or two smooth or "safe" edges so that they can be used in tight corners without accidentally damaging adjacent areas.

The "cut" of a file describes how its teeth are arranged. Single-cut files have one set of continuous, parallel teeth running in one direction. These files are designed primarily for sharpening or finishing metals. Double-cut files have intersecting sets of teeth forming sharp, diamond-shaped points designed to remove material faster. They'll cut wood quickly, though not as fast as a rasp, which has freestanding, clog-resistant teeth. Rasps and rifflers (small shaped rasps) are made primarily for woodworkers, carvers and farriers. Rasps come in several combinations of length and tooth grade, but all you really have to know is that in similar lengths and grades, the wood rasp is the coarsest, the cabinet rasp is a little finer, and the patternmakers' cabinet rasp is the finest. These cut wood rapidly, but leave a rough surface which can be smoothed with a wood file. In addition to regular rasps, there is also a tool called a shoe rasp, or four-in-hand, which is a combination of rasps and files that looks a lot more useful than it really is—its toothed surfaces are too short for an effective cutting stroke.



Any file can be used on wood, but you may find that the majority are too fine and clog up too quickly to be of much use. The coarseness of a file is controlled by two factors: the grade or size of tooth used, and the file's length. Today it's hard to find more than three grades of teeth: bastard, second-cut and smooth. Years ago, rough, coarse, dead-smooth and dead-dead-smooth grades were also available. The grade usually is stamped on the heel of the file, but this doesn't give you an exact gauge of the tooth size unless you also consider the length of the file. Within any one grade, a longer file has larger, coarser teeth than a shorter file, and fewer teeth per inch. There appears to be no industry-wide standard, but generally a file that's one grade finer and 2 in. longer has the same size teeth as its coarser, shorter counterpart. Thus, an 8-in. second-cut or a 10-in. smooth has the same size teeth as a 6-in. bastard. If you find a number on the heel of the file, it's a Swiss Pattern type; 00 is the coarsest and 6 the finest.

The two files designed for wood are the wood file (essentially a 10-in. coarse half-round) and the cabinet file, which has somewhat finer teeth than the wood file. Any double-cut bastard file, 10 in. or longer, can be effective, however, as long as you keep the teeth clean. Regardless of the type, a file's teeth face forward and won't cut anything when going backward—they'll just get dull. Don't move your file back and forth like a saw. Pick it up on the return stroke.

A file's name is based on several things: the shape of its cross section, such as flat, square, round or half-round; its use, such as for sharpening an auger bit or a chainsaw; or from traditions that no longer clearly speak for themselves—a mill file, for instance, is a single-cut flat file originally used for sharpening mill saws. The way in which files are identified in a catalog or a store may seem mysterious, but it's simply a

combination of the file's length, name and tooth grade. For example, you'd ask for a 16-in. flat bastard when you really want to rip off material and have a lot of working room, or a 4-in. mill smooth when you want the smoothest surface an American Pattern file can produce.

Taper files, for sharpening handsaws, are a special case. Tapers are made with only one grade of tooth, but the size of the tooth increases according to the degree of slimness and the length of the file. The four sizes are regular, slim, extra slim, and double extra or extra extra slim. To sharpen a saw without damaging the teeth, you must use the correct size file. For a 5- to 5½-pt. ripsaw, I recommend using a 7-in. regular. For an 8-pt. crosscut saw, use a 6-in. slim, 7-in. extra slim or 8-in. double extra slim. For a 10-pt., a 5-in. or 6-in. extra slim does the job best. For an 11-pt., use a 5-in. extra slim or a 6-in. double extra slim. A 12-pt. calls for a 5-in. extra slim; a 12½- to 16-pt., a 5-in. double extra slim. The number of points on a saw equals the number of teeth per inch, plus one.

A table describing files of probable interest to woodworkers is shown at right. The metalworking files that a woodworker would likely find most useful are the 4-in., 6-in., 12-in. and 14-in. mill smooth; the 4-in. mill bastard; the 12-in. hand second-cut; the 12-in. hand bastard; the 14-in. flat second-cut; the 4-in. flat smooth; a 5-in. extra slim taper; and a 5-in. double extra slim taper.

I'm not suggesting that you immediately buy all these files, but as you learn how useful they can be, you'll probably want to, if you can find them. It's a vicious circle: merchants cannot be expected to stock files if there is no demand, and woodworkers can't be expected to demand tools they don't know about. If you do buy files, I recommend that you avoid foreign-made American Pattern files, which don't seem to amount to much. I've also found that files packed in plastic bubbles don't seem to be of the same quality as those sold in machinists' supply houses.

• • •

One of the first things you should do with a new file is put a handle on it. An uncovered tang is dangerous: you can drive it through your palm. If you want a removable handle, buy one with a threaded ferrule or built-in clamp. It's cheaper to make your own hardwood handles with ferrules of thin copper, brass or steel pipe. Once you've fitted a ferrule onto your handle blank, use a bit the size of the tang end to drill a hole slightly deeper than the tang's length. Then open the top half of the hole with a drill the size of the middle of the tang. Insert the tang in the hole, hold the file, and bang the end of the handle with a mallet or on a bench or other hard surface, driving the handle onto the tang. Another way to enlarge the hole is to take a worn-out file with the same size tang, heat the old tang to a red glow, and shove it down the hole. Keep a bucket of water nearby in case the handle catches fire.

You should use different files for wood, soft metal and steel. A file that has been used on a hard material will not cut as well on a softer one. So if you want to use a file on wood, don't use it on anything else. Except for small sharpening files, new files that will be used on steel should be broken in first, to eliminate any irregularities that might cause teeth to break off or dull. To do this, file for a total of about an hour on a soft metal such as brass or aluminum. Properly broken in, a file will last a long time, cutting about the same throughout its life. When it does go, this will happen quickly and you'll

FILES FOR WOODWORKERS

Name and cross section	Cut*	Description
Mill 	S	For sharpening sawblades and scrapers, shaping and smoothing wood and metal, drawfiling, fitting, and truing. These files are tapered in width and thickness. Every woodworker should have a selection of these.
Flat 	D	The standard machinists' file for shaping and quick removal of material. Tapers in width and thickness. Used for forming grooves, squaring holes and filing in sharp corners. Good for starting jobs that the mill file will finish.
Hand 	D	Same as the flat file, but tapers only in thickness. Has one safe edge, making it useful for filing in corners where one surface should not be filed. Good for rough, heavy work.
Warding 	D	Tapers to a fine point. Useful for getting into tight spots, such as when you are fitting plane irons and frogs.
Pillar 	D	Narrower than a flat or hand file. Has two safe edges and no taper. Useful for filing slots.
Half-round 	D	The flat side is useful for filing on flat and convex surfaces; the rounded back is good for filing on concave surfaces. You don't need a half-round often, but when you do, nothing else will do. The rounded backs of finer, shorter half-rounds have single-cut teeth.
Wood 	D	Essentially a coarse half-round. Specifically designed to resist clogging when used on wood. Available in 10-in. length only.
Cabinet 	D	Another file designed for wood. Thinner and with a shallower back and finer teeth than the wood file. Available in 8-in. and 10-in. lengths.
Taper 	S	For sharpening 60° teeth on handsaws.
Three-square 	D	A general-purpose file for working in angular corners of more than 60°.
Square 	D	A flat file with a square cross section.
Round (Rat-tail) 	S&D	A tapered file used for dressing the insides of holes and small-radius curves. Round files longer than 10 in., except the 12-in. smooth, have double-cut. teeth. Others have single-cut.
Chainsaw 	S&D	Has special teeth designed for sharpening chainsaws. This file is not tapered.
Auger-bit 	S	A double-ended file with each end tapering to a point. Has safe edges on one end, safe faces on the other end. Very handy for sharpening the cutting edge and spurs of auger bits.

* S is single-cut; D is double-cut.

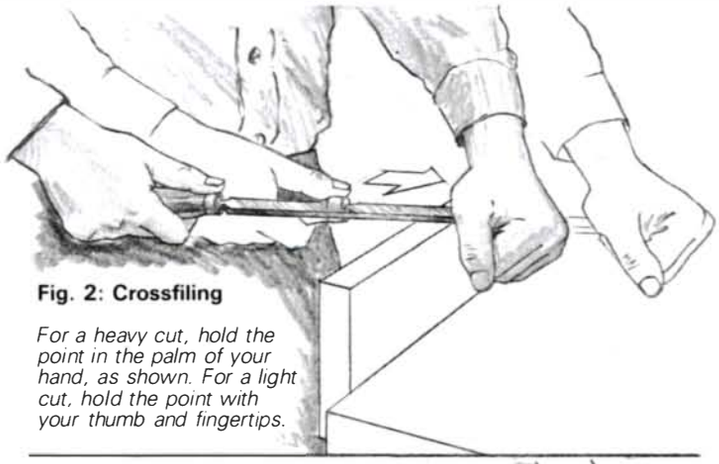
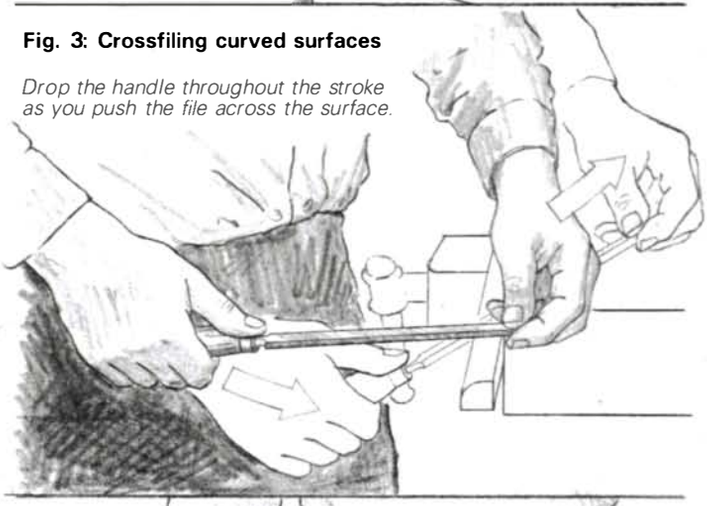


Fig. 2: Crossfiling

For a heavy cut, hold the point in the palm of your hand, as shown. For a light cut, hold the point with your thumb and fingertips.

Fig. 3: Crossfiling curved surfaces

Drop the handle throughout the stroke as you push the file across the surface.



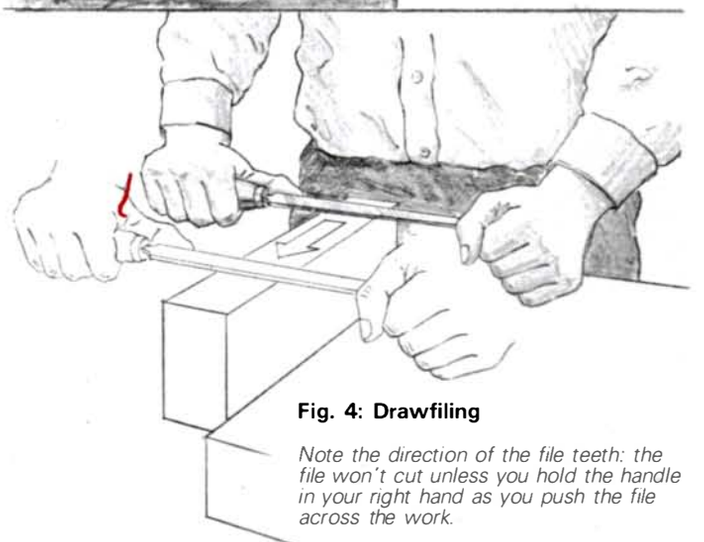


Fig. 4: Drawfiling

Note the direction of the file teeth: the file won't cut unless you hold the handle in your right hand as you push the file across the work.

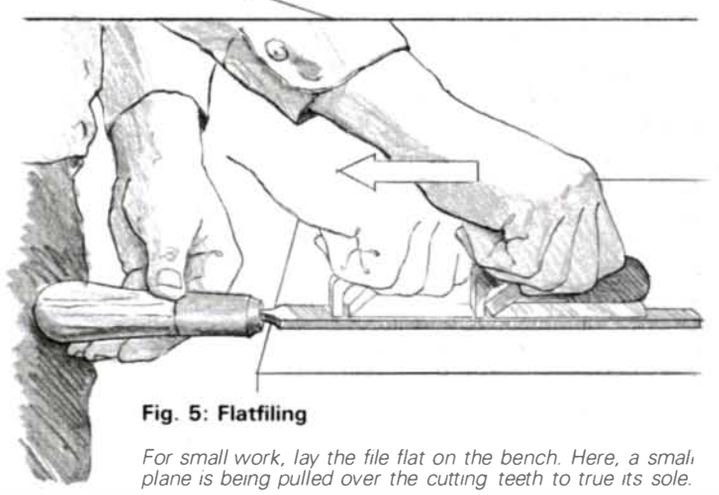


Fig. 5: Flatfiling

For small work, lay the file flat on the bench. Here, a small plane is being pulled over the cutting teeth to true its sole.

know it. Files can be resharpened, but it's impractical and dangerous in the small shop. It's best to buy a new file.

There are three common ways of filing: crossfiling, drawfiling and flatfiling. In crossfiling, which most people consider the only filing method, you usually push the file across the work, but it is sometimes done with the file held so that its long axis and the long axis of the work coincide (avoid this variation on narrow edges, or you're liable to round them). Clamp the work firmly at elbow height. Put one foot in front of the other, and stand up straight. Don't hunch over your work. For heavy filing, hold the handle of the file with your thumb on top and the point in the palm of your other hand (figure 2). To make a lighter cut, hold the handle the same way, but place the thumb of your other hand on the point and curl your fingers around the file. Think of your arms and shoulders as a parallel-motion machine swinging from the shoulders, and push the file across the work, maintaining a constant angle to the work. When filing a flat surface, first catch the vertical angle by rocking the file on the surface until it's flat. Do this each time you've stopped. On very thin material, hold the file at an angle to make a shearing cut, so the file teeth don't catch. From time to time, change the lateral angle of filing--errors in maintaining the vertical angle and any high spots will stand out clearly after only a stroke or two. If a wavy surface appears, try clamping the piece more securely, using less pressure on the file, or try a finer file.

Crossfiling with a taper file is a useful technique for notching a bar or other surface, say, to start a hacksaw cut. Notch an edge and file at a slight angle. You can crossfile a rounded or cylindrical surface if you drop the handle end of the file throughout the stroke (figure 3).

Drawfiling (figure 4), which usually is done with a single-cut mill file, is very useful to woodworkers. It's slower than crossfiling, but you'll find it easy to control the cut and produce a smooth surface. It also has the advantage of letting you file the entire surface in one continuous stroke. Drawfiling is a sharpening or finishing stroke, so don't use any more pressure than needed to feel the file cut.

Position the work so that its long axis runs away from your body, not from side-to-side. Hand position is important to ensure that the teeth are in a cutting position. If you're holding the file wrong, it won't cut—it'll just get dull. Grip the handle in your right hand, lay the file across the work at the desired angle, and grasp the point in your left. The file should be held at a right angle to the direction of the stroke. Now push. If you bear down too hard, the teeth will dig grooves and the file will walk to one side. If you are left-handed and feel uneasy with the handle in your right hand, or if the shape of the work requires it, you can hold the file handle in your left hand, but then you must use a pulling stroke. The rule is: Push stroke, handle in right hand; pull stroke, handle in left. To distribute wear evenly on the file, most workers move it slightly to the left or right between strokes.

If you want an even finer finish, wrap emery paper around the file and polish with the same drawfiling stroke. You may want to begin with 320-grit and work down to 400, then 600. Use a little light oil on the paper when sanding metal.

A good drawfiling exercise is squaring up a cabinet scraper with a 6-in. mill bastard and a 4-in. mill smooth (if you can't find the latter, use a 6-in. mill smooth or a 4-in. mill bastard, but go easy). First, use a straightedge to check that the scraper's long edge is flat or slightly convex, depending on your

Treatise on files and rasps

by Dick Burrows

Ever try to use a rasp on bread? The practice was quite fashionable among "many of the better class of English and French people" in the late 19th century when the Nicholson File Company published *A Treatise on Files and Rasps.*

High-class bakers of the day felt that bread baked quickly and hard was sweeter and tastier than bread prepared in the conventional way, once you got past the thick, singed crust. So they ordered a curved, nickel-plated rasp (above) with an enameled handle—just the thing to get rid of the crust and create lots of bread crumbs.

The bread rasp is just one of the unusual items described in the Nicholson treatise, a catalog and description of files and rasps developed to meet the needs of every specialized trade and industry. The Early American Industries Association, which recently reprinted the book, calls the slim, 80-page volumn a classic of hand-tool literature, and the engravings reproduced from the original volumn add to the nostalgia. The work is a delight to those who favor hand tools and relish the history of tools.

Many of the files available when the book was published are no longer manufactured, but the information on using and caring for files is still pertinent. And the historical glimpses are especially informative in light of Nicholson's role as a pioneer manufacturer of machine-cut files.

The text is concise, crisp and easy to follow. The files, rasps and scrapers are well illustrated, and their uses are clearly described. There are enough details—such as discussions of the lengths of file teeth needed for penetration in various types of metals, and the relationship between tooth angle and tool control—to satisfy most students. □

A Treatise on Files and Rasps *may be ordered from the EAIA, PO Box 2128, Empire State Plaza Sta., Albany, N.Y. 12220 ($7.95 to EAIA members; $13.50 to non-members). Engraving reprinted courtesy of the EAIA.*

preference. Use the 6-in. mill to straighten the edge if needed. Then, holding the same file at a slight angle to the direction of the stroke and with the file's face flat on the side of the scraper, take off any hook left from the previous sharpening. Now drawfile the whole edge until it's square to the scraper sides. Start with the 6-in. tool and finish up with the 4-in. Crossfile lightly along the sides to remove any lip left by drawfiling, then burnish.

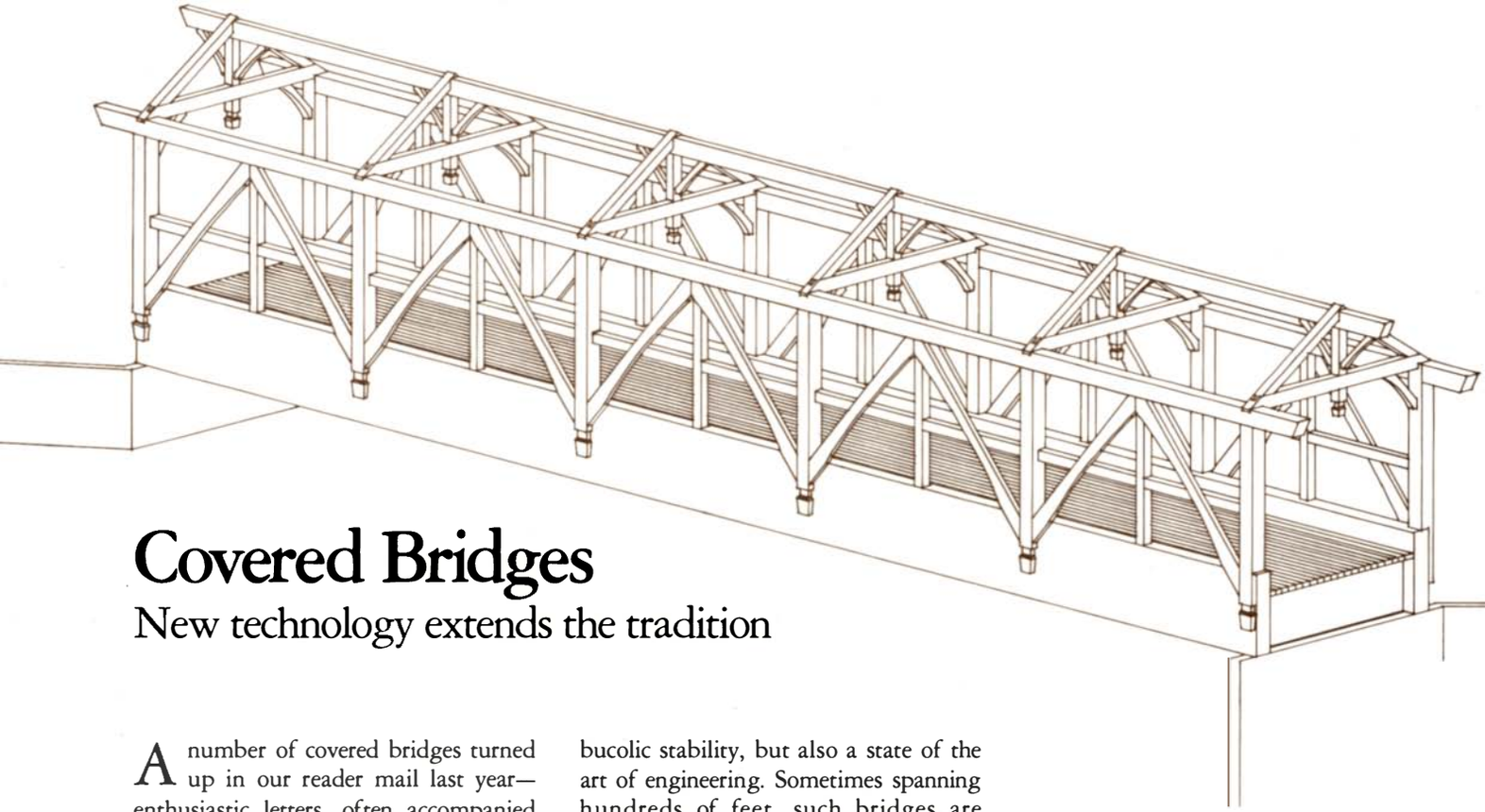
Flatfiling can be a useful technique for small work—work that generally is less than 3 in. long and no more than 1¼ in. wide, really too small to be handled easily with other handfiling methods. Start by laying the file flat on a table or a bench. If the file is handled, let the handle hang over the edge, or put the file in a fairly large machinists' vise. Now draw the article to be filed over the cutting edges of the teeth. This is a handy way to flatten the sole of an ordinary thumb plane, and most rabbet planes are narrow enough to be flatfiled (figure 5). Most rectangular-section files have slightly convex faces, and some people may think that this would work against a flat surface. Actually, this convexity is intended to help achieve flatness when crossfiling, and it seems to have the same effect when flatfiling, especially if the work is reversed every four or five strokes.

Files look rugged, but like any other cutting tool, they need care. Keep them separated in racks, not thrown loose in a drawer or stuck in an old can. Given a chance, two files try to cut each other, with bad results for both.

Keep your files clean. A file card with a brush on its back is useful here. The card's stiff, short teeth work well on large-toothed files, and the short-bristle brush does the job on all files, if used frequently enough. Generally, it's best to use the brush more frequently than you think necessary. Files clog or "pill or pin up" once in a while, and this condition can both mark the work and stop the cutting. To clean a file, try a medium-grade power-driven wire wheel, holding the file so that the wires run down the gullets of the teeth. Alternatively, you can make a pinning tool from ⅛-in. brass or hard copper rod. Hammer the end of the rod to the rough shape of a double-bevel chisel and file to a smooth, slightly round edge with sharp corners. The edge should be thin enough to touch the bottom of the gullets between the rows of teeth. Put on your magnifying glasses, take a deep breath and get comfortable, and pick each "pin" out, one by one.

In addition to cleaning the files, you should also clean the metal surfaces that you file. Filing can leave metal fragments in the pores of iron, which, as in the case of a plane sole, can be transferred to the wood. Don't trust your eye: the surface may look clean, but it's not. Clean it with an oiled rag. Besides, any newly filed metal surface needs a coating of light oil right away, unless you live in Death Valley. The best lubricants and rust preventives are things people like to argue about, but anything is better than nothing. I don't think that the files themselves should be oiled, because oil can make them slip and more prone to clogging. Files will rust, however, and when they do so badly, that's it. So keep them dry. At the first hint of rust, use the wire-brush wheel. □

Henry T. Kramer, a retired reinsurance specialist, is an amateur woodworker and metalworker living in Somerville, N.J.



Covered Bridges

New technology extends the tradition

A number of covered bridges turned up in our reader mail last year—enthusiastic letters, often accompanied by photos and drawings, described how a commission to refurbish some venerable wooden trestle, or to erect one anew, had led to a labor of love. Wooden bridges, covered for shelter from the seasons, embody not only our notions of bucolic stability, but also a state of the art of engineering. Sometimes spanning hundreds of feet, such bridges are among the woodworking wonders of the 19th century. The four bridges shown here are exemplary of those being built and rebuilt today, often employing innovative construction features combined with sound, old timber-frame techniques.

The Sturbridge ***bridge, above,*** *combines modern gluelam girders, which span the stream, with a traditional timber-frame superstructure. The two main girders are connected at intervals by plywood boxes that support the roadbed. Below, the bridge is halfway home.*

Gary Childress

Joining timbers and gluelams

When Sanford Homes Inc. asked our design team to construct a covered pedestrian bridge for Sturbridge Village, their development in Englewood, Colo., we jumped at the chance. Our experience is in modern, cost-effective timber-frame houses, and our commitment is toward owner- and community-involved building, so here was a new opportunity to combine tradition, technology and education. We decided on a combination beam/truss bridge, a replica of a 19th-century design, but with modern gluelam members. And we would set aside time throughout construction to accommodate tours from the local schools, an idea that proved popular enough to fill at least part of most afternoons.

The Sturbridge bridge is 75 ft. long and contains more than 15,000 bd. ft. of timber. The lower chords are two 48-in. thick beams glued up from 2x10 fir by the Georgia Pacific Co., which custom-laminates such beams to meet the stringent specifications of state engineering inspectors. The beams are lag-bolted to eleven 10-ft. long plywood box joists, which support the roadbed of the bridge. The face of one of these can be seen at the right end of the bridge, just under the road planking, in the drawing on the facing page. Atop this substructure we erected six bents of 10x10 and 6x8 fir, trussed together with 4x10 braces, all the joints pinned mortise-and-tenon. The roof itself, along with the siding, is boarded with red cedar.

Historically, covered bridges were assembled on the bank and pulled across the river by a team of oxen, hence the term "bridge pull." We proceeded similarly, but instead of oxen we used a 140-ton crane. This required careful selection of the bridge-building site in relation to the bridge's abutments. The crane's reach was such that the bridge had to be approached from the side, lifted, and rotated into position. The photo on the facing page shows the structure moving toward its abutments.

In contrast to the stark relief of 14,000-ft. Rocky Mountain peaks, the covered bridge over this 20-ft. streambed offers pedestrians a small sense of security. More than bridging the streambed, the project spans old and new technologies, and has become a focal point of the community it serves.

—Stewart Elliott, Dovetail Limited, Boulder, Colo.

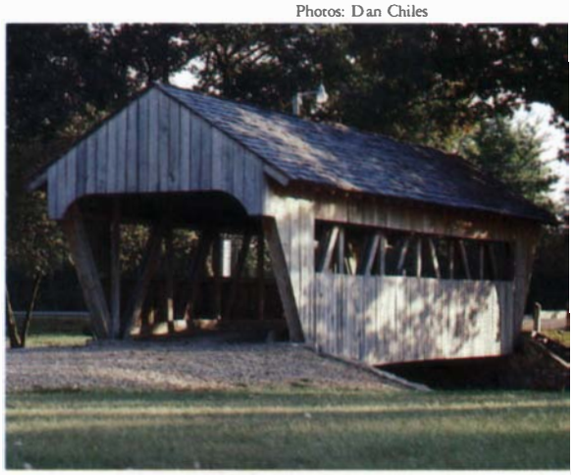
Split-ring framing

Our client, Ed Rush, was looking for a steel I-beam bridge, covered by a wooden shed, to span the 50-ft. creek that borders his property in Lebanon, Mo. We offered a contemporary alternative: a multiple king-post truss bridge of wood joined not with mortise-and-tenon and trunnel, but with modern timber-fastening hardware.

Wooden covered bridges, while relatively common in the United States during the early 1800s, gave way by 1900 to all-metal truss bridges. Inadequate wood preservation made the wooden joints—particularly compression joints—susceptible to rot and early failure. A more dramatic danger was the shower of sparks from wood- and coal-fired locomotives, which caused the immolation of hundreds of covered bridges.

Our solution? Prohibit steam locomotives from our bridge, and use split-ring timber fasteners (from TECO, 5530 Washington Ave., Chevy Chase, Md. 20815), which would eliminate traditional water-collecting joints. Our materials list included 10,000 bd. ft. of lumber, consisting mainly of 3x10 white oak for the trusses, pressure-treated 3x8 red oak for the deck, and 1x8 mixed oak for the siding. For roofing we used

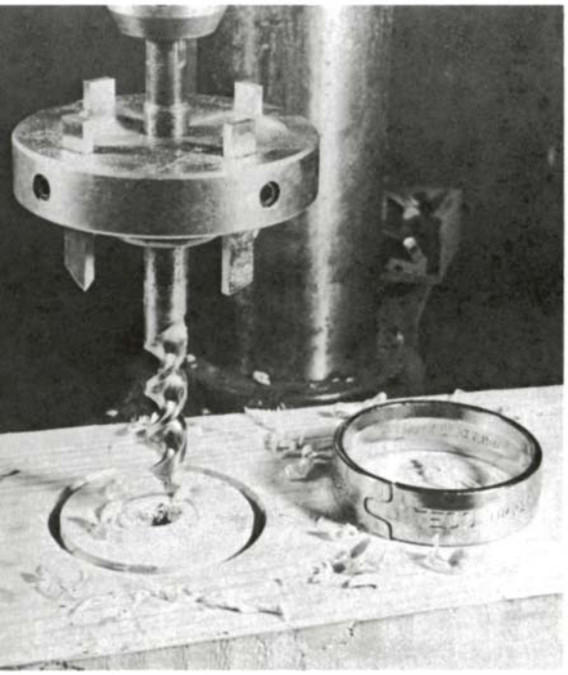
Photos: Dan Chiles



Chiles' multiple king-post bridge.

Fifty-foot sides were assembled flat, hoisted into place, then connected top and bottom.

TECO



To reinforce bolted lap joints, Chiles inserted split-ring fasteners between the timbers of his bridge. The TECO cutterhead has four grooving bits, and either a center bit, as shown, or a center pilot that follows a hole drilled during mockup assembly. In 3½-in. thick timbers, the 4-in. dia. rings (also available in 2½-in. diameter) can sustain shear loads in excess of 5,000 lb.

oak shakes handsplit by a local farmer. We estimated our labor (by consulting historical accounts from experienced builders, and taking into consideration electric drills and gasoline chainsaws) to be five man-months.

Early bridge builders sometimes erected temporary pier bridges on which they assembled the permanent timber trusses. We decided that it would be easier to build the two wall trusses on land and then rent a crane to lift them into place. Our first step was to build a large fixture on the site: 55 ft. long, flat to within ⅛ in., and capable of supporting more than 10 tons of green oak. Four-by-four oak stakes braced with 2x6s made up the platform that fit our needs.

The steel rings of the TECO system fortify bolt joints in overlapping timbers. Each ring is sandwiched between two timbers (half its thickness embedded in one timber, half in the other), and it resists shear forces many times the load limit of the bolt alone. Installation entails positioning the timbers, boring the bolt holes, and then disassembling to cut the circular grooves that receive the rings (photo, above left). The timbers are then reassembled, with care not to leave out any of the rings, and cinched together with ¾-in. carriage bolts, some as long as 22 in. When the first wall truss was completed, we built the other one on top of it, making layout easier.

The crane cost $50 an hour, so by the time it arrived one fall Saturday morning, we'd rehearsed our bridge-pulling procedures well. The crane lifted one wall truss, which we braced, then the other into place on the piers, whereupon we connected them with 4x10 oak joists. Next we hoisted 4x8 ceiling beams atop the truss walls, to form a third truss, which strengthened the whole bridge. Atop the ceiling went a roof structure of conventional frame design made of 2x6 rafters and 1x4 battens. We decked the inside, roofed and sided the outside, and our covered bridge was ready to face its first winter.

After three and a half years, the bridge has weathered to a silver gray without benefit of any wood finishes. It looks as if it's been part of the landscape for many years.

—Mike Chiles,
Chiles Power Supply, Inc.,
Springfield, Mo.

Restoring a Long-truss bridge

Shown at right is a photo of the partially reassembled Stoats Mill bridge, which I helped save here in Ripley, W.Va. When Mill Creek watershed site 13 was to flood the area where the old bridge once stood, the U.S. Soil Conservation Service contracted me to move the 105-ft. bridge nine miles to Cedar Lakes Park, restore its deteriorated trusses, and re-erect it across the small lake.

The truss design was patented in 1830 by Col. Stephen H. Long of the U.S. Army Corps of Engineers and it carries his name. The Long truss is unique because it deflects little at midspan, and wear at the joints is minimized by pre-stressing the braces and counterbraces. The Long truss can also be retuned by adjusting an integral wedge system in the joints to compensate for shrinkage and wear.

As we took the joints apart, we discovered that the Stoats Mill bridge had been prefab—all its parts were coded and numbered for assembly. The bridge was originally built in 1887 by local residents, who copied the plan from a nearby bridge instead of paying the patent holder the usual $1-per-linear-foot royalties. Ironically, although they copied the external design faithfully, they left out the wedges that made Long's design so sturdy. We wrote away for a copy of the original patent, and made the missing parts, installing them as we reassembled the structure.

We set the bridge trusses on abutments of hewn stone taken from other bridge sites, without disturbing the mossy faces of these 2-ton stones. Although we replaced several of the bridge's 8x10 pine members that had rotted due to neglect, we saved every piece we could in order to keep the structure's historic fiber intact. Much of our refurbishing should have been part of the bridge's regular maintenance. I'm encouraged that the state of West Virginia is now working at restoring all of its remaining 16 covered bridges.

The Stoats Mill bridge is particularly graceful for its camber, rising 9 in. at midspan. After rebuilding the bridge, we parked a 4-ton truck and two cars at the center of its deck, and there was less than ¼ in. of deflection at midspan.

- Bob Parsons,
Parsons Builders, Ripley, W.Va.

Arched timbers in Oregon

Oregon once had an estimated 450 covered bridges, of which about 50 still survive—at least one in every county except Multnomah. So when the small Multnomah community of Happy Valley needed a bridge, they opted for wood, hoping that they would be able to afford it. We came up with a covered bridge that took advantage of standard prefab parts such as church arches and laminated bridge girders manufactured by Weyerhaeuser. By searching the catalogs for standard parts that could be fit together in unusual ways, we were able to come up with a custom design without incurring the extra cost of custom setups. Accommodating a two-lane highway that carries 1200 vehicles a day, the 65-ft. bridge cost the county a little under $100,000, which is less than they would have had to pay for a steel or concrete bridge. A county leader hailed it as "a bargain and an amenity." We're pretty well pleased with it, too. —*Marshall Turner, Western Wood Structures, Tualatin, Ore.*

Western Wood Structures

Multnomah County's (Ore.) covered bridge, of prefab arched gluelam fir with cedar.

Harvey Mitchell

Purchased in sheets and worked with unpretentious joinery, plywood lends itself to straightforward furniture projects such as this child's loft bed, plans for which appear on pp. 52-53.

Plywood Basics

The ideal material for box furniture

by Ann Taylor

If you want to store something, put it in a box. If you want to store something in particular, turn the box up on one of its ends and fit it with shelves, dividers, drawers and/or doors. The basic box is basic furniture. It can stand on its own as a bookcase, hang on the wall as a cabinet, line up in rows as a wall system, or stretch out into a loft bed with plenty of room for storage. For fast, easy construction, nothing beats a box: it's simply four panels joined at the corners, with a back added on for strength or for appearance. And it can be built, without apology, out of plywood.

Cabinet-grade hardwood plywood is the perfect material for furniture-box construction. It's sold in 4x8 sheets, so you can simply cut box parts from a sheet, without having to mill and glue up as with solid wood. Because it's made up of a stack of thin veneers, plywood doesn't swell and shrink with seasonal moisture changes. This makes for some interesting design possibilities. You can, for example, decorate the end of a plywood panel with a contrasting wood without fear of the cross-grain construction cracking. I've found plywood to be economical, too. Even at a cost of between $20 and $100 per sheet, depending on grade and species, it's less expensive than hardwood bought for $3 and more a board foot.

Designing with plywood—Because plywood comes in big sheets, there's a temptation to build hulking, ill-proportioned monoliths that fill every inch of the available space, or use up every bit of the plywood purchased. Just because all the space under the stairs could be filled with plywood boxes doesn't mean it should be. I plan my furniture-boxes by first measuring the space they will occupy, then making a scale elevation drawing, which helps me visualize how my design will fit in with the rest of the room's furniture and architectural elements. If the drawing doesn't tell me enough, I make a scale mockup out of cardboard.

A box with classic proportions has a short-side to long-side ratio of 5:8. Adhering to this so-called golden mean is likely to produce a well-proportioned box, but you must also consider real-world dimensions: the room where your boxes will live, and the doorways and staircases through which you'll have to maneuver them. If the boxes must contain specific things, measure these objects, make allowances for clearance, and keep the numbers in front of you as you plan. Multi-box furniture—such as a wall system—compounds the design decisions. What are the best dimensions for each box? How many boxes should there be? Working out the relationships on graph paper, I try to size the boxes so that they'll work in many different configurations, thus increasing the versatility of my designs.

Plywood is marginally more rigid along the grain of the face veneer than across it, but decisions about grain direction still can be more aesthetic than structural—a plywood shelf will bear the same weight regardless of grain direction. Grain does affect the visual size of a box, though. If you run the grain in a box's sides horizontally, the box will look shorter. Drawer fronts with vertical grain look deeper. This is most

noticeable with oak and other vividly figured woods.

Plywood will sag if it must span too great a distance, vertical or horizontal. Besides drooping shelves, this also causes the sides of tall carcases to bow outward under their own weight, making it impossible to fit them with smooth-working doors and drawers. For ¾-in. plywood, I've found that 36 in. is the maximum horizontal span unless support is provided by a vertical divider or a face frame. For storing heavy objects, such as big books, 30 in. is better. The long sides of a tall bookcase can span 48 in. or so; if taller, the sides should be tied together with a horizontal member.

After I've designed and drawn the boxes, I make a cutting list that names each part, its thickness, width and length. The length is always along the grain, the width always across. To reduce waste, it's sometimes helpful to draw each piece to scale on graph paper, and after drawing an arrow to indicate grain direction, to cut out the panels and arrange them on a rectangle scaled to represent a 4x8 sheet. Once you have determined how to cut the plywood, decide which cut to make first and mark it with a numbered arrow, indicating grain direction, on the drawing. Then label each piece as you cut it.

Cutting and joining—Plywood rips cleanly along the grain, but the face veneer of the sheet splinters when crosscut. Minimize the damage by using a good-quality plywood-cutting blade. On my 10-in. tablesaw, I prefer a 40-tooth carbide-tipped blade with a triple-chip tooth pattern. The 100-tooth steel blades sold in most hardware stores will work, though, if kept very sharp. Get in the habit of positioning what will be the show side of your plywood up when you tablesaw; that way, any splintering will be hidden later. If you're using a radial-arm saw or a portable circular saw, position the good side down. A strip of masking tape applied along the line of cut before sawing will also reduce chipping. Since my basement shop is cramped, I usually have the lumberyard make

Taylor crosscuts panels on her Sears tablesaw, using a shopmade cutoff box. For larger cuts, she feeds sheets against a Biesemeyer fence, which permits cuts to the center of an 8-ft. sheet.

the first rip cut. I ask them to allow at least ¼ in. extra, and then I square the panel on my tablesaw, using the factory edge against the fence.

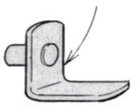
It makes sense to rough-rip full sheets first, cutting the panels about ⅛ in. oversize, then trimming them to the final size when they're smaller and more manageable. For accuracy, trim all panels of the same width at the same rip-fence setting. Since most box parts are too large to saw with the tablesaw's miter gauge, I use a homemade cutoff box to trim them square. Panels that are too cumbersome to tablesaw can be cut with a portable circular saw or a saber saw guided against a wooden fence clamped to the work. Clean up any ragged edges by cutting the panel a bit oversize and trimming cleanly to the line with a router guided against the wooden fence.

The parts of a basic plywood box can be joined in many ways, ranging from a simple nailed butt joint to dowel or plate joinery. I use four joints for plywood: the rabbet-and-groove (offset tongue), double rabbet, tongue-and-groove, and rabbet—all cut on my tablesaw with a sharp dado

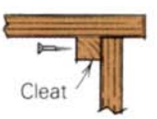
Fig. 1: Designing with plywood

The basic plywood box can be a wall cabinet, a floor cabinet with doors and drawers, or a tall bookcase.

Support shelves on dowels or metal hangers.



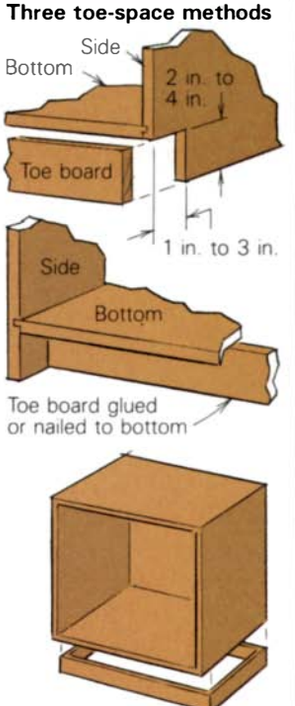
Carcase detail: Top fastened with cleat



Grain direction affects visual proportions: vertical grain makes cabinet appear taller; horizontal grain, wider.

To prevent bowing, case sides taller than 48 in. should be tied together with a fixed shelf.

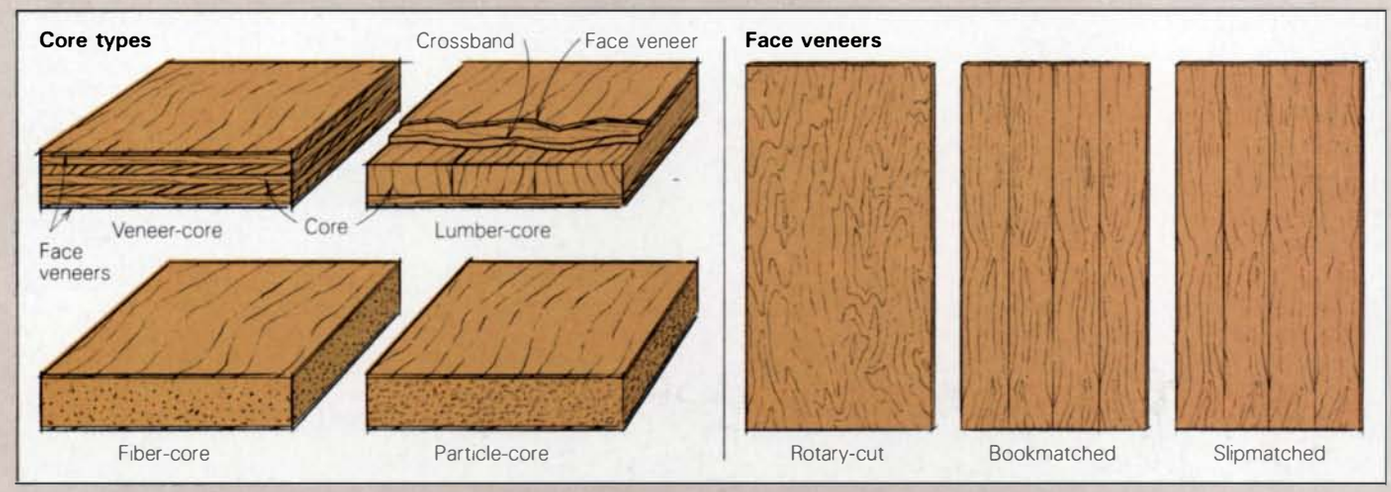
Three toe-space methods



Cabinet overhangs platform.

Drawings: Lee Hov

How to buy hardwood plywood



Most local lumberyards sell a big selection of fir structural plywoods and paneling, but far fewer stock cabinet-grade plywoods. You may have to look around to find what you need. Yards that support busy millwork and cabinet shops, because they use hardwood plywood, are a good place to start. These yards usually keep a good supply on hand, and they're familiar with the hardwood-plywood grading system, if what you want needs to be special-ordered. In most cities, a check of the "Plywood & Veneers" heading in the Yellow Pages will turn up wholesale suppliers. Wholesalers won't always sell small quantities to amateurs, but it doesn't hurt to ask. At worst, they'll refer you to a well-stocked retailer, or to one who can order for you.

Hardwood plywoods are graded by the quality of their face or surface veneers and by the way these veneers are arranged on one of four kinds of cores, as shown in the drawing. The chart shows the six veneer grades. Typically, one side of a sheet will be premium or A grade, the other side will be a lower grade; thus a sheet might be graded A-1, A-2, and so on. Most suppliers stock grades A-1 through A-3, and will also have on hand something that they call "shop grade." This grade, which doesn't appear in the official rule book, refers to seconds, or sheets that have been damaged in transit or storage. Defects in these sheets are often hardly noticeable, and the lower price makes this grade a good buy.

In addition to the letter-number grade, a sheet will be identified by how the face veneer is cut and laid. Rotary-cut veneer is peeled off the log in one big sheet and glued to the core. It's usually cheaper, but the figure tends to be pronounced. Plain-sliced (also called flat-cut) veneer is usually bookmatched or slipmatched and has a more subdued (and usually more interesting) figure.

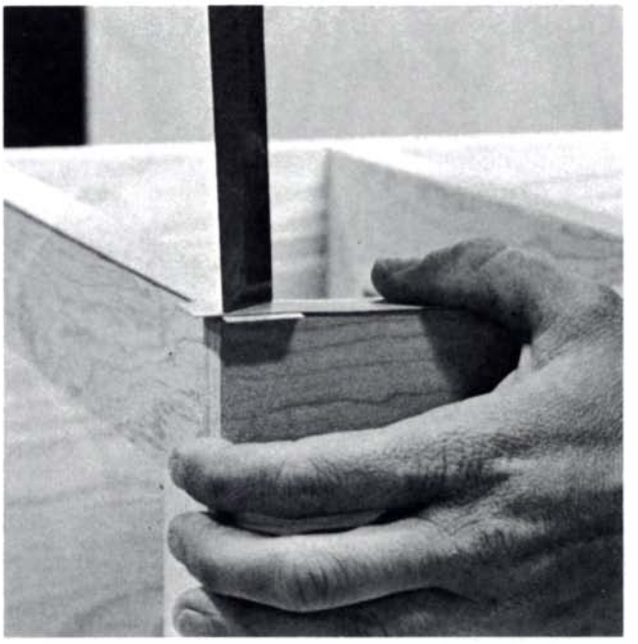
Face veneers of any grade or type can be applied to a veneer, lumber, fiber or particle core. Veneer is the most common core and consists of an odd number of veneer sheets or plies, frequently fir or a cheaper hardwood, built up to the required thickness. The face veneers are then glued on top. Veneer-core plywood may contain interply voids, but these usually don't cause much of a problem. Lumber-core—strips of a solid, stable lumber such as mahogany glued up into a large sheet and veneered over—is the most expensive, but the nicest to work with. Fiber-core, similar to Masonite, is made up from sawmill waste ground to a powdery consistency and pressed into sheet form. Particle-core is similar, but is made of larger fibers.

Which grade and core should you buy? That depends on what you're building. Mostly I make children's furniture, so I buy shop-grade (A-1 or A-2 seconds) ¾-in. veneer-core oak and birch. This grade is also excellent for kitchen cabinets and wall units. If I were investing more time in a piece of furniture, I might consider an A-1 lumber-core plywood.

Another thing to keep in mind when buying is that wholesale plywood prices, like lumber prices, are commonly given in dollars per thousand square feet. So if you ask the price on A-2 rotary-cut oak, for example, the salesman might quote $1,380. To find the per-sheet price, move the decimal point three places to the left and multiply by 32, the number of square feet in a 4x8 sheet. In this case, the price is $1.38 per square foot, or $44.16 per sheet. —*A.T.*

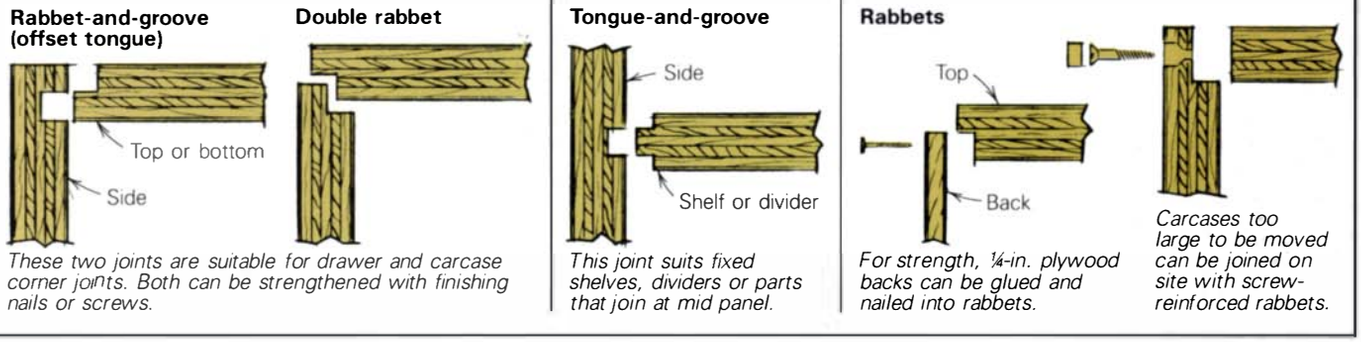
HARDWOOD PLYWOOD GRADES

A **Premium grade**	Whether veneer is one piece (rotary-cut) or several (plain-sliced), it's free of defects and discoloration. If the veneer is sliced, the grain is bookmatched or slipmatched for figure and color.
1 **Good grade**	Face veneers are smooth and tight, but, if sliced, may not be figure- or color-matched.
2 **Sound grade**	Face veneers are smooth and tight, but not matched for color or figure. Sound knots up to ¾ in. and discoloration are allowed.
3 **Utility grade**	Veneer can have tight knots up to 1 in., discoloration and slight splits.
4 **Backing grade**	Open splits and knots up to 3 in. are allowed in face veneer. This grade is rarely found in off-the-shelf plywood.
SP **Specialty grade**	Custom-made to buyer requirements. Most architectural paneling is of this grade.



Iron-on veneer tape covers the plywood's ugly edges. An iron set to 'linen' melts the tape's glue; a wood block or roller sets the tape as it cools. At corner joints, Taylor miters the tape with a chisel or a knife.

Fig. 2: Plywood joints



These two joints are suitable for drawer and carcase corner joints. Both can be strengthened with finishing nails or screws.

This joint suits fixed shelves, dividers or parts that join at mid panel.

For strength, ¼-in. plywood backs can be glued and nailed into rabbets.

Carcases too large to be moved can be joined on site with screw-reinforced rabbets.

set. Figure 2 shows which joint is used where. A box with four flush corners, for example, might hang on the wall, or sit on the floor atop a platform that forms a toe space. I join flush corners with a rabbet-and-groove or, if the box is large and must be delivered knocked down, with a rabbet that I screw together on site. Pilot holes will prevent screws from splitting the plies, and if the screws show, they should be counterbored and plugged. I use No. 8 or No. 6, 1½-in. wood or drywall screws to join ¾-in. plywood. The bed project illustrated on pp. 52-53 shows another knockdown joint.

For fixed shelves and dividers where the end of one plywood panel joins the face of another, use either a tongue-and-groove or a rabbet-and-groove. Brace a box against racking by adding a back. I find that ¼-in. plywood glued and nailed into a rabbet milled into the back edges of the box is fine for this purpose. Make the rabbet for the back the last joint cut, however, since it determines which panels become the left, right, top and bottom of a carcase. And in case of splintering or cutting errors, you can put mistakes at the back of the box.

As a rule of thumb for ¾-in. plywood, I make grooves ⅜ in. wide and ⅜ in. deep. I size the tongues accordingly, but leave a 1/64-in. space between the groove bottom and the end of the tongue for glue clearance. To prevent chipping, I cut cross-grain dadoes in two steps. First, I set up the dado blades and rip fence, and lower the blades so that they just cut through the face veneer. Then I raise them and mill the cut to final depth. Before I pass good plywood through a setup, I always try it first with scraps of the same stock that I'll be using. A test tongue should be deliberately too thick to fit the groove so that you can raise the blade in tiny increments until it fits exactly, or it can be trimmed by hand with a plane.

Adjustable shelves can be supported by ¼-in. dowels tapped into ⅜-in. deep holes bored into the case sides before the box is assembled. I space shelf-pin holes about 1 in. apart, and locate them about 1½ in. in from the back and front edges of the case. Be very accurate in laying out these holes, else the shelf will teeter when it's installed. A template of ¼-in. Masonite pegboard will ensure consistent hole location. To keep the drill bit from wandering out of line, I dimple each hole with an awl and use a brad-point drill bit in a Portalign tool. Make sure the bit has a depth stop to keep you from drilling through the plywood. Another way to support shelves is with metal or plastic shelf standards let into grooves milled in the case sides, or with steel shelf hangers that plug into ¼-in. holes.

Gluing up—To check the accuracy of the joinery, assemble the box without glue. Examine each joint, and trim away tight spots and ridges with a chisel or a plane. Fix a sloppy-fitting joint by gluing a strip of veneer to the tongue, sanding it smooth after the glue has dried. Since plywood faces are easily marred by clamps, and because there's no other way to apply pressure to a long joint in the middle of a big box, I use 2x4 cauls for each assembly job. If you plane the edge of

Plans for a child's loft bed

Like all the furniture I build for children, this loft bed is durable enough for the small child who plays under the desk and runs his toy cars along the shelves, but spacious enough for the older child whose stereo sound system spreads over the desk behind his computer. And because the bed is up high in a box, it doesn't need to be made each morning. The project was designed for a six-year-old whose room in the family's newly restored Victorian house had a high ceiling but no closet and only one wall long enough for a bed.

The bed consists of four basic boxes—one each for the bed, storage cabinet, desk and bookcase. All but one are made of ¾-in. shop-grade veneer-core birch plywood. To keep the size down, I used a 30-in. wide cot mattress (no box springs) rather than a standard twin-size mattress. Whichever you use, measure it before you begin cutting. Drawers are made of ⅝-in. fir plywood, to keep costs down, but if you prefer, use hardwood plywood. The desk top can be hardwood plywood, let into a rabbet, instead of laminate-covered fir plywood.

The drawing shows a refined version of the piece shown in the photo on p. 48, so it differs in some details. For extra strength, for example, the stretcher connects the center of the leg support to the storage cabinet, instead of fastening at its back edge. The desk can be longer or shorter to suit the child's room, or to more economically use what plywood you have available. —*A.T.*

CUTTING LIST

Amt.	Description*	L x W
	Storage cabinet	
2	Cabinet sides	60 x 32
1	Cabinet top	31¼ x 31¾
1	Fixed shelf	31¼ x 31¾
1	Cabinet bottom	31¼ x 31¾
1	Toe board	30½ x 2
1	Cabinet back (¼-in. fir plywood)	60 x 31¼
2	Cabinet doors	18¼ x 14¾
2	Door pulls (¾-in. solid birch)	18¼ x 1½
1	Top drawer false front	30⅜ x 4½
3	Middle drawer false fronts	30⅜ x 7
1	Bottom drawer false front	30⅜ x 8½
5	Drawer pulls (¾-in. solid birch)	30⅜ x 1½
5	Drawer bottoms (¼-in. fir plywood)	29⅝ x 21⅝
10	Drawer runners (¾-in. hardwood)	31 x 5/16
	Drawer parts listed below are ⅜-in. fir plywood:	
1	Top drawer front	29⅝ x 4½
3	Middle drawer fronts	29⅝ x 7
1	Bottom drawer front	29⅝ x 8½
2	Top drawer sides	22 x 4½
6	Middle drawer sides	22 x 7
2	Bottom drawer sides	22 x 8½
1	Top drawer back	29⅝ x 4
3	Middle drawer backs	29⅝ x 6½
1	Bottom drawer back	29⅝ x 8

Amt.	Description*	L x W
	Bed box	
2	Bed sides	78 x 12
2	Bed ends	31¼ x 12
1	Bed bottom (¼-in. fir plywood)	77¼ x 31¼
5	Bed supports (fir 2x4)	30½
2	Mattress boards (½-in. fir plywood)	76⅜ x 15⅛
	Desk box	
1	Desk top (⅝-in. fir plywood)	72¼ x 29¾
1	Top surface (plastic laminate)	73 x 30½
2	Long sides	73 x 3
2	Ends	29¾ x 3
4	Desk crossmembers (¾-in. pine)	29 x 2⅜
2	Leg uprights (¾-in. solid birch)	27⅜ x 3
2	Leg crossmembers (¾-in. solid birch)	29 x 3
1	Stretcher (1-in. solid birch)	72¼ x 3
	Bookcase box	
1	Front side (¾-in. solid birch)	60 x 12
1	Back side	60 x 12
1	Bottom	31¼ x 12
1	Top	31¼ x 12
4	Toe boards	30½ x 2
2	Adjustable shelves	30½ x 11⅞
1	Fixed shelf	31¾ x 12
3	Bookstops (¾-in. solid birch)	30½ x 1½
1	Roll of iron-on plywood edge tape	

**Parts are ¾-in. birch plywood, except where noted. Dimensions allow for joints.*

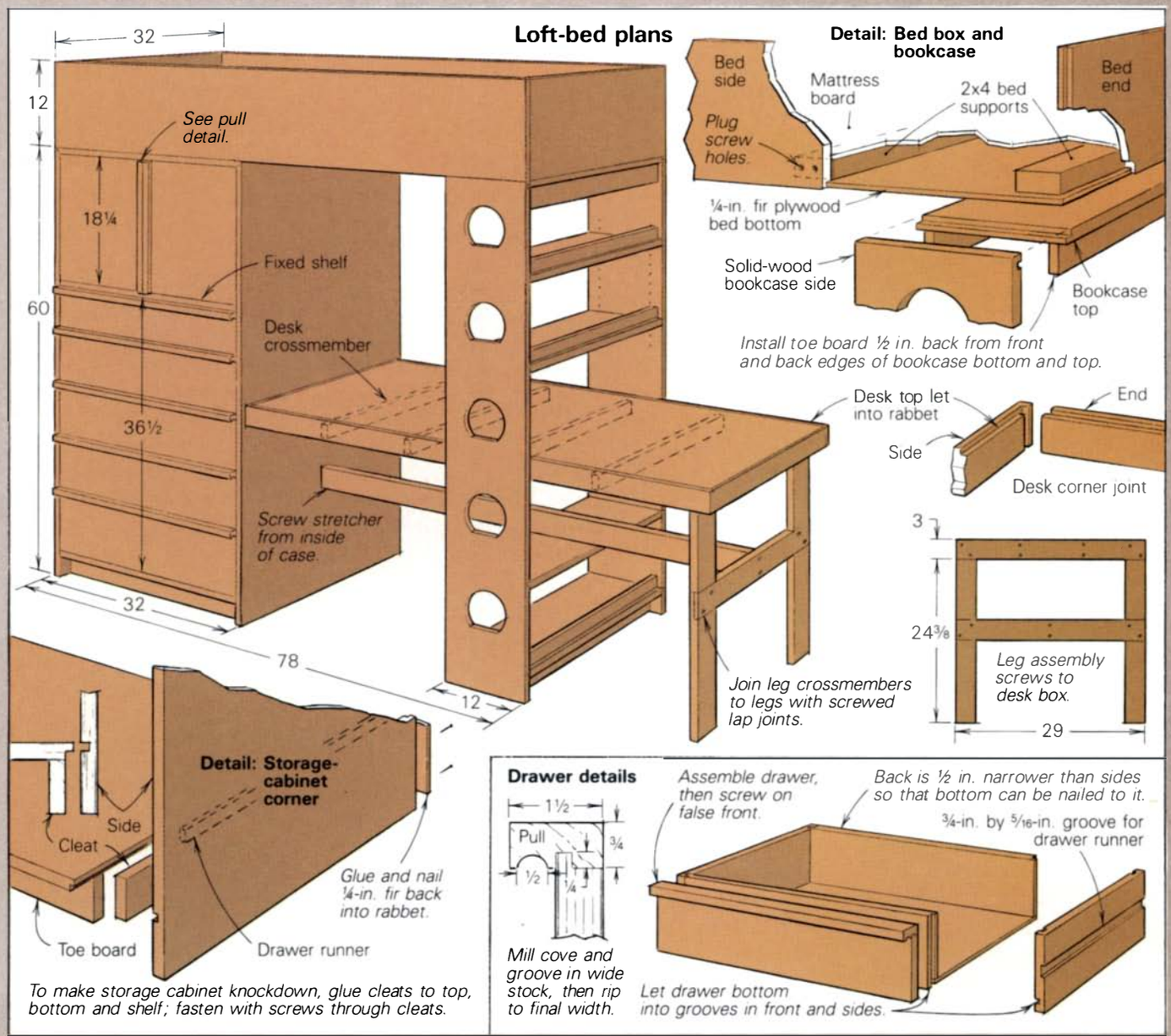
each caul slightly convex, it will bear down harder on the middle of the joint, pushing the joint home more effectively.

Once the box is dry-assembled, check it for square by measuring diagonally from corner to corner. Both diagonals should measure exactly the same, but for practical purposes a 1/16-in. tolerance is good enough. Another way to check for square is with an accurate framing square, but it isn't as reliable, especially if the box parts bow a bit under clamp pressure. Correct small out-of-square errors by adjusting the clamps; if this won't work, disassemble and check each panel for square.

Before gluing up, sand the box parts with at least 100-grit, finer if you want. Be careful when sanding plywood, particularly with a belt sander. It's surprisingly easy to sand right through the face veneer, resulting in a blemish that's impossible to repair. If the wood appears to darken, the sander is going through the veneer into the next veneer layer. I finish after assembly, but some woodworkers finish before, so that glue squeeze-out won't stick. Don't dribble finish into the joints, however, or the glue won't hold. Let squeeze-out dry completely, then slice it off with a sharp chisel, scraper or razor blade. Wiping the glue, even with a damp cloth, will only force it into the grain, where it will show up when you finish.

Before the glue is dry, I attach the back, which helps square the box. If the back won't be seen, as in a chest of drawers, make it out of ¼-in. Masonite or fir plywood. Open bookcases and cabinets should be backed in plywood that has the same face veneer as the rest of the box. In either case, size the back so that it fits snugly into the rabbets. Don't measure between the rabbets—the clamps may have bowed the carcase in a little, and your measurement will give you a back that's too small. I put a light bead of glue in the rabbet, and nail the back in with 1-in. ring-shank paneling nails, first on one side and then along the top or bottom. If the sides bow, pull them in gently with a pipe clamp before nailing.

Finishing up—There are two ways to hide the ugly exposed edge of plywood: by edgebanding it with thin strips of wood before assembly, or by covering it with iron-on veneer tape or a solid-wood face frame after the cabinet is put together. Some people argue that edgebanding is more durable and a



face frame stronger. While this may be true, I find iron-on veneer tape faster and a lot easier to handle. Bought in 250-ft. rolls (from The Woodworkers' Store, 21801 Industrial Blvd., Rogers, Minn. 55374, or from some lumberyards), it costs about 15¢ per linear foot. You can cut it with scissors and apply it with an ordinary household iron. If incorrectly positioned, the tape can be reheated and moved.

To apply the tape, cut a strip about ¼ in. longer than you need and iron it in place with the iron set on "linen." While the tape is hot and the glue melted, press it down with a block of scrapwood; the pressure of the iron alone is not always sufficient to set the tape. Even though plywood corner joints are rabbet-and-groove, the veneer tape looks best if it's mitered at the corner (photo, p. 51). These miters can be cut with a 1-in. chisel, but a straightedge and X-acto knife makes a neater cut. With two layers of tape overlapping at the corner, I place a straightedge diagonally from the outside corner to the inside, then knife through both thicknesses of veneer at once. Reheat the tape, then pull the joint tight and press down. Since the tape is 13/16 in. wide, I trim it flush with a chisel, and then sand the outside of the box with 100-grit and finer belts. I round the taped edges and corners slightly with 120-grit sandpaper. This helps bond the tape to the edge, and prevents it and the face veneer from being snagged and chipped.

A completed box can be fitted with drawers or doors using the construction methods shown in the drawings above. You can buy metal drawer slides or make your own out of hardwood. Doors can be hung on butt or knife pivot hinges, or on the adjustable concealed hinges described in *FWW* #43, p. 59.

Plywood boxes can be finished with just about any wood finish, or even covered with plastic laminate. A clear, fast-drying finish such as shellac or lacquer, or an oil finish is the easiest to apply. If the box is stained, discolorations from glue and uneven sanding, and ripples and other imperfections in the plywood will become more obvious, as will variations in grain. Paint will hide all these and any mistakes that you've had to fill or patch. □

Ann Taylor makes furniture in Winnetka, Ill. Photos by the author.

Made in Taiwan

Copycat tools give U.S. makers a run for their money

by Paul Bertorelli

Browsing through a gift shop last summer, I came across a shelfful of what must be the classic American roadside souvenir: cheap cedar knickknacks stenciled with an epigraph or the name of a tourist attraction. When I picked one up—a little box whose crudely slotted top suggested a piggy bank—I couldn't help but wonder who makes these things. And at less than $2 apiece, how can the makers survive after the store takes its cut? Stamped on the box's bottom was the not-too-surprising answer: "Made in Taiwan."

Crated Taiwan tablesaw.

Even if the box had been made in the United States, chances are the cedar could have been planed in a Taiwanese planer, sawn on a Taiwanese tablesaw and maybe even glued up with Taiwanese clamps. Though the Taiwanese have earned a reputation as maker of the world's throwaway goods—everything from cut-rate clothes and shoes to cheap radios and watches—they have graduated to more sophisticated and expensive products, including woodworking machine tools, a market once dominated by U.S. companies.

For the past ten years or so, Taiwan has been exporting to the United States a slowly expanding line of the most popular stationary woodworking tools: tablesaws, jointers, planers, bandsaws, lathes and drill presses. Some of these are heavy-duty tools of Taiwanese or European design, but many more are out-and-out copies of familiar trade-tool machines made for years by companies such as Rockwell and Powermatic. Even the ingenious Shopsmith has been cloned. Some copiers duplicate the original machines bolt-by-bolt, even casting in Rockwell's foundry numbers and tossing in a plagiarized owners' manual.

Early knockoffs were so inept that few Americans were willing to gamble, despite absurdly low prices that were commonly as little as one-fifth the cost of the real thing. During the past couple of years, though, the Taiwanese have noticeably improved quality, attracting more customers and a network of dealers willing to offer the service and warranties that the early copies lacked. I couldn't dig up reliable sales figures, but Rockwell seems to have been hit the hardest by the Taiwanese invasion, particularly in the trade-tool market, which is the bread and butter of its power-tool division. Determined to win back lost sales, Rockwell has lowered prices through factory rebates, and last fall it asked the U.S. International Trade Commission to bar importation of the most slavish copies.

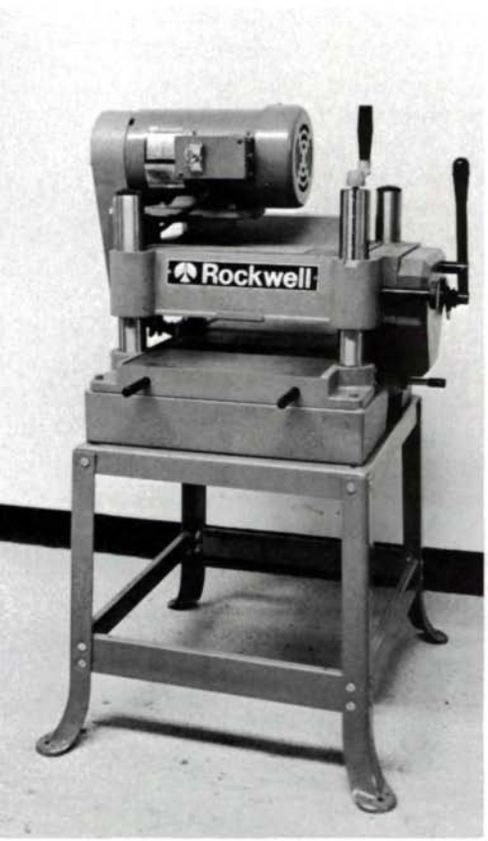
Taiwan-made tools are sold in the United States through direct importers—companies who buy from Taiwanese factories and then resell to individuals, or to dealers who want to broaden their line of U.S., Japanese or European tools with cheaper alternatives. Some importers, such as Jet Equipment and Tool of Tacoma, Wash., are big corporations that bring in woodworking equipment with the other goods they sell. Others, such as Conover Woodcraft Specialties and Wilke Machinery, are smaller firms that specialize in foreign-made woodworking tools.

Ernie Conover got into importing in the late 1970s, when he needed metalworking machine tools to produce a wooden threadbox he planned to market. Like most of us, Conover didn't have the money for American-made tools, so he bought what he could afford: a Taiwanese vertical milling machine. The mill worked well enough to convince him that Taiwanese tools, if chosen carefully, were a bargain, so he began importing woodworking equipment to augment his growing tool business.

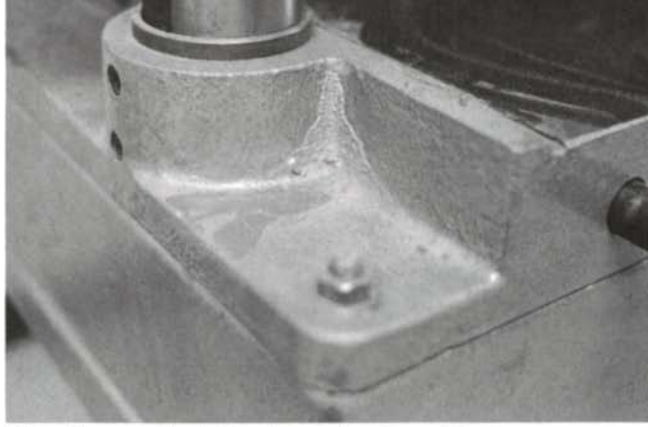
Conover's catalog shows ten Taiwanese machines, including a couple of 10-in. tablesaws cloned from Rockwell's popular Unisaw and Contractors' saw, and a Rockwell 6-in. jointer look-alike. I'd seen enough cheap Taiwanese merchandise to expect the worst, but I have to admit that the jointer I inspected at Conover's Parkman, Ohio, store was impressive. The table and fence castings were quite clean, the machining was crisp, and the entire machine had an even, gleaming coat of gray paint. At $495, Conover's jointer sells for less than half Rockwell's $1200 asking price.

So, for a $700 saving, how much quality do you lose? Conover believes that the only sure way to tell is to use the machine over a period of time. Even then, he cautions, quality is liable to vary from machine to machine. The other tool sellers I talked to seem to agree. Machines I saw at Conover's and at other dealers generally looked good, with big, beefy castings and smooth, polished machined surfaces. Some fall down under closer scrutiny. The ribbed undersides of a Taiwan-made machine's cast parts, for example, are often rough and malformed. On one tablesaw I inspected, the factory hadn't cleaned the underside of the table but had merely painted over the mess—sand, casting dross and all. Rough castings don't necessarily degrade performance, but details such as access plates, handwheels, pulleys and threaded parts are often similarly dispatched without clean-up or deburring, so some clearly fit and work better than others.

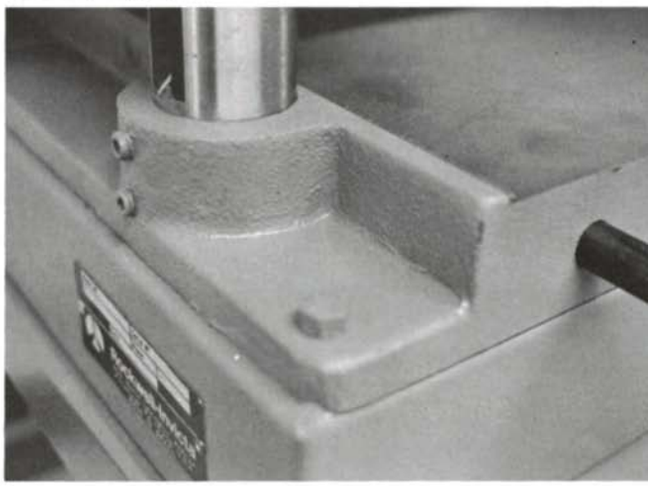
All this seems to suggest that the Taiwanese are generally very good at what the United States used to excel at—basic smokestack work such as founding and smelting, industries that don't require engineering finesse and innovation. They're less adept at the finer points of mass production—the precisely organized assembly steps, jigged setups and automatic adherence to tolerances that add up to airtight quality control. The poor record of Taiwanese electric motors and controls illustrates this point: beefs about motors and electrics lead the



If a U.S. company scores big with a hot-selling machine, the Taiwanese are likely to be right behind with a copy. At right above is a Taiwan knockoff of Rockwell's popular Invicta planer, at left, which is itself made in Brazil. The copy is atypically modified: it's 2 in. wider and the depth-adjusting crank has been replaced by a handwheel.



Though generally improving, copycat quality is hit-or-miss, especially in detailing. The photo above shows painted-over sand and dross in the fillets of the Taiwanese planer's table casting. The photo below shows the same detail on the Rockwell original.



customer-complaint list, and none of the importers I talked to would guarantee a Taiwanese motor for more than ninety days. From the outside, the motors look great, often sporting heavy cast housings whose cooling fins make them look like the American-made motors of forty years ago. In use, I'm told, the motors tend to overheat or run erratically, or occasionally burn out after a few hours. They're not always repairable, either. "We just chuck 'em out," says Ted Grieco of Rudolph Bass, Inc., a big machinery house in New Jersey that sells some Taiwanese equipment. "If we get a bad motor, we just eat it. In the import business, there's no returning a motor to the factory for a credit."

I got a look at the guts of a Taiwan-made motor when I visited Rockwell's Pittsburgh headquarters, where the company maintains its own museum of copies in a room adjacent to the product-testing lab. Rockwell technician Fred Weimer ushered me through the collection of clones, which includes a really awful Unisaw copy with a tabletop that looks more carved than cast. Weimer, who's been poking and probing these machines for a couple of years, showed me the wreckage of a motor he had pulled from an 8-in. motorized tablesaw copy. In the Rockwell version, a router-type motor connected through a gearbox drives the sawblade. The counterfeit apes the motor and gear drive faithfully enough, but instead of mounting the shaft in ball bearings, as Rockwell did, the copiers substituted bronze bushings. Spinning at 20,000 RPM, the bushed shaft had so much end play that its cooling fan cut into the motor winding and stopped it dead after four hours of use.

Repairing the other parts of any Taiwan-made machine may or may not lead to as much grief, depending on which factory built it and which importer brought it in. Taiwanese woodworking tools spew from a group of factories clustered around the industrial city of Tai-chung. Importers say that these factories—which range from garage-sized machine shops to a few modern factories outfitted with state-of-the-art tooling—compete viciously for a share of the North American market. Since they all build identical machines, copycat companies beat out their competition by selling at the lowest price, not by offering better quality. "I can buy a six-inch Rockwell-type jointer from maybe six shops," importer David Wilke of York, Pa., told me. "The cheapest one might be a hundred dollars out the factory door; the best one will be twice that much. But I'll tell you, I wouldn't want that hundred-dollar machine in my shop."

Taiwan's cottage-industry manufacturing approach plays havoc with quality control and parts interchangeability. One foundry might make up accurate patterns to cast an American machine's parts, but another will use actual parts from the original as patterns, ignoring the fact that cast iron shrinks when it cools, thus producing parts smaller than the originals. The assembly shop is left to cope, machining parts one at a time on outdated, run-down machine tools without any setup jigs to ensure interchangeability.

"On one of my first trips to Taiwan," says Conover, "I went through a shop where they had a little kid making wrenches for the cutterhead bolts in planers. He'd chalk the outline of each wrench onto a piece of steel plate as big as this room, then he'd burn each one out with a torch. When you've got lots of cheap labor and no tools and dies,

that's the way you do it. Here, we'd just stamp them out on a hundred-ton press." Low-skill, labor-intensive manufacture doesn't necessarily produce inferior goods, but some lemons are inevitable. "You've really got to be careful of what you buy from Taiwan, and you have to sit on the quality control," says Wilke, who, like Conover, has been importing for about seven years. Wilke has his Taiwanese suppliers bolt rather than nail crates so that he can unpack machines for testing and repair before they're shipped to the customer.

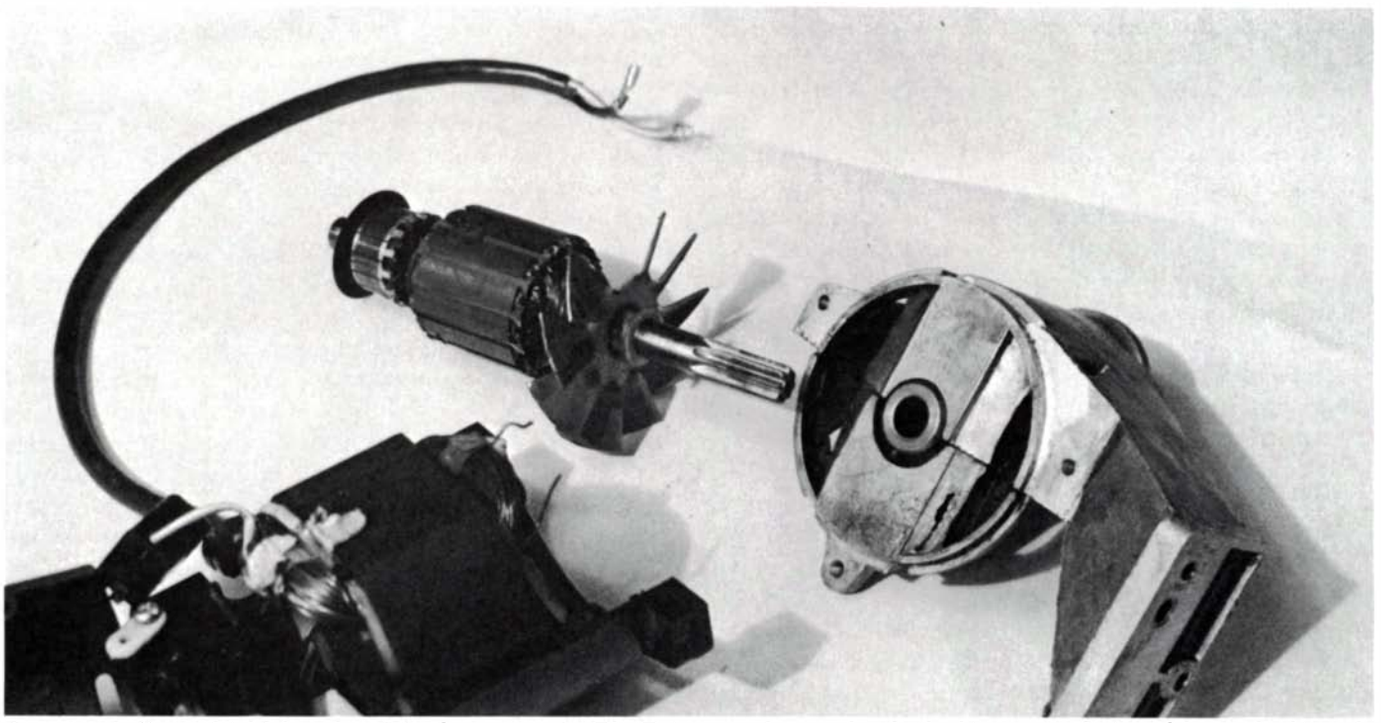
Some Taiwanese factories are capable of excellent work. Besides the look-alike tools, both Conover and Wilke import a line of more expensive machines that the Taiwanese seem consistently good at making: big, heavy industrial tools that are a notch above the trade-tool category but still priced at a fraction of what you'd pay for the equivalent U.S. machines. These aren't copies but generic heavyweights—mostly jointers and planers—of some indeterminate design origin, probably dating to the 1930s.

In addition to generally nicer detailing and finishes, these machines have design features found only on the most expensive industrial equipment. This sophistication suggests that they come from factories more competent than those that do copies, factories that are also clever enough to improve and innovate at the behest of savvy importers. A 12-in. jointer that Conover and Wilke buy from the same Taiwanese supplier has a beautifully made, crank-adjusted fence and fluted table castings that reduce cutterhead noise. One of the nicest Taiwanese machines I saw was a 13-in. planer that Wilke sells under his own Bridgewood label. For $1995, this machine has a cast-iron stand, segmented cast-iron chippers, a segmented feed roller, variable feed speed, and, best of all, a little lever for adjusting the bed rollers, sparing you the hassle of crawling under the machine, wrenches in hand. Compared to the $2500 Powermatic 12-incher (with none of the same goodies) sitting next to it on Wilke's showroom floor, the Bridgewood looked like a decent buy. Wilke, by the way, says he has been satisfied with Taiwanese motors. Conover, on the other hand, bolts American motors onto his heavier machines.

The fact that some importers have overcome the stigma of cheapness once attached to Taiwanese goods suggests that their market toehold is permanent. Everyone I talked to, including Rockwell executives, seemed to agree that except for occasional lapses, the quality of Taiwanese machines is improving. Rockwell obviously plans to put up a stiff fight. In gathering evidence for its trade-commission maneuvering, the company has been running magazine ads asking purchasers of Taiwan-made machines to report misrepresentations involving look-alikes. This, in fact, is the heart of Rockwell's argument before the trade commission. Most of its patents on copied equipment have long since expired, so Rockwell, wishing to hamstring the Taiwanese in any way it can, is pleading unfair competition. Its main gripe is that copies wear the Rockwell "trade dress," that is, they are not just functional copies, but are gussied up and sold to look like the real thing, thus hurting Rockwell's sales and reputation.

Rockwell has other options. "We could get into bed with a Taiwanese company and have our machines made under license," says Lou Brickner, head of new-product development for Rockwell. Other U.S. firms troubled by counterfeiters have done just that. "It wouldn't take the Taiwanese much to improve their quality to our standards," Brickner says. "They're almost there now. Then again, that would put six hundred people out of work in Tupelo [Rockwell's largest tool plant]. . . we don't see that as a solution."

It's hard to say how effective Rockwell's tactics will be, but I think we'll be seeing fewer dead-ringers. By midwinter, two of the twenty-two companies named in Rockwell's trade-commission suit (some U.S., some Taiwanese) had agreed to a confidential informal settlement, which probably means that they will stop selling copies altogether, or will change them to look appropriately non-Rockwellish. This outcome is prob-



Some knockoffs are faithful to the original, some aren't. The Taiwanese factory that built this motor substituted bronze bushings for the bearings used in the original. The sloppy fit allowed the motor's fan to slice apart the windings.

ably in everyone's interest. After researching this article and inspecting plenty of credible Taiwan-made equipment, I can't escape the feeling that there is just something sleazy, if not downright wrong, about copying if it extends to matching the color of a machine's paint and duplicating the typeface on the instruction plates. Some copycats push the ruse even further by tacking on U.S.-sounding brand names such as "American" and "Chicago."

When confronted with this moral unease over copying, most importers just shrug and say competition is competition. Evidently their customers agree—we've yet to get a letter from a reader complaining of buying a Taiwanese copy that was palmed off as the genuine article. Finally, I suppose, it shakes down to money. If buying a copy meant the difference between woodworking and not woodworking, it would be hard to pass up the prices on some of this equipment. I guess I'd strip the "Buy American" bumper sticker off my Japanese pickup truck and take my chances. □

Paul Bertorelli is managing editor of Fine Woodworking.

Tips on buying Taiwanese machines

Compared to the best U.S., Japanese and European equipment, the rough-and-tumble castings and crude detailing on some made-in-Taiwan tools seem undeniably second-rate. Look around carefully, though, and you'll find plenty of bargains, copycat or not. I'm no machine expert, but when I asked tool dealers how they'd go about buying Taiwanese tools, I got enough useful advice to limit my chances of getting stuck with a junker.

First of all, don't buy on price alone. A 6-in. Taiwanese jointer, for example, might sell for $275 through a discount importer, while the identical tool goes for $450 elsewhere. For the extra money, the higher-priced dealer will usually uncrate and test a machine, repairing any damage or defects before shipping it on to the customer. Discounters are less likely to offer such services. They trim their overhead by shipping direct, so if a defective or incomplete machine is sent out from Taiwan, you'll be the first to find out about it. And you may have to wait quite a while for repairs or parts.

Buying a bum machine from a reputable company shouldn't be a problem, since most dealers will take it back or repair it to your satisfaction. But before you buy, get straight on the seller's warranty policy and, if possible, get it in writing. Like quality, warranties on Taiwan-made machines are all over the map: some sellers guarantee the machine and its parts for a year but the motor for only 90 days; others offer only 90 days on both machine and motor. Also find out who pays the freight if you have to send a machine back for warranty work, or if parts must be shipped to you.

If you live near a dealer, go and look at the equipment you plan to buy. Have it uncrated and inspect it for broken, damaged or missing parts. Examine machined surfaces for rust—seawater sometimes leaks into shipped-on-deck marine containers. If you're buying sight unseen via mail order, you can't inspect before you buy, so go over your machine as soon as it arrives, and if anything is amiss, file a claim right away with the dealer or shipper. Here are some things to look for:

Check a tablesaw by sighting the table casting with a straightedge. You shouldn't find any appreciable hollows or lumps in either the main table or its wings. Test the miter gauge for reasonably smooth travel in its slots, and see if the rip fence locks tightly and parallel to the miter-gauge slots. If it won't lock correctly, be sure it has an adjustment mechanism—some copycats omit or bungle this feature. With a blade on, crank the depth of cut to both limits of travel and angle the arbor to its 45° limit, and see if the blade spins freely without banging into the saw's internal parts. Taiwanese tablesaws have been built with arbors too short to accept a dado blade. For a full ¾-in. dado set, the arbor has to be at least 1¼ in. long.

In jointers, machined tolerances are critical, particularly the flatness of the tables. To check it, crank both infeed and outfeed tables into the same plane, then span the length of both tables with an accurate straightedge. If you see any daylight between the edge and the table surfaces, the tables are not parallel, a condition that may be impossible to repair economically. Use a pair of wooden winding sticks (*FWW* #13, pp. 50-51) to check the tables for twist. Sight the fence as well; a slight bow isn't as big a problem as a twist is. Crank the infeed and outfeed tables to their travel limits, while occasionally spinning the cutterhead by hand, to make sure everything clears. The table lead- and lock-screws should turn smoothly, without binding.

A bandsaw has fewer critical-tolerance parts, but if it's to run smoothly, the wheels should be true and, ideally, balanced. To check, remove the blade and the motor belt, and spin each wheel. A warped or bent wheel will wobble noticeably. Spot a lopsided one by chalking a mark on the rim and giving the wheel another spin. If the mark comes to rest at the same point each time, the wheel may be heavy enough on one side to vibrate at sawing speed. Blade guides are harder to judge. Some Rockwell copies mimic the original faithfully, others only halfway. Just make sure that the machine has guides of some sort and that they are adjustable. Check the blade length, too; it should be a standard size, not an oddball that will have to be custom-welded. Also, make sure that replacement tires are available.

The best Taiwan-made motors are heavier and larger than their Western counterparts, and are likely to provide good service. The worst reveal themselves by overheating and occasionally burning up during the first few hours of use. There's no practical way to pick a good one. You ought to check the wiring, though. A single-phase motor should be wired with a two-conductor cord, plus a ground wire—usually green—through a three-prong plug. The ground should be connected to both the motor frame and the machine itself. A three-phase motor should have a three-conductor cord, plus the ground. Make sure that none of the three-phase legs is grounded to the machine frame, or a shock hazard will exist if the plug is incorrectly wired. Ground wires often get fastened to painted metal surfaces, defeating their purpose. Disconnect them and clean up the mating surfaces with sandpaper.

Finally, don't expect to uncrate a perfect machine, at least not every time, and don't plan on it having much resale value. Besides using cheap labor, Taiwanese factories are notorious for cutting corners to keep prices down. This might mean you'll get a lousy paint job, sand-bound castings, or burred edges left undressed—all minor problems you can fix yourself. But defects serious enough to render a machine useless aren't uncommon, so your best bet is to try to spot a dog before you pay. It's one thing to have to file a few parts to a perfect fit. It's something else entirely to have to remachine a warped casting. —*P.B.*

A Swing-Away Drill-Press Table

Versatile accessories help sand and rout

by R.J. DeCristoforo

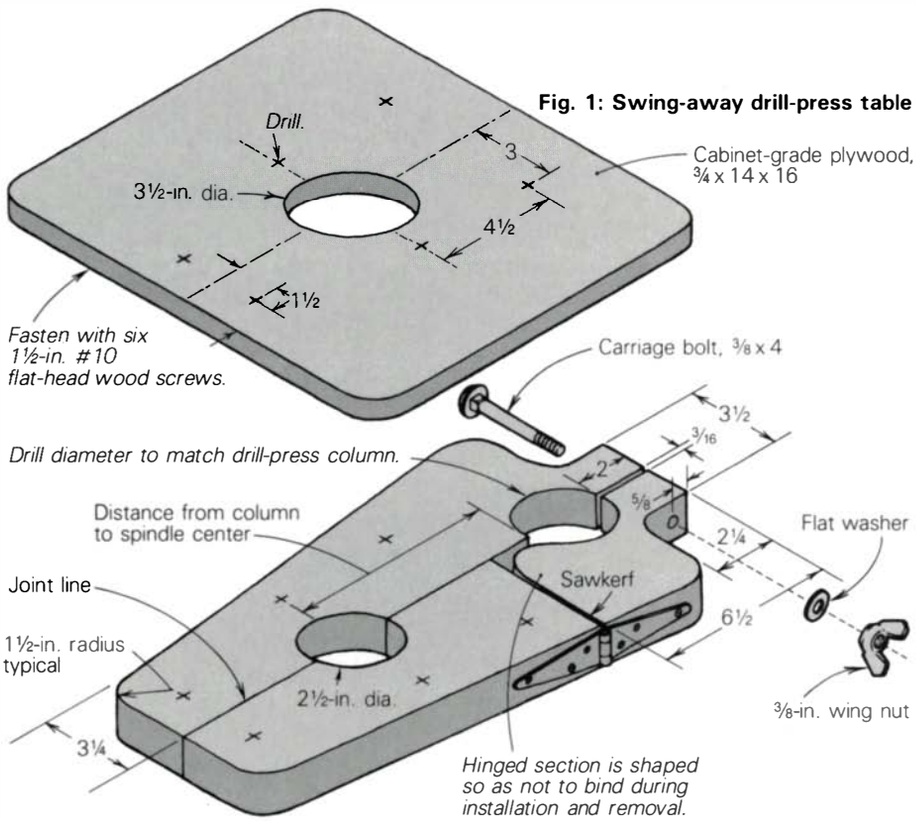
The drill press is one of the most versatile tools in any woodworking shop, but you need special accessories to get the most from it. Many times these accessories aren't available commercially and you must make them. Here's an auxiliary swing-away table with custom-made inserts that will help you use your drill press for drum-sanding inside or outside curves, pattern-sanding and pin-routing. When the jig isn't needed, it swings out of the way, and can be used as a platform for other tools.

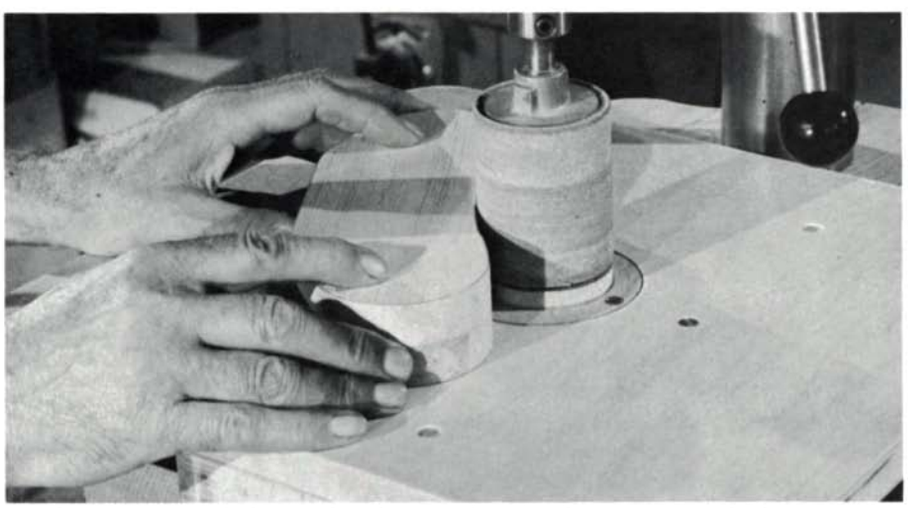
To construct the jig, cut two 1½-in. thick pieces of maple, birch or other hardwood, 5¼ in. wide by 19½ in. long. Clamp the pieces edge-to-edge and use a hole saw or a fly-cutter to make a hole the same size as your drill-press column. Locate the hole so that its rim is 2 in. from the end of the jig and its center is directly on the joint line.

Unclamp, and draw the outside profile on one of the pieces, as shown in figure 1. After sawing and sanding it, use it as a pattern to mark the mating piece. If you have a bandsaw, you can speed up the process by taping the pieces together and cutting both at the same time. Locate and drill the hole for the ⅜-in. carriage bolt that tightens the jig on the drill-press column.

Mark the centerline for the strap hinge on one half of the jig. Before cutting along this line, mark the location of the hinge screws, or, better yet, install the hinge and then remove it. Replace the hinge after making the cut and rounding the corner of the cut-off

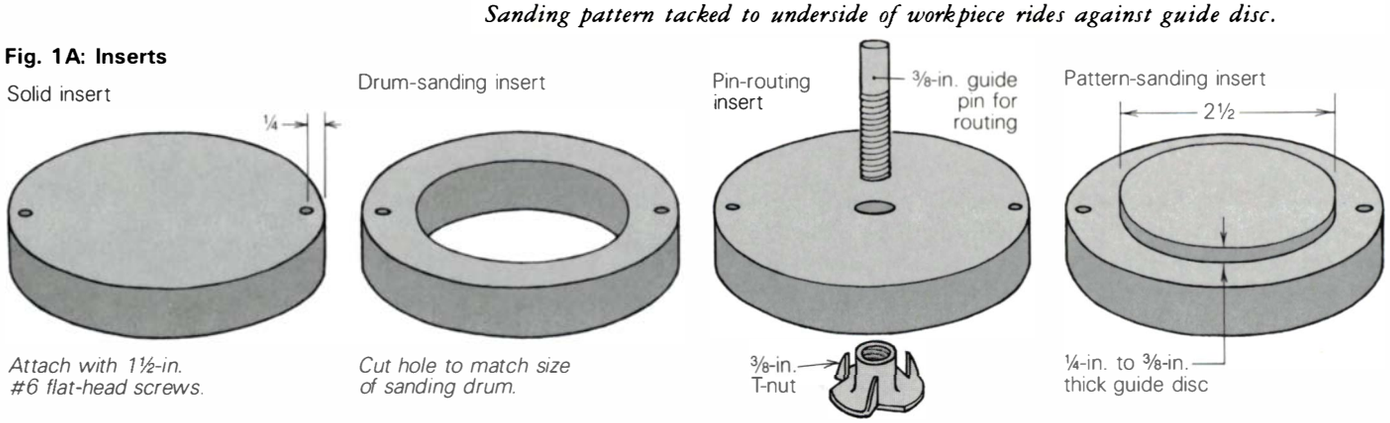
Fig. 1: Swing-away drill-press table





Sanding pattern tacked to underside of workpiece rides against guide disc.

Fig. 1A: Inserts



piece. Remove just enough material from the corner to allow the hinged section to swing around the drill-press column. Glue the two table pieces together.

Make the top piece now, but don't cut any of the holes yet. Center the top on the base and attach it with six 1½-in. #10 flat-head wood screws. The front edge of the top should be flush with the front of the base piece. Now center the assembly on the drill-press table, secure it with the carriage bolt, and, with the drill press, drill a small pilot hole through both top and base. Take the two pieces apart, and cut the 3½-in. hole through the top and the 2½-in. hole through the base. Sand all parts carefully and then screw the top to the base. Finish with lacquer or shellac, followed by paste wax.

Now use your bandsaw, fly-cutter or hole saw to make the inserts shown in figure 1A. All the inserts are 3½ in. in diameter, to fit snugly into the jig. The solid insert provides a good surface for normal drilling and helps prevent tear-out. The drum insert, designed for a 2½-in. drum, supports the workpiece so that its edges can be sanded square to surfaces. To sand inside areas, put the workpiece in place before you lower the drum.

To make the insert for pin-routing, drill the hole for the pin and T-nut while the insert is locked in the table. This ensures that the router bit and the pin, which is made from a cut-off ⅜-in. bolt, will be perfectly aligned. Alignment is crucial since a pattern, exactly the size and shape of the part you need, is tack-nailed to the bottom of a rough-cut piece. Moving the pattern along the pin enables the router bit to transfer the shape of the pattern to the rough-cut piece. Use a similar alignment procedure in making the pattern-sanding insert, which serves as a guide disc when pieces are being drum-sanded to size. Have the insert in place and mark the location of the guide disc while your sanding drum is mounted in the chuck. The sander and the guide disc must be perfectly concentric. The pattern rides the disc, so the work is sanded to match. Remember that this is a sanding operation—workpieces should be sawn as close to the line as possible. □

R.J. DeCristoforo, of Los Altos Hills, Calif., is a woodworker and author of numerous articles and books on woodworking. Photo by the author.

Drawings: Karen Pease

An Oscillating Spindle Sander

Taiwanese drill press spins and bobs

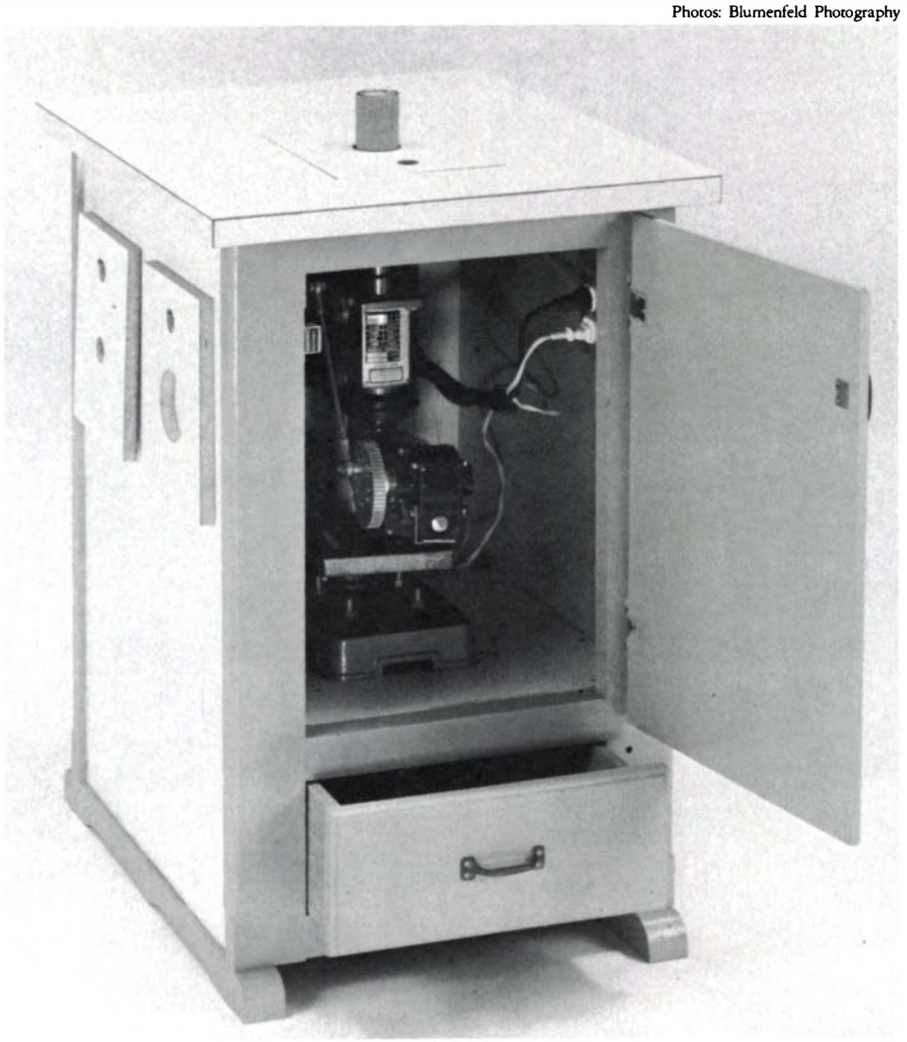
by Wesley P. Glewwe

An oscillating vertical spindle sander, whose drum moves up and down as it spins, doesn't leave the scratches that a conventional drum sander does. With a few inexpensive parts, you can turn a cheap Taiwan-made benchtop drill press into a durable, efficient oscillating sander, for a fraction of the cost of a manufactured unit, and you won't need to do any welding or machine work.

Not all Taiwanese drill presses are suitable for conversion. The one I used is about 23 in. high, weighs just under 50 lb., and costs less than $100. Made of cast iron, it has a ½-in. chuck, a ⅓-HP single-phase motor, and stepped pulleys for variable speeds. These machines are sold under many different names (American, Duracraft, Chicago, Intergram, Sterling, Central, Guardian, etc.), but all brands are about the same. Larger, more expensive Taiwanese drill presses, about 30 in. to 38 in. tall, cost more and can't be modified because of the way the head casting is attached.

The drill-press motor will rotate the sanding drum, but you'll need to buy a reduction motor to move the spindle up and down about ¾ in. to ⅞ in. There are two types of reduction motors: one with

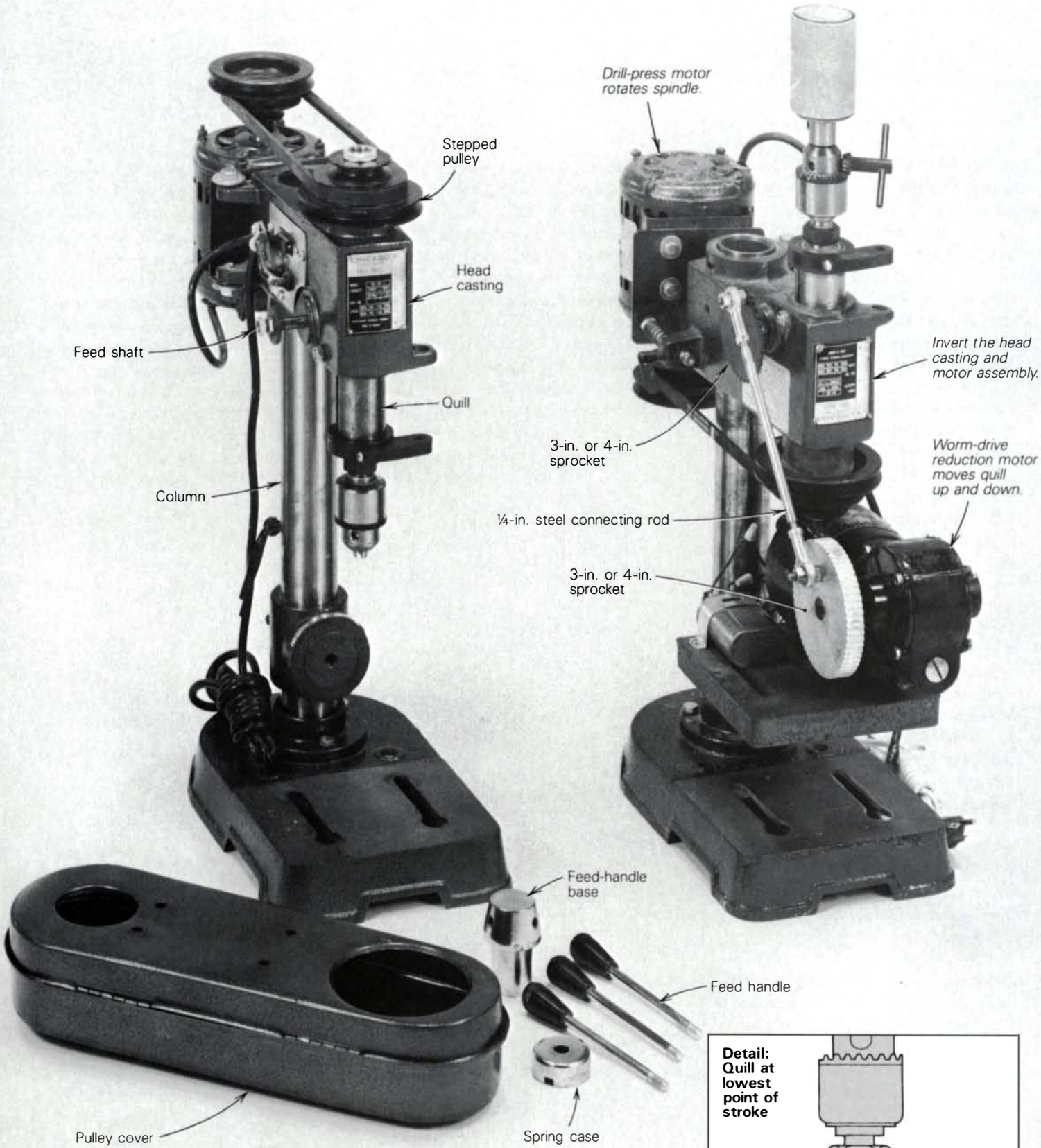
Photos: Blumenfeld Photography

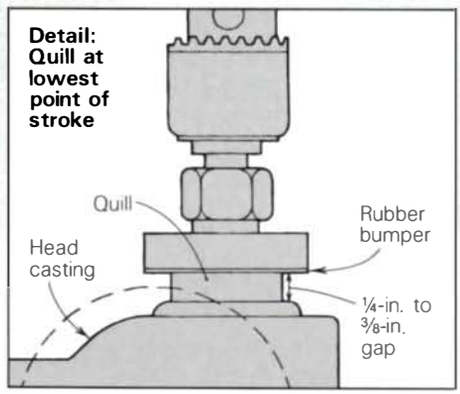


With a few extra parts, Glewwe converted a Taiwanese drill press into this oscillating spindle sander. The sanding drum moves up and down as it rotates, eliminating scratches. The particleboard cabinet has a plastic-laminate top with different size inserts, shown hanging on the cabinet, that lift out for drum-changing.

Drill press dismantled . . .

. . . becomes oscillating spindle sander





The drill press on the left is stock from the factory. A similar machine is shown at right, after conversion. The drill-press motor turns the spindle, and a worm-drive reduction motor drives a connecting rod to move the quill up and down. To convert the drill press, Glewwe first stripped the stock unit of the parts shown at center, then inverted the head casting and motor. The small canister strapped to the left side of the table is a capacitor (required with some motors).

a sun-gear mechanism, and one with a worm-gear assembly. Either type will do, but the worm-gear motor is easier to mount because the shaft is perpendicular to the axis of the motor. Buy a motor with at least 1/20 HP, rated continuous-duty with an output speed between 25 RPM and 60 RPM. My motor is a 115-volt AC, 1/15-HP worm-gear type with a 60:1 ratio and an output speed of 28 RPM. It was made by Bodine Electric Co. (2500 West Bradley Pl., Chicago, Ill. 60618), but I bought it at a surplus house (Surplus Center, 1000-1015 West "O" St., PO Box 82209, Lincoln, Neb. 68501) for about $30.

Two 3-in. or 4-in. sprockets form the crankshafts that oscillate the spindle. One fits on the reduction-motor arbor, the other on the drill-press feed shaft. Each sprocket must have a setscrew or some other means of locking it on the arbor. You can substitute gears or pulleys for the sprockets, or you can make the crankshafts from flat bar stock—they don't need to be round.

The connecting rod between the sprockets is made from an 8-in. length of 1/4-in. steel rod, capped by two rod ends with 1/4-in. bearing inserts (available from Alinabal, Division of MPD Corp., 28 Woodmont Rd., Milford, Conn. 06460). Buy the kind with female threads where the rod attaches.

Begin the conversion of your machine by removing the stepped pulley on the quill shaft. This is a press-fit and may be tough to get off. To loosen it, give the shaft end a few sharp taps while a helper tugs on the pulley. Be careful not to break the flanges. After you get the pulley off, remove the sheet-metal pulley cover, then replace the pulley on the quill shaft. If you can't get the pulley off, just cut the cover off with a hacksaw.

Next, remove the quill-return spring, which is in a case on the left side of the head casting, and slide out the feed shaft and handle assembly. Remove the three feed handles, and with a pin punch, drive out the pin that secures the feed-handle base to its shaft. Remove the base, which is also a press-fit.

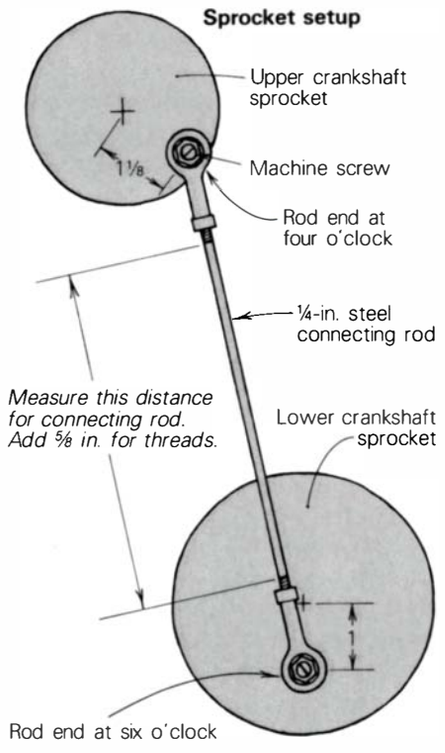
The small end of the feed shaft is slotted for the spring (which you've removed). Epoxy a metal shim in this slot to prevent the shaft from crushing when you tighten the sprocket on the shaft. Slide the feed shaft back through the head casting, and slip a few washers on the end of the shaft to take up the space originally occupied by the spring.

Now lift off the entire head assembly and invert it on the column. There are three cast-iron ribs on the inside of the head assembly. If the inverted head assembly won't slip over the column, file off the burr on the center rib.

One crankshaft sprocket goes on the feed shaft, but first drill a 1/4-in. hole 1 1/8 in. from the center of the arbor hole for the connecting-rod end. Mount the sprocket on the shaft. Drill a 1/4-in. hole through the other sprocket, 1 in. from the center of the arbor hole, and mount this sprocket on the gear-reduction motor arbor. Making sure the table isn't tilted, position the reduction motor on the worktable. Line up the upper and lower sprockets with a straightedge, and bolt down the motor.

Rotate the upper sprocket so that the rod-end hole is at four o'clock. At this position, the low point in the quill-shaft stroke, there should be a 1/4-in. to 3/8-in. gap between the head casting and the rubber bumper on the quill shaft. If there isn't, remove the sprocket, slide out the feed shaft, rotate it slightly, and replace it. Put a scrap piece of wood in the gap temporarily to prevent the quill from dropping while you're measuring. Now rotate the lower sprocket, by running the reduction motor, so that the rod-end hole is at six o'clock. At these positions, the quill will be at the bottom of its stroke. Now you're ready to measure for the connecting rod.

With the sprockets in the right position, measure the distance between the rod-end threads and add 5/8 in. to allow for threads. Cut the 1/4-in. rod to this length and thread the ends with a die that matches the rod-end threads. Just start the rod into the rod ends—you'll need to make adjustments later. Mount the rod assembly on the sprockets with machine screws, and add lock washers and nuts, finger-tightened.



Test the action by quickly switching the reduction motor on and off. Don't plug in the drill-press motor yet. The upper sprocket should make less than half a revolution, then reverse direction. You'll probably have to adjust the length of the connecting rod to get a smooth up-and-down motion. The easiest way to make this adjustment is to turn the connecting rod farther in or out of the rod ends, but you can also raise or lower the worktable or the head casting. Don't allow the reduction motor to run continuously until you get a smooth stroke of about 3/4 in. to 7/8 in. with no "thumps" at the top or bottom of the quill's stroke.

You can mount the sander underneath an existing workbench in your shop, but I built a particleboard cabinet to house mine. Plastic laminate makes a good work surface for the top. The spindle protrudes through a hole in a removable insert in the worktable that lifts out when you want to change drums.

I usually plug both motors into an outlet box controlled by a single switch. Sometimes you may want only the spindle to rotate, and with this setup, all you have to do is unplug the reduction motor.

In my machine, I use 3-in. long sanding drums with 1/2-in. dia. shanks (available from Singley Specialty Co., Inc., Box 5087, Greensboro, N.C. 27403). I like the kind with a clamping mechanism to hold regular sheets of abrasive paper, so I don't have to buy abrasive sleeves. These drums come in diameters from 3/4 in. to 3 in. Use the larger ones for long, sweeping curves, and the smaller ones for short arcs and scrollwork.

For best results, feed the work against the rotation of the drum, and keep it moving to avoid burn marks. You also risk burns if the drum turns too fast, so adjust the rotation speed by moving the V-belt on the pulleys. □

Wesley Glewwe is a retired FBI special agent. He lives in West St. Paul, Minn., and makes wooden-gear clocks as a hobby.

The Great American Pines

Forty species yield three distinct families of cabinet woods

by Jon W. Arno

The newspaper ad might read: "Common pine shelving boards, only 59¢ a board foot!" So the weekend woodworker, on his precious hobby budget, hustles off to load up. With just 100 bd. ft. of that affordable pine, he might reproduce that beautiful 17th-century New England china cupboard he's admired in the local museum.

Yet when the reproduction is finally done, something just isn't quite right. The joinery is accurate, the antique finish genuine, the hardware hand-forged. Nevertheless, there is something unmistakably 20th-century about the piece.

Our craftsman resigns himself to the apparent fact that it simply takes a couple of centuries for pine to develop its mellow, pumpkin-orange patina. The truth is, this particular pine lumber is never going to mellow, not in a thousand years. Why? Because pine isn't just pine. That bargain wood was a western yellow pine, probably *Pinus ponderosa,* while the Colonial original was almost certainly made of a decidedly different species: *Pinus strobus,* or eastern white pine. Both woods have a distinctly individual character. To a reproduction cabinetmaker, their lumber is not interchangeable.

The genus *Pinus* of the botanical family *Pinaceae* contains more than ninety species worldwide, several of which are among the most important in the timber and paper industries. The range of the pines is restricted to the Northern Hemisphere, except for one species that strays below the equator in Indonesia. As with fine hardwoods, North America is especially blessed with pines. Half of our 40 native pine species are important timber producers, and some have become major reforestation species, growing now where no true pine had grown before.

In Colonial days, the East Coast pines fit nicely into three basic groups. In the North were a "soft" (white pine), a "hard" (pitch pine), and an "intermediate" (red pine) which was very like Scotch pine, the wood that European cabinetmakers call "deal." In the South, the many kinds of pines were all very hard. In comparison with soft white pine, whose uniform texture works easily, some of the southern yellow pines have earlywood as soft as basswood, while the latewood within the same annual ring is as hard as rosewood. The southern yellow pines are therefore difficult to work, and have a showier grain pattern than the softer pines, especially when stained.

Throughout the Colonies, the hard pines provided building timbers, tough construction lumber and wear-proof floors. For furniture, the northern cabinetmakers favored the bland, easier-working white pine, but the southern cabinetmakers utilized the harder wood of the local trees. For this reason, museum curators today routinely find drawer runners and sides of southern Colonial furniture to be in good condition still, while in northern furniture the same parts have mostly worn out.

As local lumber stands were exhausted, loggers moved west and discovered other species of pine: two soft pines (western white pine and sugar pine), and a number of western yellow pines, the most important of which are much softer and more workable than the southern yellows. At the very least, today's cabinetmaker ought learn how to distinguish between the white pines as a group, the southern yellow pines, and the western yellow pines. Amateur lumberjacks might note that with one or two minor exceptions, the soft pines have needles growing in bunches of five, while the harder pines have them in bunches of two or three. The chart on the facing page compares pines within each of the three groups and shows macrophotographs of typical species.

Keep in mind that pine furniture has always been decidedly local in character. The Europeans made Scotch pine tables, New Englanders made white pine chests, and southern farmers built yellow pine cupboards with flashy grain. In the television show *Bonanza,* Ben Cartwright's furniture would have been of pure ponderosa pine. Country-style pine furniture was originally made of whatever pine grew in the particular geographic area.

The white pines—If you like traditional American furniture and want your projects to be "authentic," your first choice will naturally be eastern white pine. This is the "pumpkin pine" of early New England, so called because of the rich, golden-orange patina it develops with age. It's also the tree that Paul Bunyan harvested as he made his way from pinery to pinery along our northern border. The lumberjacks called it cork pine because its extremely low density caused it to ride high in the river as the logs were floated to the sawmill. For the cabinetmaker, this low density means that the wood is soft, easily worked, and lightweight. Wood from the white pine group is, in general, less dense than that of the species in the other groups. It is also not as resinous and has less contrast between earlywood and latewood. Thus the white pines cut more predictably, and can be finished to a mellower, more uniform tone.

The woods of eastern white pine and western white pine are so similar that I doubt whether a Colonial cabinetmaker could have told one from the other. The sapwood of both trees is light cream, almost white, in color, with the heartwood ranging from yellow to light orange-tan. Idaho has been the primary producer of western white pine, and the term "Idaho white pine" or the initials "IWP" stamped on a board identify one of America's finest softwoods.

Unless historical authenticity is important, however, I'd most likely choose the third major member of the group, sugar pine, for the primary wood in a furniture project. It has outstanding working characteristics (though it mars quite easily) and great stability, and it is available in large, wide, blemish-free boards—volumetrically, sugar pine is the largest true pine in the world. The wood is extremely consistent in

THE THREE GROUPS OF PINE LUMBER

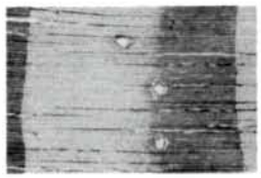
Group A: White pines

Prime lumber from trees in this group is soft, light, easily worked, and commonly available in lumberyards. As shown in the 10X end-grain macrophotograph at right, *Pinus strobus* (eastern white pine), which is typical of trees in this group, has a gradual transition from earlywood to latewood within each growth ring, and an evenness of cell-wall thickness throughout, which means that earlywood and latewood have similar densities. These characteristics make for good woodworking and staining properties.

BOTANICAL NAME	COMMON NAME(S)	RANGE	PROPERTIES OF THE WOOD
P. strobus	Eastern white pine, northern white pine, cork pine, Weymouth pine.	Northeastern United States and eastern Canada, Appalachians south to Georgia.	Creamy white wood with yellow to orange-tan heartwood; traditional pine of Colonial New England. Average specific gravity 0.34.
P. monticola	Western white pine, Idaho white pine.	Western Montana, Idaho, into Washington and Oregon.	Virtually identical to eastern white pine. Specific gravity 0.35.
P. lambertiana	Sugar pine.	Oregon, northern and eastern California.	Creamy tan color, prominent "fleck" marks; available in large, clear stock; excellent carving wood. Specific gravity 0.34.

Severe growing conditions make the woods of the following western trees extremely variable: Limber pine, *P. flexilis;* whitebark pine, *P. albicaulis;* the pinyon pines (four or more species and hybrids); bristlecone pine, *P. aristata;* and foxtail pine, *P. balfouriana.*

Group B: Southern yellow pines

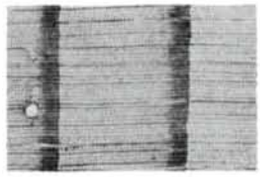


Woods in this group vary according to growing conditions, but latewood is predictably very hard and sometimes wide, while earlywood is soft, making for hard-to-work woods with racy grain patterns. Wood is resinous, dense, strong. Not generally a cabinet-quality wood, except for period furniture that demands it and for a long-lasting secondary wood. Makes good pressure-treated decking. The 10X macrophotograph of *P. echinata* (shortleaf pine), typical of the southern yellow pine group, shows wide, dense latewood, abrupt transition between earlywood and latewood within each growth ring, and extreme differences in wall thickness between earlywood and latewood.

P. palustris	Longleaf pine.	Southeastern and Gulf coastal plain.	Hard; yellow to orange-brown color; very resinous. Specific gravity 0.54.
P. echinata	Shortleaf pine.	From Texas to Georgia, and from Kentucky to northern Florida.	Similar to longleaf; slightly less dense. Specific gravity 0.47.
P. taeda	Loblolly pine.	Similar to shortleaf, except more southerly.	Same as shortleaf. Specific gravity 0.47.
P. elliottii	Slash pine.	Florida, southern Georgia and Gulf coastal plain.	Much like longleaf pine; one of the denser southern yellow pines. Specific gravity 0.54.

Minor species include Virginia pine, or Jersey pine, *P. virginiana,* specific gravity 0.45; pond pine, *P. serotina,* specific gravity 0.51; pitch pine, *P. rigida,* specific gravity 0.47; spruce pine (cedar pine, poor pine), *P. glabra,* specific gravity 0.41; sand pine, *P. clausa,* specific gravity 0.46; and Table Mountain pine, *P. pungens,* specific gravity 0.46, not abundant.

Group C: Western yellow pines



Woods in this group are slightly denser and more yellow than the white pines, but are lighter, less resinous and more workable than the southern yellow pines. *P. ponderosa,* shown at 10X in the macrophotograph at right, is typical of the pines in this group. Transition from earlywood to latewood is abrupt, yet latewood is not as wide or hard as in the southern yellow pines. Wood works well, holds crisp edges. Stain accentuates grain pattern. Dimpled grain common. Commonly seen in lumberyards as moldings and trim. The minor species listed are of little importance as timber producers due to their limited range and/or poor quality.

P. ponderosa	Ponderosa pine.	Inter Rocky Mountain region from Mexico to Canada, northern California and Oregon.	Best cabinet wood of the yellow pines. Specific gravity 0.38.
P. jeffreyi	Jeffrey pine.	Northern and eastern California, southeastern Oregon.	Virtually the same as ponderosa and marketed with it as "ponderosa" pine.
P. contorta	Lodgepole pine.	Northern Rockies, eastern California, Pacific Northwest.	Usually knottier than ponderosa or Jeffrey. Specific gravity 0.38.

Among the minor species are Torrey pine, *P. torreyana;* Monterey pine, *P. radiata;* Digger pine, *P. sabiniana;* and knobcone pine, *P. attenuata.* These may be available locally to western woodworkers. Some may be cut and shipped with the major species, especially in the lower grades and/or as dimension lumber.

The following species are not western trees, but are included in this group because of their wood's working characteristics:

P. banksiana	Jack pine.	Eastern Canada, northern Great Lakes states, New York and New England.	Wood most resembles lodgepole pine; knotty; light in color; wide sapwood; coarse-grained, may have dimpled grain. Specific gravity 0.40.
P. resinosa	Red pine, Norway pine.	Northeastern and Great Lakes states, eastern Canada.	Midway between the southern and western yellow pines in density; creamy white to yellow sapwood, orange to brown heartwood; less grainy and resinous than southern pines, but not as soft and workable as western yellow pines. Specific gravity 0.41.

Photos: John Limbach, Ripon Microslides

texture and a creamy light tan or beige in color, with a distinctive pattern in the grain caused by its characteristic resin canals. While all pines have numerous, fairly large resin canals (when compared to larch, spruce and Douglas fir), no other pine displays them so plentifully and prominently. This gives sugar pine the most distinctive—some think it beautiful—appearance of the white pines.

Several other western species—including limber pine, bristlecone pine and the pinyon pines—are listed in the chart as part of the white pine group, but their gnarly, short growth habit limits their value as lumber.

Southern yellow pines—These trees are hard, strong, dense and resinous, and a major source of paper pulp, plywood and construction timber. On the basis of commercial value and volume, the southern yellows are our most important pines, but very little lumber from this group finds a place in my shop. The trees produce a large band of latewood during the growing season, and they exhibit an abrupt transition between earlywood and latewood, with enormous contrast in density between the two zones. The knots are virtually impervious to stain. I don't like southern yellow pine, and much prefer to work with wood from either of the other two groups, yet I understand how southern yellow could be close to a period cabinetmaker's heart.

In reproducing a period piece in southern yellow pine, you would be better off trusting your eyes than relying on the differences listed in the chart. Woods from this group may be quite variable, but this seems less a matter of species than of growing conditions. Trees seeded on abandoned plantation lands grow faster than those that struggle up in mature forests. Producing broader annual rings and wider sapwood, the wood of these fast-growing trees may be considerably less dense than that of the typical southern yellow pine.

Western yellow pines—Most of the western yellow pines are less dense and resinous than the southern yellow pines. For a cabinetmaker, western yellows are a fine secondary wood, and some have novel grain patterns that can be attractive as a primary wood as well.

Ponderosa pine is one of the largest and most plentiful of the pines, which explains its ready availability and moderate price in lumberyards throughout the country. Unfortunately, it is not a rapid grower in the somewhat arid habitats of its range, and the day may come when this close-grained wood is no longer plentiful enough to hold its place as America's general-purpose, low-cost timber.

Ponderosa is only about 10% denser than the white pines, and therefore only a little harder, yet it is still undeniably a yellow pine in most ways. Just take the description of the southern pines and tone it down to the point where the wood's personality becomes amenable. The annual rings, for instance, are distinct and sometimes very showy, but there is less contrast in hardness between earlywood and latewood. Ponderosa has very narrow latewood, and the old-growth timber, with its narrow growth rings, can look surprisingly even-grained. The wood is superb for millwork: it machines beautifully and holds crisp edges.

Lodgepole pine is similar to ponderosa in color and density, but usually has smaller knots and many more of them. This species yields far less lumber per log than ponderosa. Growing in dense stands, the trees look like telephone poles with crowns of short needles, two to the bunch.

The ponderosa and lodgepole pines often exhibit a dimpled grain pattern. If you split a piece of the wood with an ax, small bumps on one side will be matched by dimples on the other. This abnormality, almost "normal" in these two pines, is caused by resin blisters in the inner bark which distort the cambium layer. The pattern is sometimes visible on the surface of plainsawn boards, and when the surface is tight enough to finish smoothly, it can resemble bird's-eye maple.

Northern yellow pines—Woodworkers may want to distinguish the northern yellow pines, species with which the first New England Colonists were familiar. Although two of these trees have working characteristics that assign them to groups we've already considered, the third, red pine, has qualities that help put all three groups in perspective.

Pitch pine is used primarily for pulp and only occasionally for lumber, although it was an important Colonial species before the stands were razed. Its wood resembles that of the southern yellow pines in color, resin content and hardness, and the lumber trade treats it as a "minor species" of the southern yellow pines. With a specific gravity of 0.47, it is by far the densest of the pines native to the northeastern United States.

Jack pine is a Canadian spillover invading the northern Great Lakes states and parts of New York and New England. It is a small tree which quickly seeds on burned-over land but is eventually displaced by more dominant species. Its wood—weak with wide sapwood, light in color, excessively knotty and somewhat coarse in texture—is something like inferior lodgepole pine, but jack pine seldom grows as straight. Like lodgepole, it sometimes has dimpled grain. In Canada, where their ranges overlap, these two trees will produce natural hybrids.

Red pine, the dominant yellow pine of the northeast, is a massive and beautiful tree. Legend has it that its other common name, Norway pine, stems from Norway, Maine, and has nothing to do with Scandinavia. In any event, it is definitely a native Northern American species. The wood of red pine falls somewhere between the western and southern yellow pines in most characteristics. It is slightly heavier than ponderosa, but substantially lighter than the southern yellow pines. The contrast between earlywood and latewood is more pronounced than in the western yellow pines, but substantially more gradual than in its southern cousins. Like the western yellow pines, its sapwood is light enough in color to resemble the white pines; its heartwood, however, is often a bright orange-brown. If carefully selected, the dark orange heartwood of red pine can be substituted for deal (Scotch pine) in the reproduction of European furniture designs.

Arbitrarily, I've assigned red pine to the western yellow pines in the chart, where it shows up as one of the worst cabinet woods. If I'd put it in with the southern yellow pines, however, it would be a star. So understand what your project requires and pick the group before you try to pick a species. And keep in mind that any wood comes in several grades—no woodworker should buy materials blindly. Yet getting to know the pines is an adventure no woodworker, and certainly no American woodworker, should miss. □

Jon Arno is an amateur woodworker in Brookfield, Wis. He wrote about elm in FWW *#25, pp. 86-87, and about the poplars in #41, pp. 62-64.*

Jimmy Carter, Woodworker

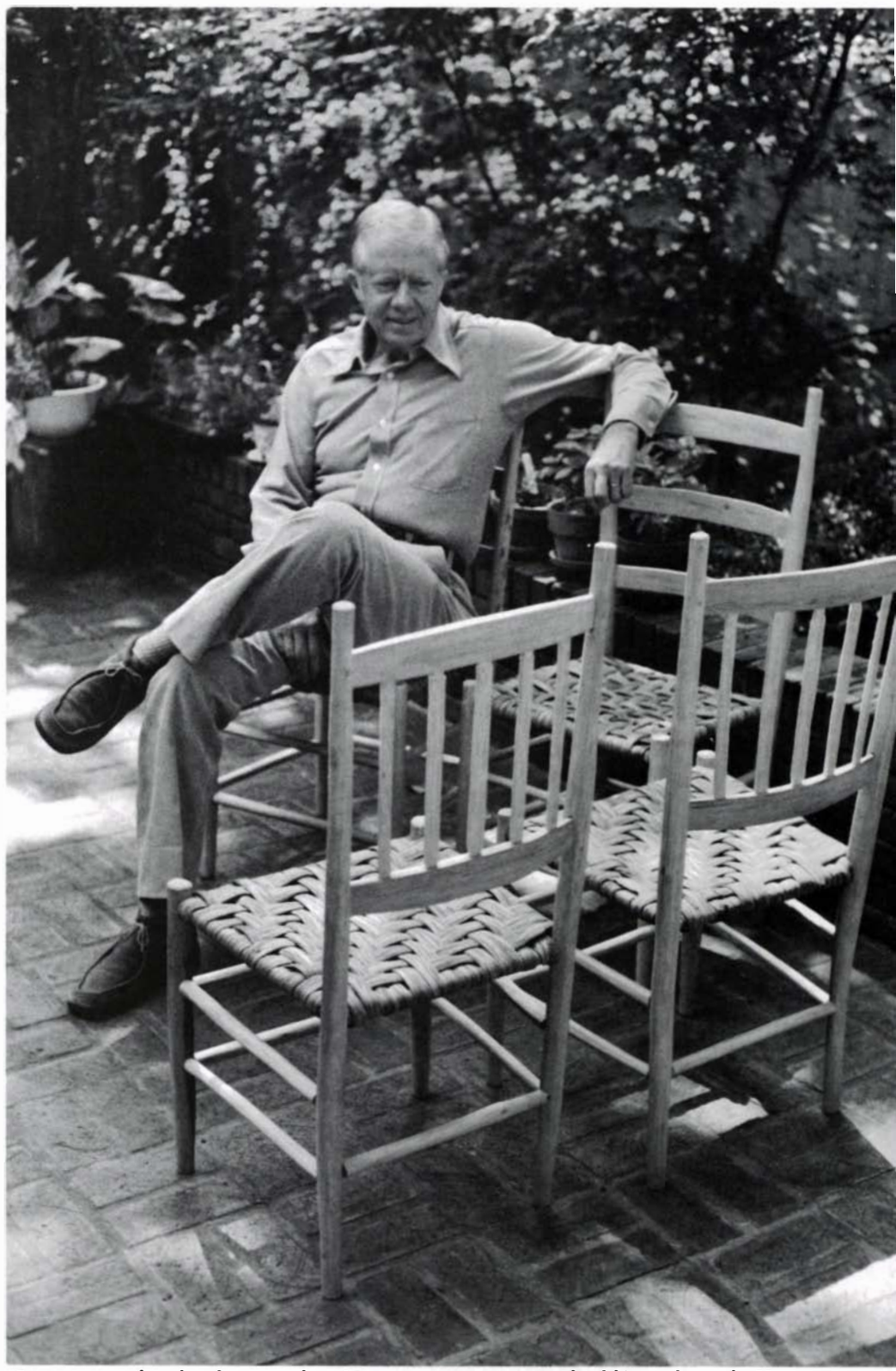
A visit with the former president, and drawings of his porch swing

by Jim Cummins

Jimmy Carter grew up in rural Georgia, joined the Navy and served in nuclear submarines, became governor of Georgia, then was elected 39th President of the United States. On the private side, Carter has been quietly making furniture for more than thirty-five years. He has turned himself into a creditable cabinetmaker who sits on his own chairs, eats at his own table, and sleeps in his own bed. When the talk turns to woodworking, he relaxes, laughs a lot, and could swap sawdust stories with anybody.

Carter says he never got much time in the shop while he was president. "The White House has a fully equipped woodworking shop," he told me, "but I never found time to use it." About all he was able to do was to search out the carpenters' shed at Camp David and steal some time to work there on weekends. Whenever he travels to a foreign country, he goes out of his way to visit local woodworkers. He treasures some woodworkerly souvenirs: a primitive African lathe, like the one shown in *FWW* #21; a carvers' hatchet from Togo; a set of Chinese gouges; some lathe tools made from files. A missionary once gave him a box of agricultural tools, among which were a primitive plow, a hand-wrought hooked knife for cutting sugar cane, and an adze. Carter showed me the plowshare and reflected that when he was a child in Plains, "People right down the road were working with the same basic design." In those pre-electric days, woodworking was one of the chores everybody took for granted—Carter can't even recall when he first began to use hand tools.

As a teenager, he joined the Future Farmers of America. Like the 4-H Clubs, the FFA gives instruction in the skills a farmer needs. One way of finding out whether the lessons have stuck is to stage contests. In Carter's day, one competition required each teenager to determine from plans the length, pitch and valley angle of a rafter, then with hand tools to cut it to fit. Carter says he

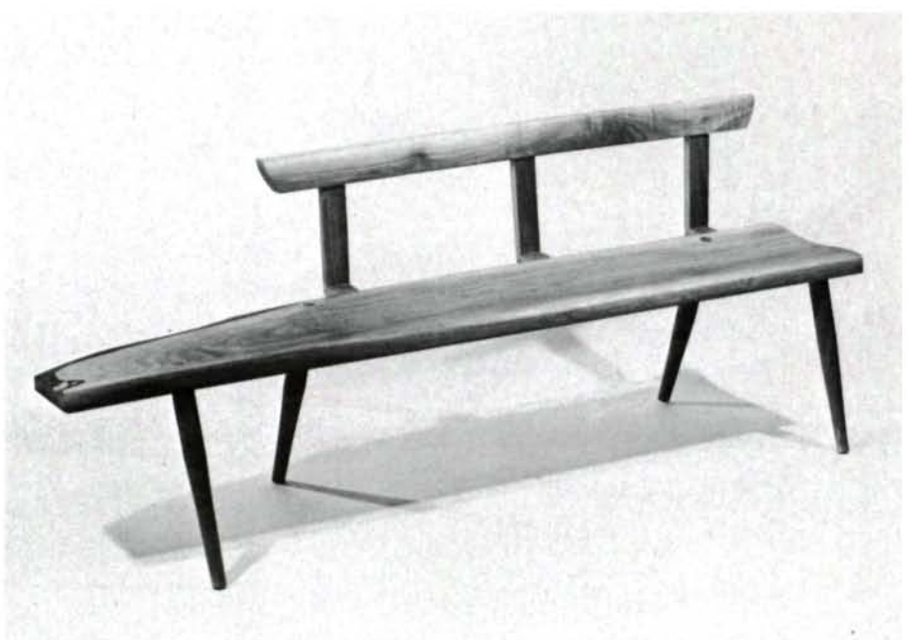


Carter, a woodworker for more than 35 years, gave away much of his early work. He turned pro with these chairs, which brought $41,000 at a benefit auction last October.

Jimmy Carter

Jimmy Carter

Courtesy of the Atlanta Historical Society



Carter's output has included quick, sturdy pieces such as this chaise (top) and couch (center), built many years ago to meet his growing family's needs. The more recent slab bench (bottom) was photographed while on loan to the Atlanta Historical Society. The pieces reflect Carter's changing perceptions of what furniture should be.

remembers that particular contest out of dozens of others because one year he was able to win it.

In 1948, when the Navy sent him and his young wife, Rosalynn, to Hawaii, they rented an unfurnished apartment and Carter began making furniture out of necessity. The Navy maintained a shop for the servicemen to use, with a resident cabinetmaker to oversee the work and to help out. Carter learned mortise-and-tenon joinery and was encouraged to work with hardwoods. He remembers that one of his first pieces was an oak dining table. Most of this early furniture was left behind when the family moved back to the United States in 1950. With a raise in salary, they could now afford to buy factory furniture from Sears. But Carter soon discovered the Navy shop on his new base and resumed woodworking—this time more for relaxation than from necessity. He built other pieces, including a white-oak hi-fi cabinet which he and his family have enjoyed for more than thirty years.

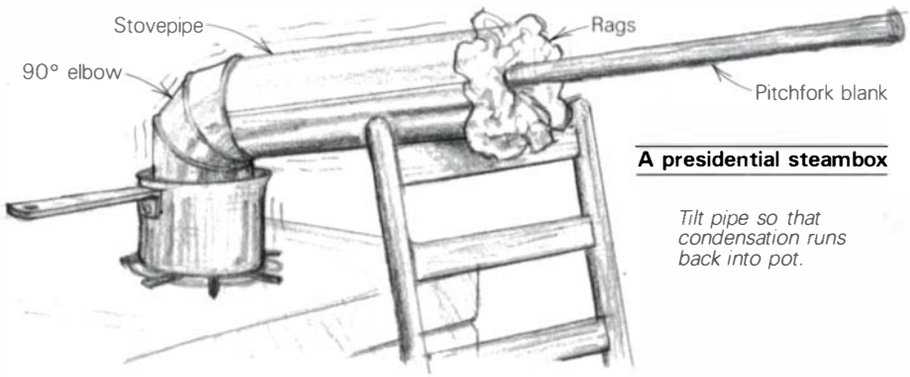
After the Navy, when the family moved back to Plains, Carter had no real shop of his own, just the sort of tools that everybody picks up along the way: a circular saw, an electric drill, random hand tools. But there was a carpenters' shed down at the family peanut warehouse, and Carter worked there in his spare time, as well as whenever necessary to keep the business running. Elevators would break down, the roof would leak, a floor would need patching. Carter did the engineering designs, and, often as not, swung his hammer with the rest of the crew.

Like many young fathers, when the kids needed desks, cabinets and bunk beds, Carter made them. When the family moved or the kids left home, the Carters "loaned" the furniture to friends. After passing from hand to hand a few times, the pieces sort of faded away, as old furniture does. Somebody recently told Carter that some of the beds had finally been donated to the local nursing home, but he hasn't had a chance to run over and see for himself. When I asked if he would even recognize those beds after all these years, he replied, "Of course."

He took me through his house, and if I'd been forced to guess which pieces were his own work, I would have missed more than a few. Over the years, Carter has made about fifty pieces of

Jimmy Carter

After years of working in borrowed quarters and carpenters' sheds, Carter finally got a fully-equipped shop of his own, a gift from his staff when he left the White House. Much of his recent work, such as this armoire in 19th-century Southern style, was made to fill his vacation cabin near the Tennessee border.



A presidential steambox

Tilt pipe so that condensation runs back into pot.

furniture in many styles, and has given away about half of them. One of his earliest, a chaise longue that sits in the sunporch, is vastly overbuilt of southern yellow pine, most likely out of the common beginners' fear that homemade furniture will mysteriously fall apart someday. The chaise (shown on the facing page) works, though. It may look clunky, but its wooden wheels won't wear out, or sink into the lawn. Its garden-gate-style leg rest and backrest will adjust to fit a weary body, and—unlike some modern aluminum lawn furniture—won't collapse and throw you out of the chair. To the old chaise, comfort is everything and visual harmony is irrelevant.

In contrast, the recent piece beside it on the porch is a walnut-slab bench, cantilevered out at one end, with a stylish offset backrest (bottom photo, facing page). It could be an engineer's example of the minimal use of structural wood, and a designer's example of the maximum use of pure tree. Carter looks at it critically, and says he wishes he'd made the legs at more of an angle, that from the front they're too straight. These days, he doesn't have to give a thought to what is actually a complicated technical feat—setting a shouldered, angled leg through a mortise at any orientation he likes.

When Carter left the White House, his staff pooled money for a going-away present. Nobody was allowed to contribute more than $100, but the total added up to about $8,000 worth of tools and machines from Sears. It was the first real shop he had ever had, and he set it up in his garage: the Carters don't own an automobile because they ride in Secret Service vehicles. Back in private life, Carter began writing his memoirs, and during the 18 months this took, he offset his time at the word processor by working several hours in the shop every day. The work was both therapeutic and practical. He needed furniture again, this time to fill a vacation cabin in the Blue Ridge Mountains, up near the Tennessee border.

Rosalynn determined what they needed, then gave her husband a list: a lazy-susan table, a deacon's bench, two armoires (one of which is shown at left), chairs, some stools, stands and beds. Carter took to the list with great pleasure, and designed the pieces after traditional Southern furniture he'd seen and liked. Much of the wood was recycled yellow-pine boards, salvaged from the old house where Rosalynn was born. Carter counted the annual rings in the lumber and figured that the trees had been growing 350 years ago.

Carter doesn't usually bother with detailed plans. If he sees something, he can build it. He borrows designs that take his fancy, and he's tried out a lot of tricks from the masters: a slab table in his den owes a lot to George Nakashima, his bed's headboard is a variation of Art Heinkel's in *Fine Woodworking Design Book Two,* his living room coffee table is pure Tage Frid. He says he'd "like to hear Krenov explain just how he makes one of those cabinets."

One wall of Carter's shop is stacked with pine, poplar, ash, maple and walnut boards, with a few exotic turning blocks tucked away. Hand tools hang on the walls. His workbench and shaving horse are both near the center. His planer is set up so that he can run long pieces out through the garage door. The most complicated piece of equipment is a Zinken combination machine—a tablesaw, jointer, planer, mortiser and shaper—that was given to him at a recent trade show in Atlanta. His Sears tablesaw is still in service, but he keeps it fitted with a dado blade. Except for the Zinken, Carter's shop looks like a Sears centerfold—jointer, lathe, planer, bandsaw, just about everything. These machines have been his mainstay, and any complaints are on the order of: "I wish the bandsaw could take a stiffer blade for resawing." Like any other woodworker, when the job demands it he hankers for industrial-grade equipment.

Yet Carter unhesitatingly says his favorite tools are a drawknife and spokeshaves. I suspect that he enjoys green woodworking so much because it's the most personal involvement with wood itself. He starts with the tree, choosing one from the woodlot bordering his

Building a porch swing

by Jimmy Carter

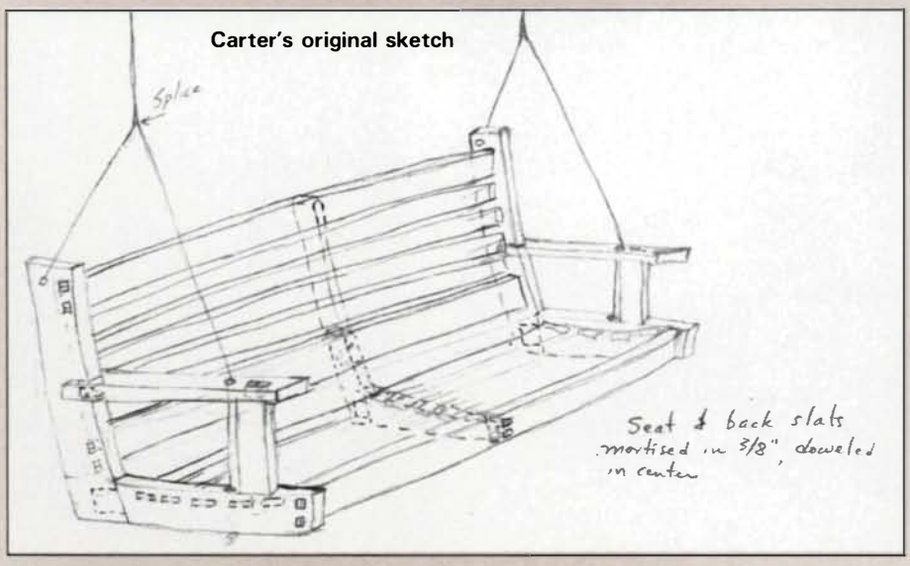
We wanted a swing for the front porch of our mountain cabin, so on one of my business trips I sketched the design on an old file folder. As my drawing shows, I wanted the swing to have no metal fasteners, be suspended by grass rope, and be strong enough for heavy use but light enough to be taken down easily and moved inside when we weren't there. Later I made a few changes in the arms and arm supports to improve stability and strength, as seen in the second sketch. The photos on these two pages show a couple of other changes that evolved during construction: In the center frame member, I cut a notch for the lowest back rail, for more rigidity. And, in several places, I decided that single tenons would be more than strong enough.

The wood is ash. The back and seat slats are 60 in. long. Some are 3 in. wide and some are 2 in., but all are ⅝ in. thick. I adjusted the spacing of the slats so that the armrests could pass between them where they're doweled into the frame. The front rail is ¾ in. thick, as are the other main frame parts. The whole seat is 18 in. deep and 17 in. high, and the armrest supports are 6 in. long, shoulder to shoulder.

I derived the configuration of seat and back from our most comfortable chair. Although the back slopes only 5° from vertical in relation to the seat, the entire swing is also tilted back on its support ropes, which I adjusted to the best angle before permanently knotting the ends.

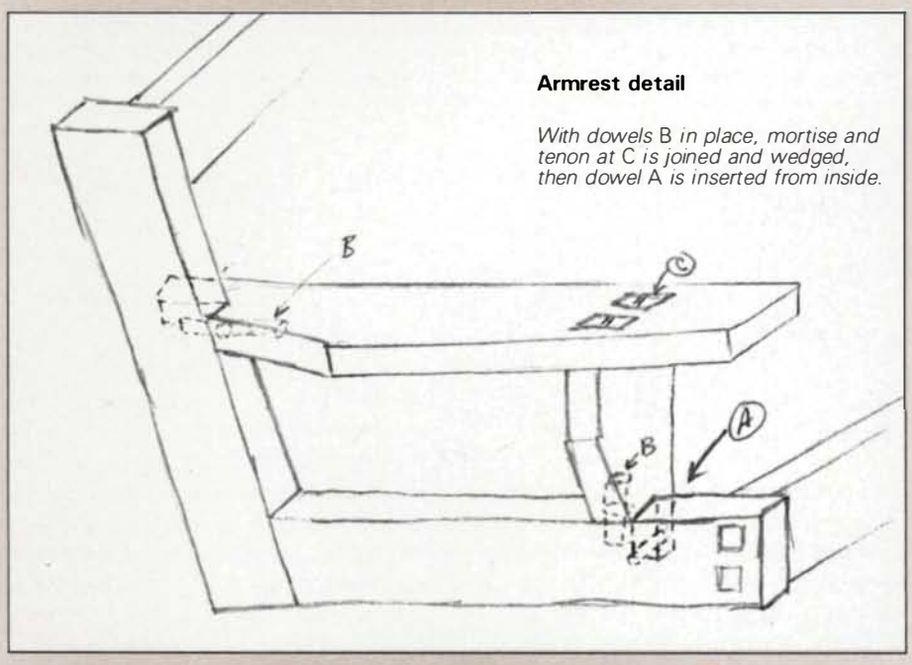
The whole frame is locked together by mortise-and-tenon joints, wedged when appropriate, and the centers of the slats are doweled to prevent shifting or warping. I routed the blind mortises for the seat and back slats, and glued all the joints. The most difficult task was putting the whole thing together—it's somewhat like a complicated jigsaw puzzle. Two coats of polyurethane varnish protect the ash boards from the moisture of a roaring mountain stream twenty feet from the porch. A soft pillow, the swing's movement and the water's music make sleeping easy. □

Carter's original sketch



Armrest detail

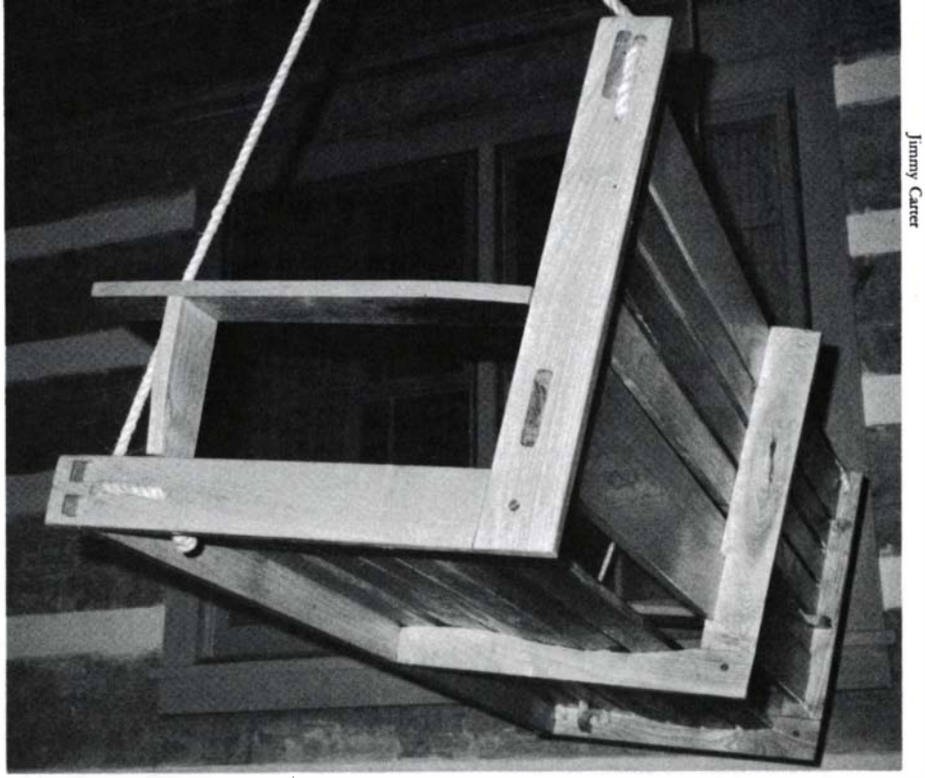
With dowels B *in place, mortise and tenon at* C *is joined and wedged, then dowel* A *is inserted from inside.*



The finished swing at Carter's cabin in northern Georgia.

Drawings and photo: Jimmy Carter

160-acre backyard, most of which is farm (the house sits at the front corner). In addition to southern pines and the pecans that are such an important cash crop in central Georgia, Carter's backyard boasts several kinds of oak, a few black cherry trees, some poplar and lots of prime hickory. Carter had just finished a yard rake and a couple of pitchforks, so I asked him what sort of steambox he'd used to bend the tines. He pulled out a length of stovepipe with a 90° elbow on the end (drawing, p. 67). "You just put the elbow in a pot on the stove and prop up the end of the pipe so that the condensed steam runs back into the pot. Then you plug the other end with rags," Carter said. "For longer work, just add another length of pipe." I told Carter that it was as ingenious a method as any I'd seen, and asked if he'd invented it. He shook his head. "I don't really know. I probably read about it someplace."



Jimmy Carter

On the facing page, Carter explains how he made this porch swing. This end view shows joinery details, how he curved the seat, and the positions of the rope holes.

It's Carter's nature to keep busy and to keep trying new things. When an old chair in the living room lost its woven-cane seat, he bought an instruction book and some cane and rewove it himself. He'd take the chair along when he visited his mother, who was in the hospital, and they'd watch ball games together while he wove. I asked him how long it took to do the job. "Two ball games," he said. I asked him if he ever wanted to cane another. He laughed. "One was enough."

Carter says that when he's woodworking, everything else goes out of his mind. His other hobbies affect him the same way. Formerly oil painting and golf and now fly fishing top the list. "Fly fishing is my passion," he says. He ties his own flies, and has an old roll-top desk in his den overflowing with fur and feathers. As we talked fishing, there wasn't a favorite Catskill stream of mine which he wasn't familiar with, even to knowing the average size of the trout, and whether things were getting better or worse. His woodworking lore is similarly encyclopedic, which is one of the reasons he's so unassuming about his own skills—he thoroughly knows the work of the masters, and gets a kick out of emulating them, but he knows he's no Nakashima. Carter also keeps a sense of humor about his work. Hanging on his shop wall, for instance, is the first dovetail joint he ever cut. "I followed the steps in Tage Frid's book, and the joint fit together so well," he grins, "I framed it."

Personal appearances, travel, and political business had been cutting into his planned woodworking time, Carter told me when I visited him late last September. His shop was covered with a thin layer of sawdust, and under that was a thin layer of rust. The set of Chinese scoop gouges he showed me had ragged edges, the marks of a woodworker pressed for time—if a tool dulls, it's all too tempting to pick up the next one in the set and use that for a while. Yet he'd managed to finish an ash swing for the porch of the cabin (which he tells about building on the facing page). Typically, he drew up some sketchy plans while waiting for an airplane, then stole enough time to do the job.

Since my visit, he's started another book, and things are getting back to normal. He tells me that his chisels and other cutting tools are back in condition, and that he's been finishing up a maple rocking cradle with woven cane sides for his forthcoming fourth grandchild.

Carter has never tried to make political hay from his woodworking hobby, but recent publicity has let people know about it. Now whenever he travels, somebody is likely to come up to him and say, "I'm a woodworker, too." He has never sold his work, with the exception of four green-wood chairs auctioned to benefit the Carter Presidential Center at Emory University in Atlanta (photo, p. 65). Carter felled the trees and peeled the bark, then split, steamed and bent the wood. He cut and pinned the joints, then wove the seats. The chairs match a set of six that he made for the cabin, and Carter ran out of hickory bark for the last two chairs. Chairmakers prepare their bark in the spring and early summer—when the sap is up and the bark slides off easily—and any full-time chairmaker puts enough in reserve to last the year. Carter could have gotten surplus bark from other chairmakers by making a phone call, but instead he felled an autumn-dry tree and prepared another batch of his own—a painstaking, difficult job at that time of year. The two pairs of chairs netted more than $40,000. Having made ten, he has no present urge to make more.

Carter knows that his furniture will be valuable, so these days he signs his pieces as he makes them. He signs little else. Rosalynn is forced to sign the family's checks, for instance, because the ex-president's signature is worth too much money on the collectors' market. If Carter signed the checks, people wouldn't cash the smaller ones, and the bankbook would never balance. Recently, an old family friend did the Carters a small favor, and Carter asked if there was anything he could do in return. "Well," said the friend, "I've got this old table and two benches you gave me years ago. You could come on over and sign them." Carter laughed, went on over, and did. □

Jim Cummins is associate editor at Fine Woodworking.

Making a Blind Finger Joint

Miter hides the router-cut fingers

by James A. Rome

The finger, or box, joint is one of the strongest choices for drawer, box or carcase construction. It's easy to make and easy to clamp, and there's a lot of long-grain to long-grain contact—the ideal gluing situation. In some applications, the finger joint is also quite handsome, but in others, the exposed end grain of through fingers clashes with the overall design. For that reason, I developed a method of making a joint that looks like a simple miter but retains the finger joint's strength.

Most of the steps in making my blind finger joint can be done on a router table and tablesaw, but some have to be performed by hand.

The completed joint is shown in figure 1E. The slots and fingers are cut on a router table using the jig shown in figure 2. Both halves of the joint are identical, each beginning with a finger and ending with a slot, so when one board is flipped over, the two parts mesh together.

After struggling with a small, metal router table, I built a big wooden one with a ¾-in. birch plywood top. I routed two grooves in the tabletop from front to back for the finger-joint jig to slide in. My router table has an adjustable fence which, for this job, acts as a stop behind the jig. A board clamped to the table would also work as a fence.

A note about routers: My first experiments using a Sears Craftsman 1½-HP router were unsatisfactory. No matter what I did, my slots were 0.011 in. oversize. I wrote to Sears about the problem, and received an answer from Singer, manufacturer of the router. Their specs permit runout of up to 0.007 in. at a distance of 1 in. from the collet. Since my bit was cutting farther from the collet, I got even more runout. Thus, the Sears router proved unsuitable for the job. I now use a Hitachi TR-12 plunge router, which cuts a slot accurate to within 0.001 in. With the router mounted on the table, however, it requires herculean strength to push upward against the router springs to adjust the depth of cut.

The jig must be rigid and accurately made to guarantee precision in the finished joint. I waxed the two hardwood runners on the bottom so that they would slide easily in the table grooves. Two screws countersunk into the side of one runner can be backed out to rub the side of the groove for a tight fit.

Router-bit diameter determines finger and slot width. I used a ½-in. straight-flute bit to make fingers and slots ½ in. deep, ½ in. wide and ¾ in. long, but you can change these dimensions for different size fingers. To index

Fig. 1: Steps in making the blind finger joint

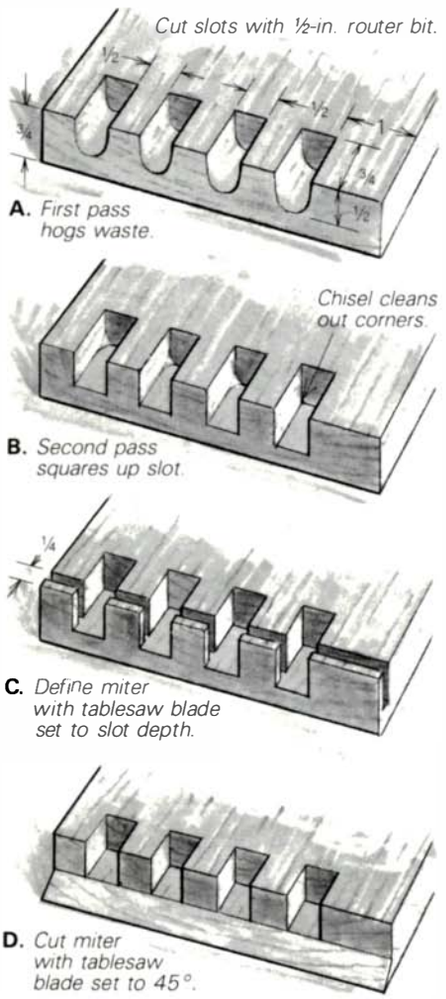
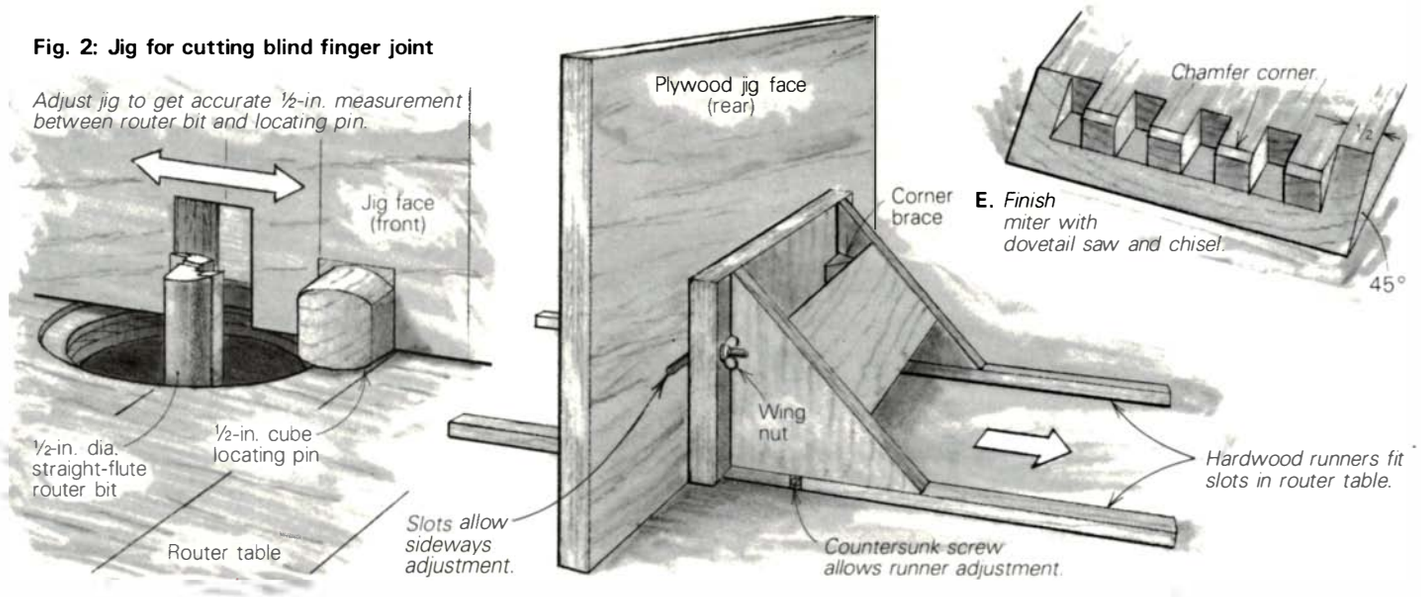
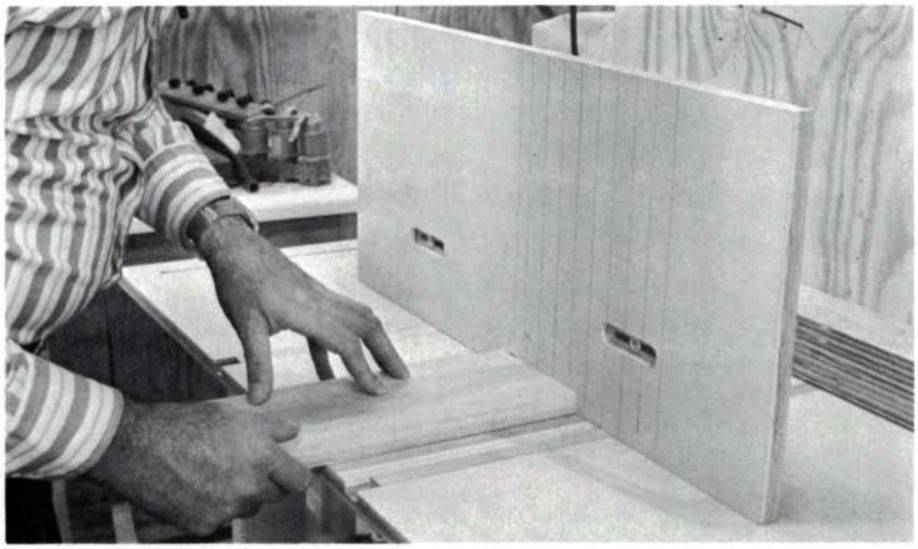


Fig. 2: Jig for cutting blind finger joint



Drawing: Ken Daniel



To cut first slot, clamp board vertically against jig face (left), right-hand edge against locating pin. First slot, placed over pin, locates next cut. Pencil lines on jig and router table make it easy to square up board. Bolts in jig face allow sideways adjustment of jig. After cutting slots, Rome readjusts router bit and makes a second pass with board horizontal (right), a light cleanup cut that flattens bottom of slots. Jig slides back until it stops against router-table fence shown at far right, behind jig.

the fingers, I installed a ½-in. cube-shaped locating pin in the front of the jig, as shown in figure 2. If you want larger or smaller fingers, make a pin with faces equal to your router-bit diameter. For ⅜-in. fingers, for example, use a ⅜-in. router bit and a ⅜-in. locating pin. Board width must be an even multiple of finger width. Finger length before mitering, as shown in figure 1A, must equal stock thickness. To make the joint shown, I used a board ¾ in. thick and 5 in. wide.

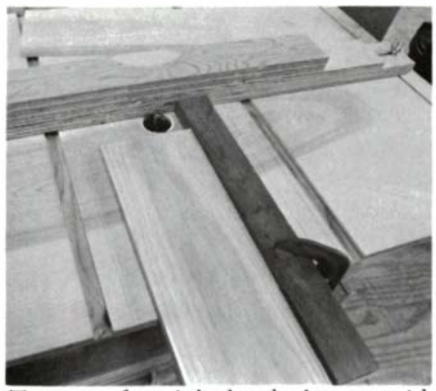
With the preliminaries out of the way, here's how to make the joint. The trick is to rout the slots between the fingers two times—once vertically, to remove the bulk of the waste, and once horizontally, to square off the round corners left after the first pass. With the jig set in the router table, adjust the router so that the bit extends ¾ in. above the table, to set the length of the fingers. Now adjust the fence behind the jig so that, pushed back against the fence, it stops when the front of the router bit extends ½ in. in front of the jig's face. Adjust the jig sideways to get exactly ½ in. between the locating pin and the router bit, as shown in figure 2. Clamp the board vertically against the face of the jig, with one edge against the locating pin as shown in the photo at left above. Use a square to ensure that the board is exactly vertical. (It's a good idea to test the setup using scrapwood before risking good stock.)

Cut one slot by pushing the jig toward the fence until it stops. Check the measurements and make any necessary adjustment. To cut successive slots, position the slot over the locating pin and repeat the process, going from right to left. Do not cut a slot on the left edge, however. This edge must be mitered by hand later. The board at this point should look like the one in figure 1A. Cut the mating board in the same manner.

Next, lower the router bit so that it extends ½ in. above the table, and adjust the fence so that when the jig is pushed back against it, the bit extends ¾ in. in front of the jig's face. For this step, hold the board horizontal, with the slots and fingers down (photo, above right). Place the second slot from the left over the pin. Make a cut, move the board to your left one slot, and recut the remaining slots in the same way.

The first slot on the right of the board (shown at arrow in figure 1B) can't be recut with the jig. After cutting all the other slots on both halves of the joint, remove the jig from the table, put this slot over the router bit (with the router turned off), and clamp a guide board on the table against the right-hand edge of the board. Adjust the fence so that it stops the cut at the ¾-in. point and recut the last slot without the jig. After the second pass with the router, only the corners need to be cleaned up with a chisel.

On the tablesaw, adjust the rip fence so that it's ¼ in. away from the far side of the blade and adjust the blade height to ½ in. With the slots downward, and the end against the fence, cut a slot through the end of each half of the joint (figure 1C).



To recut far right-hand slot, a guide board clamped to router table substitutes for jig.

Cut the miter on the tablesaw with the blade at a 45° angle. I screw a wooden fence to the crosscut/miter gauge, make a cut through the fence, and use that kerf as a reference to see where the blade will cut. For accuracy, I clamp the board to the fence. The joint should now look like the one shown in figure 1D.

Now the outer finger and uncut slot in each board must be cut by hand to a 45° miter (figure 1E). I'm partial to a Japanese dovetail saw (*dozuki*) for this operation. Use the existing miter to guide the saw, or make a 45° guide block.

The final step is to chamfer the outer edge of each finger. When the joint is assembled, the fancy cabinetwork is invisible, but the joint is incredibly strong. □

James A. Rome is a full-time plasma physicist and part-time woodworker in Oak Ridge, Tenn. He wrote about jointer-planers in FWW *#43. Photos by the author.*

Seat-of-the-Pants Chair Design

A scrapwood mockup solves basic problems

by Jeremy Singley

For me, chair design is a choreography of happy accidents. Since I've never "thought up" a design that didn't turn out to be pretentious, I've learned to stumble onto new ideas gracefully. Thus my most trusted guide is the seat of my pants. That's how it should be. After all, my head may be the seat of my thought, but I don't sit on my head.

I usually begin with nothing particular in mind—rarely even so much as a sketch—but start right in by experimenting with scrapwood, cordwood and leftover chair parts to create various combinations of forms. I see—or, rather, feel—what works and what doesn't work. With perseverance (and a little luck), I may discover the means to bring together a tree and a human body in a way that is pleasing to both.

The best way to encourage this sort of serendipity is to build the design around a person, so I invariably start with a living, breathing body (my own or a helper's) and sit it on a crate. Then I proceed like a tailor to cut, tack together and try my scrapwood pattern against this live model. Patterns that work I earmark for subsequent reproduction in fine hardwood. Those that don't work return to the firewood pile. This way, only my posterior or my model's suffers my mistakes, and the public is spared yet another "—uh. . . very nice" chair. My firewood pile receives the majority of the shapes I try.

A wooden apple crate is my starting point. On this I might place a 20-in. by 20-in. square of plywood as a seat. I position the crate near a wall to give my model something to lean against, but for now this is all the back my chair-in-progress has. By shimming the plywood with blocks and wedges, I can create a variety of heights and cants for the seat. By moving the crate closer to the wall or farther away from it, I can adjust how far back my model leans. If I'm designing a dining or writing chair, I pull a table up to the crate to see how the two work together. This method lets me interpolate a set of comfortable and functional overall dimensions.

Once I have a seat position that seems comfortable for my first model, I retest the seat by using other models or by "altering" the one I have. To see what would happen if my model were a different height, I put blocks under the model's feet to simulate longer legs, or under the crate to raise the seat so that the model's legs seem shorter. Often I find I must adjust the dimensions to develop a compromise that will be reasonably comfortable for a wide range of people.

At this stage, I begin to play with specific contours for the seat. To determine a cross-sectional contour that will cradle my model's derrière comfortably, I experiment with bandsawn scrapwood blocks taped to the plywood's top surface, as shown in figure 1.

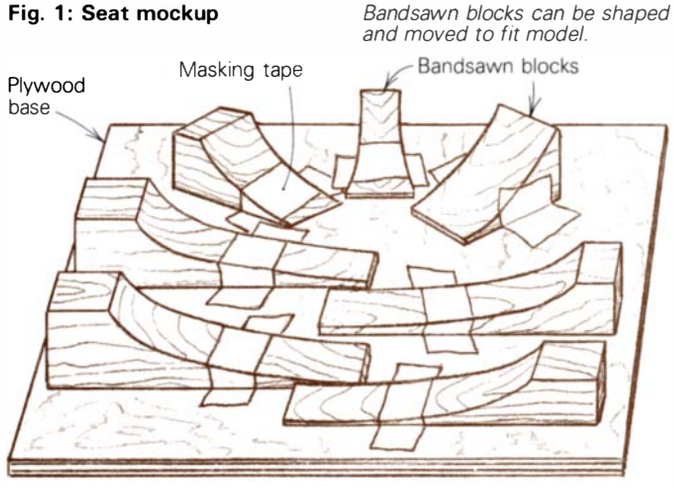
When I've found a shape that seems to work, I ask more questions. What if my model were fatter or thinner? And—the question often overlooked by chairmakers—what if my model were the opposite sex? A healthy woman could hardly fit into some chairs I've seen. Others, where a woman apparently was the model, are so spacious that a slender man could get lost in them. Once again I collar a variety of different size models, or make the one I'm using seem thinner by spreading the bandsawn shapes apart, or fatter by pushing the blocks together (making the seat seem wider makes the model feel smaller, and vice versa). Pushing the shapes together across the width of the seat, but not in its depth, approximates how a woman's hips would fit the seat. Spreading the shapes across the seat width will make the seat fit a woman as if she were a man. Next I run through the slouch test: Can the model shift about upon the seat and still be comfortable?

I follow a similar procedure to determine the form of the chair's back. Without worrying about how the back will be attached to the chair, I hand-hold strips of bandsawn or bent scrapwood, or bent lengths of electrical cable, plastic water pipe, metal strapping, cardboard or other materials against my model's back. Since a chair back must support people in a variety of positions as they shift, lean or slouch, I avoid a literal interpretation of my model's back, looking instead for gradual, grand sweeps that support the back over broad areas.

When a likely back form has been found, I cobble it to the prototype seat firmly enough to be leaned against (sometimes I just nail it to 2x4s leaned against the wall). I then test it with models who are taller, shorter, wider, narrower, or bent more or less than the original model, or I again use shims or other tricks to simulate more sitters. In this way, I make sure that no part of the back will bother the backbone, shoulder blades or hip bones of a wide range of individuals. This test also helps me determine the tilt of the chair's back and the distance between the chair back and the seat's front edge.

Once I've evolved a set of functional seat and back forms,

Fig. 1: Seat mockup



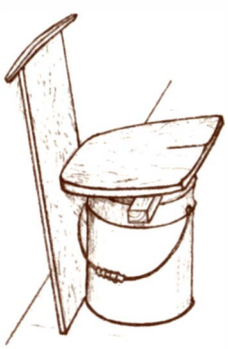
Jeremy Singley is a full-time woodworker in East Middlebury, Vt.

Singley's Wainscot chair began as a trial splat leaned against a wall and a seat supported on a paint can.

Simplicity is the key in this Cheshire chair—turned tenons in round holes, and a sawn rather than steamed crest.

I've reached the end of the piecemeal stage of design, when the chair has only the most nebulous structure. The next step is to choose from among my forms (some forms won't work, but these may find their way into future designs) and see if any suggest a particular mode of construction. Whether my precarious pile of scraps will end up a Windsor, a Wegner or a what's-it must now be decided.

This is the hard part for me. I can't seem to accept that the decision is not mine to make: it's up to the chair. Sometimes this isn't a problem because the parts I've tacked and leaned together make themselves into a chair before I have a chance to meddle with them. In a case like this, I haven't found the chair, the chair has found me. The Wainscot chair shown in the photo at left above, for example, is hardly more than the original scrap board that was leaned against the wall as a trial splat (drawing, right), with the seat and crest—parts from a different chair that were pirated from my inventory shelves—balanced, respectively, upon a five-gallon paint can and the top of the trial splat.



At other times I may undertake a more traditional chair type. My goal here is to make an existing chair design more attractive, or simpler, or more functional, or, if possible, all three. My version of the fan-back chair, the Cheshire chair shown in the photo at right above, is such a case.

Both the Wainscot and Cheshire chairs show my way of hooking the parts of a chair together: from functional part to functional part via the most direct route. Thus turned tenons in round holes, sawn curves rather than steamed bends, and simple, machine-cut joints predominate. Wherever a part or a process can be eliminated, I do so. I follow this standard most rigidly for dining chairs, which must be affordable in multiples, and which tend to look cluttered around a table unless each is rather austere.

At the other end of the scale is the personal chair—such as the rocker or the executive's desk chair—where the cost of the additional comfort and visual appeal that can be attained with complex steambends and joints is justifiable. I have never found complexity a virtue in itself, however. The fact that a technique is difficult or different is no reason to include it in a design; it's usually a good reason to leave it out.

Getting from the apple crate to the finished hardwood chair is a matter of recording the relative proportions, locations and angles of the protochair's scrapwood parts so that they can be reproduced. The specific procedure for determining the chair's dimensions varies with the particular type of chair, the individual designer, and the situation. To outline them all would require a book. A look at how one chair might evolve, however, will give a general idea of this process and the thinking and experimenting that precede it.

Let's say I've decided to build a fan-back chair. This decision determines the general form of the chair: since the fan-back is a Windsor, we know we're talking about a scooped seat of solid wood, as opposed to a slatted, upholstered or webbed seat. Since in this case the seat is the part of the chair I'm most interested in improving, I begin here. After drawing a centerline on the plywood trial seat, I make tape-on contours, like those shown in figure 2 on p. 74, adjusting their shapes and their positions on the plywood seat until I've developed a seat scoop that works.

Because the chair back largely determines the seat's outline, I resist the temptation to fool with the seat any more at this stage and I go right to the back. I cut out a flat cardboard or scrapwood crest, stick dowels (to serve as spindles) onto it with glaziers' putty or tape, and lean the works

Photos: Erik Borg; drawings by the author

against the wall behind the seat. Then I rearrange the parts until they look right.

I use a generous number of dowels to determine the spindle layout. If a chair has too few spindles, I've found that they end up being spaced too far apart to act as a team, and will instead be felt as individual edges digging into the sitter's back. I also use an even number of dowels, since an odd number will put a center spindle where it is unlikely to get along well with the sitter's spine.

Once I've found a back that looks right, I make a firmer version that I can have models try to see if it feels right. To keep the bottoms of the dowel spindles from being forced off the seat when the model leans back, I make a shallow, oversize hole in the seat at each spindle's proposed location. Then I bandsaw a scrapwood crest, drill holes for the tops of the two outermost spindles (called post or king spindles), and cut notches for the inner (pawn) spindles. I fit the king spindles into their shallow seat holes, add the crest, and lean the whole assembly against the wall. I insert the pawn-spindle dowels, cut somewhat over-length, into their seat holes and into the crest notches. The "chair" is then sat in (figure 2A).

The advantage of this lackadaisical method of non-construction now becomes apparent. Say the curve of the crest is wrong. I can throw it away and bandsaw another. If the seat holes are wrong, I can bore new ones. If the holes start to overlap, I make the new ones deeper than the ones they intersect, to keep the dowels from wandering.

Eventually my "chair" will look like figure 2: one old crate, one chunk of used plywood with a million holes in it, a lot of odd scrapwood affixed to the plywood, a rough bandsawn crest cut from an old 2x6, perhaps ten dowels, at *least* a mile of tape, and a variety of blocks, shims, wedges and reject parts everywhere. But when I sit in it, it feels good. Voilà! Now to make it pretty (and portable).

Fig. 2: Ugly comfort

Tape, dowels, shaped blocks and scrapwood make a comfortable, but crude, chair.

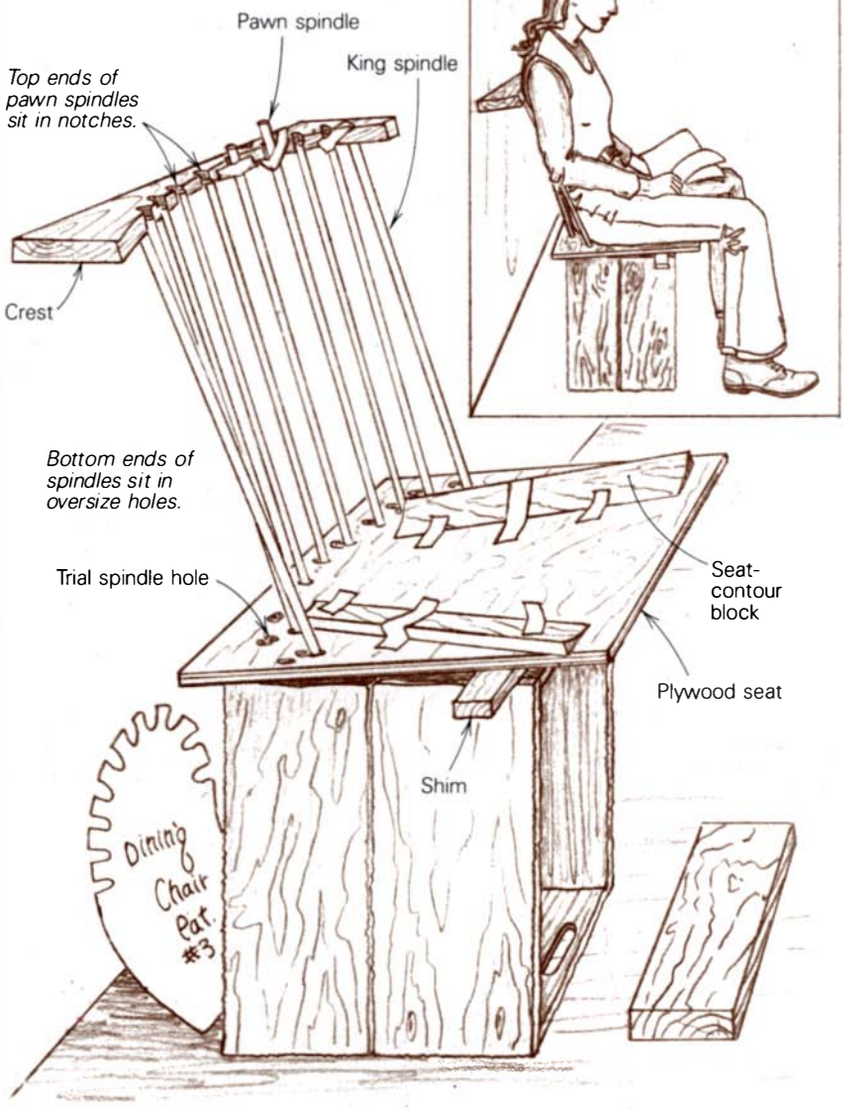


Fig. 2A: The real test

First, I bandsaw a scrapwood crest rail with the front view of my first, flat trial crest and the top-view curve of the second, notched trial crest. I tape this new crest in front of the notched crest, so that it appears to be mounted on the spindles. The seat's plan view comes next. This is fairly easy to determine. The back edge is a curve ⅞ in. or more behind and usually (but not always) parallel to the curved centerline of the spindle holes, the width is whatever looks good with the back, and the shape will usually suggest itself from the former two dimensions and from the seat's scoop. I label the scoop blocks, trace their positions onto the plywood, and remove them. I cut out a paper pattern (figure 3) in the shape suggested by the back and scoop, with a slot or hole for each spindle, and I lay the pattern over the mockup's plywood seat. With the pattern and the back in place together, I stand back and take a look. If the pattern looks bad, I burn it. If it looks good, I laminate a trial seat blank by edge-gluing softwood scraps together.

While the glue is drying on the scrapwood seat blank, I follow the procedure outlined in the box on pp. 76-77 to transfer the position and angle of the king spindles onto a duplicate paper seat pattern, but without spindle notches. Each spindle has an angle at which it tilts, and an axis along which this angle is aligned and measured.

At this time I also make a paper pattern of the crest's shape, and record on it both the spacing between the king-spindle holes and the number of pawn spindles. Then I kill time by roughing out stock for the legs and spindles, leaving the dimensions oversize, since I don't yet know exactly what size these members will be.

By now the glue on my scrapwood seat blank is dry, and the real fun begins. I trace the pattern of the proposed seat shape onto the scrapwood blank, transferring the pattern's centerline and the king-spindle locations to the wood as well. Then I bandsaw out the seat. I may later bevel the edge, but for now I cut it square.

Next I scoop the seat using an adze, an inshave and a fish-tail gouge, with the scrapwood tape-ons derived in the first step serving as guides. I place the seat on my apple-crate test stand at the altitude and cant I settled on previously, and

Fig. 3: Paper pattern

Use paper pattern to record axis, centerline and spindle locations.

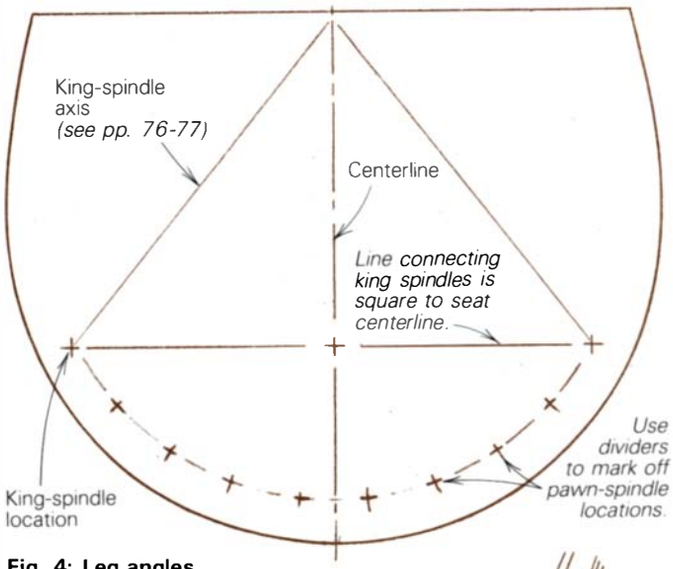
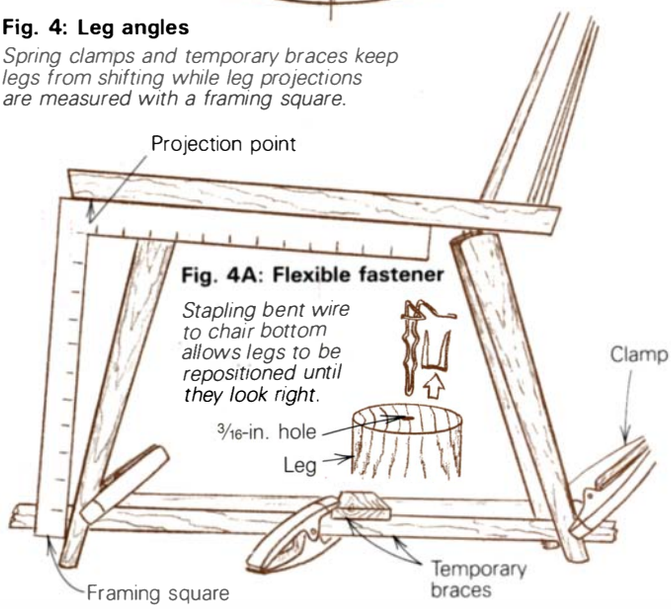


Fig. 4: Leg angles

Spring clamps and temporary braces keep legs from shifting while leg projections are measured with a framing square.



sit in it. If it feels good, I go on to the next step. If it doesn't, I make adjustments. If it's still not right, I put it aside for future reference—somewhere within reach of the woodstove—and make another.

By now I generally have enough information to get a feel for the chair's overall proportions. Judging from the bulk of the seat and crest, I gauge the spindle diameters that should look right. If I'm not sure, I cut out a couple of trial spindles, square in cross section, on the bandsaw and see how they look when tried against the seat and crest. Then I turn a set of finished hardwood king spindles. I lay out the seat's spindle holes according to my pattern and bore the holes, using the method described in the box on pp. 76-77.

Finally, I insert the king spindles in the seat and crest, measure how long the pawn spindles need to be to span from seat to crest (allowing for tenons), and turn these spindles. I dry-assemble the chair seat and back, and try the whole thing out on the test stand.

I have never reached this stage and been happy with the result on the first try. I make adjustments: I chamfer the seat bottom to make the seat appear thinner; I cut the seat smaller, or glue on stock to make it bigger; I change the crest's shape, taper its ends, or make its top edge thinner; I turn thinner spindles; I turn fatter spindles; I throw it all in a corner and forget about it for a week.

Finally, like birthing pains, just at the point when it seems hopeless, it all comes together. I'm ready to build a real chair. Using my scrapwood parts and paper patterns as models, I laminate a hardwood seat blank and bend a hardwood crest blank (see *FWW* #8, pp. 40-45, for an article on steam-bending), or, as with the Cheshire chair, saw and smooth a hardwood crest. While the glue is drying on the seat blank—and the bent crest blank, if one is needed, is seasoning in its form—I set the softwood protochair back on its pedestal and think about legs. I cut four lengths of 1-in. dowel to approximate length, and wedge them with wads of glaziers' putty between the chair seat's bottom and the floor. This gives me something to look at that I can easily shift around.

Once I have an idea of leg positions and lengths, I turn some softwood or green-wood prototype legs to suit, shaping their contours in a way that I hope will be pleasing. These legs are hooked to the softwood chair bottom with staple-nails and bent lengths of wire coat hanger as shown in figure 4A.

Now the chair can stand on its own (but I don't dare sit in it yet!). If it looks right the first time, I can expect to wake up at any moment, because I'm dreaming. Most likely it won't seem right until I've pulled the staples and shifted the leg positions, bent the wires to change the splay of the legs, and/or turned new legs and refined their contours.

When I've arranged the legs so that they look right, I tie them together with braces and spring clamps, measure the distances between their bottom ends, and take a projection of the front legs' splay (figure 4). Then I turn the chair over. With the splay measurements just taken, I check that the legs haven't shifted, then I lay out the leg positions and axes on the bottom of the seat, using the same method I used for the king spindles. These positions and axes are recorded on the back side of the paper pattern, along with the leg angles. Now I turn a set of hardwood legs, bore tenon holes in the softwood seat bottom, and dry-assemble the complete protochair.

Even at this stage, I'm not committed. If the chair with real spindles and legs leaves me only lukewarm, I can plug the offending tenon holes with dowels, rebore at another position or angle, and try again.

Despite the lack of glue, the chair can now be sat in if blocks are nailed to the floor around the leg bottoms to keep the legs from spreading outward. Often this final test leads to some sawing-off of the ends of the front or back legs.

The rest, for the woodworking half of me, is denouement. The hardwood seat and crest are worked up, finished, bored, test-assembled and checked for accuracy. The tenons are kerfed with a veining tool to prevent air-lock as the parts are driven home, a small dab of glue is spread on the walls of each hole but not on the tenon (to eliminate the chance of excess glue bead) and the chair is glued up. That's when, for the designer half of me, the excitement becomes a fever. What began as a vague possibility waiting to be discovered in my firewood pile now exists: a chair.

Is it perfect? After all the previously described fussing and tinkering, I must confess it's not. But that doesn't dampen my enthusiasm, it only makes me itch to build another chair that's a little different, and then another. For me, chair design is not a process with an end. Good design, after all, cannot be created; it evolves. *(continued on next page)*

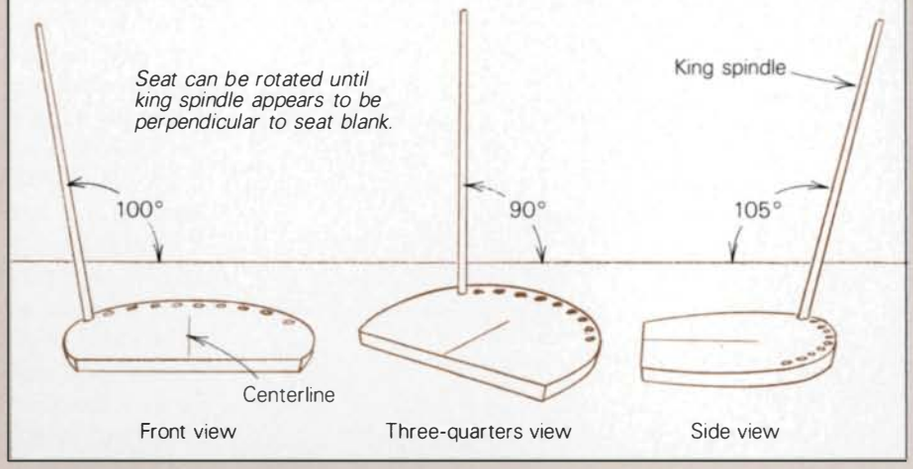
Boring angled holes

When the novice chairmaker gets out his drill bits and protractor, it usually isn't long before he's stumped. How do you get the spindle and leg holes at the correct angles? It can be puzzling, because each of these chair parts involves a compound angle—an angle at an angle—as shown in figure 5.

We could measure the two angles with a protractor, but I find that it's better to do as loggers do: consider a compound angle as one angle leaning in a particular direction. To a logger, the direction in which a tree leans is the axis along which it will fall, at least on a windless day. To determine that direction, the logger walks around the tree at some distance, sighting its trunk against an object hanging plumb from his fingertips, such as a key chain. When the tree appears to be perpendicular to the ground, he is standing on the fall line.

I apply the same trick when making a real chair from a scrapwood prototype, such as the one described on pp. 72-75. On the prototype, I sight the axis line of the spindle—its "fall line." Perpendicular to the axis, I sight the lean-angle of the spindle. Then I set a drill press to bore the lean-angle, align the spindle axis with the bit, and bore the hole. I use a radial drill press because the head, not the table, tilts, making it easier to hold and align seat blanks on the table. When you understand the principles, however, you can adapt the method to a regular drill press by making an auxiliary table that tilts the work.

Fig. 5: Spindle angles



To determine the spindle axis, I set up my trial plywood seat and mark on it a centerline. Then I add the trial king spindles in the position I want.

I now stand a try square on the flat plywood seat and slowly move it to the left or right until the vertical edge of the square's tongue is parallel to the king spindle's centerline. I mark the point where the tongue's edge meets the seat (figure 6). The process is repeated for the other king spindle. Then I draw the spindles' axis lines—corresponding to the direction in which each spindle leans—as shown in figure 7. The two lines should either meet at the seat's centerline, or run off the front edge of the seat at points equidistant from the centerline. If they don't, I check whether the back is on straight, measuring the crest's height from the plywood at each end and comparing the back's diagonal measurements from the top of one king spindle to the bottom of the other one. If that's not the problem, I check the crest for twist by sighting the side view of one king spindle against the other (they should line up), and by sighting down from above to see if the crest is symmetrical to a line connecting the two king-spindle holes (line A–B in figure 7). If none of this resolves the error, I split the difference. One has only so much patience.

Now, to determine the lean-angle, I hold a protractor along a sight line perpendicular to a spindle's axis line (figure 8). The protractor's hairline should split the centerline of the spindle (I use a protractor with a clear plastic tongue). It's best to hold the protractor dead-upright and read with your eye at the same level as the protractor's base—sighting across the seat's horizon. The lean-angle shown on the protractor, which will be the same for both king spindles, is the angle at which the drill press will be set.

I use Powerbore bits for spindle holes. To set up for drilling, I transfer the centerline, the crossline A–B, the

Fig. 6: Finding the spindle axis

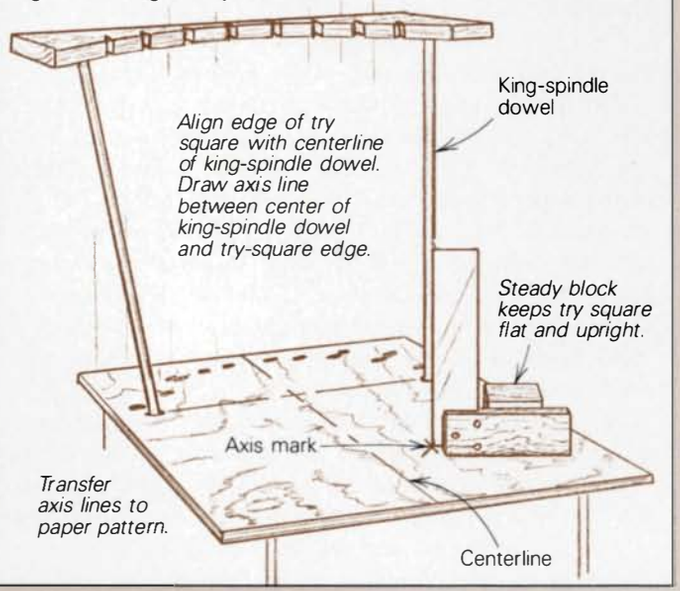
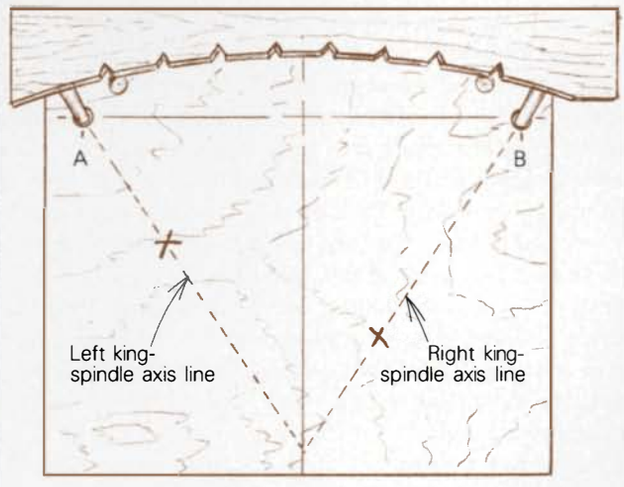


Fig. 7: Checking alignment



When crest and king spindles are properly aligned, spindle axis lines will meet at seat centerline.

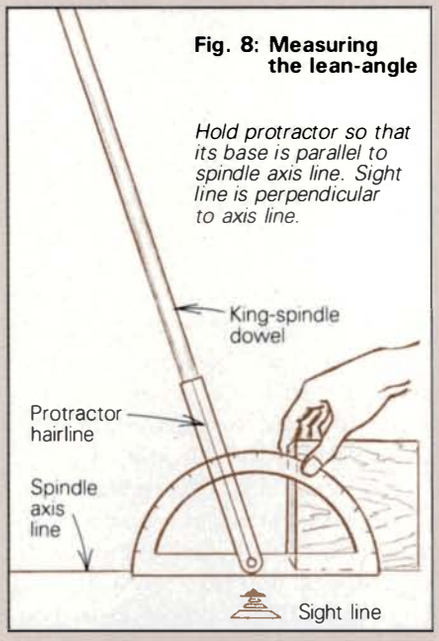


Fig. 8: Measuring the lean-angle

hole locations and the axis lines from the prototype seat to the seat blank. One critical adjustment remains: the axis line on the seat must be set on the table in the exact plane in which the head of the drill press tilts. This plane should be parallel to the front edge of the press base, but to be sure I check by chucking an eyebolt in the press and tilting the head all the way to one side. I drop a plumb line from the eyebolt and mark the point on the floor. The process is repeated in the other direction. Connecting the points with a straightedge placed on the drill-press base shows the plane in which the head tilts, and along which the axis line must be set. If this plane doesn't correspond to the front of the press's base, I rotate the head assembly about the column until it does. Then I mark the position with matching scratch

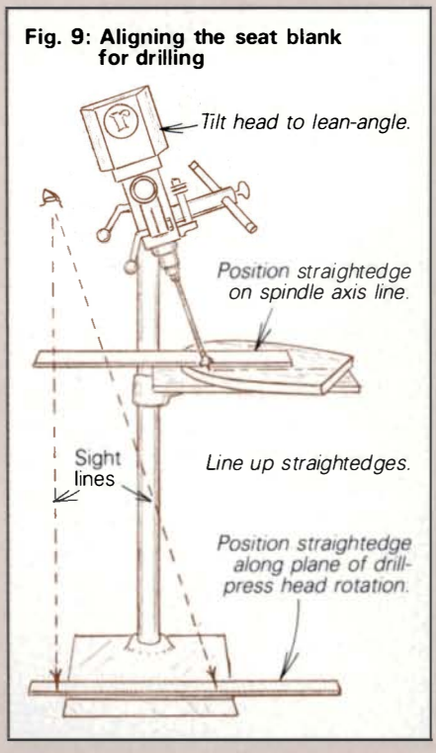


Fig. 9: Aligning the seat blank for drilling

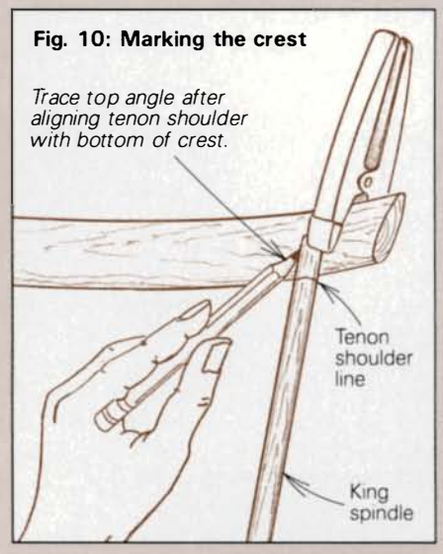


Fig. 10: Marking the crest

marks on the column and head. After that, I just use the scratch marks to check press alignment.

After setting the press at the spindle's lean-angle, I place the seat on the press table and align the spindle's axis with that of the press. To do this, I lay a straightedge along the spindle axis line of the seat and, with the machine turned off, I lower the quill until the tip of the bit's center brad pierces the hole location on the blank. Then I rotate the seat blank until the top straightedge is parallel to the bottom straightedge (or, on my drill press, to the front edge of the base), as in figure 9. When everything lines up, I bore the hole, then I move the seat to the other spindle location, align that axis, and bore that king-spindle hole.

At this point, I have a seat blank with two king-spindle holes. I make the king spindles, based on the trial ones from the prototype, and plug them into the seat. Now I can set up to drill the rest of the spindle holes in the seat and in the prototype crest rail. (With these parts assembled, I can refine the design, including the outline of the seat itself.) To find the angles for the spindle holes, I clamp the crest rail to the king spindles and trace off the angles of their top tenons, as shown in figure 10. Then I bore the holes as shown in figure 11. Now I can mount the crest on the king spindles and drill the pawn-spindle holes with a hand-held electric drill (figure 12), eyeballing the drill's alignment from point to point.

To drill the seat's pawn-spindle holes, I use a bit extension with the power drill. I set up the notched crest made before the model sat in the prototype, as explained on p. 74, and run the extension in the notches (figure 13). —*J.S.*

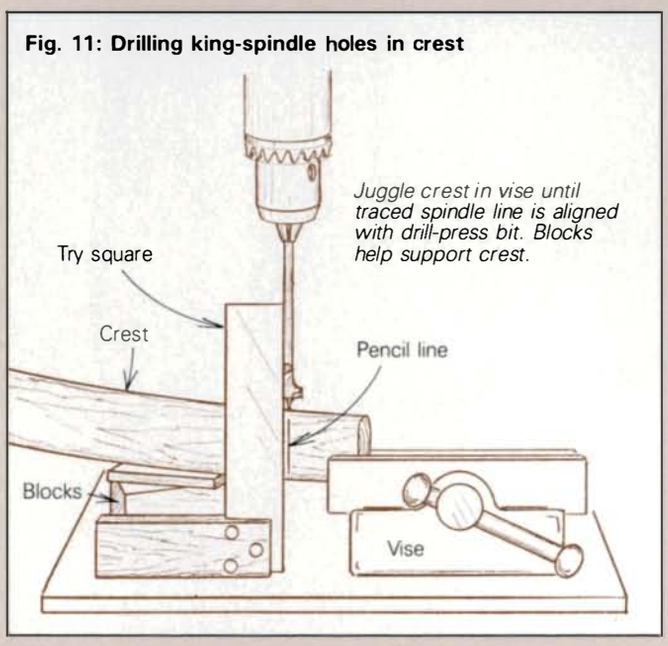


Fig. 11: Drilling king-spindle holes in crest

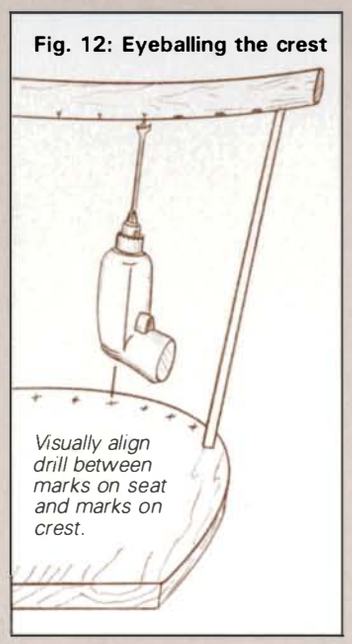


Fig. 12: Eyeballing the crest

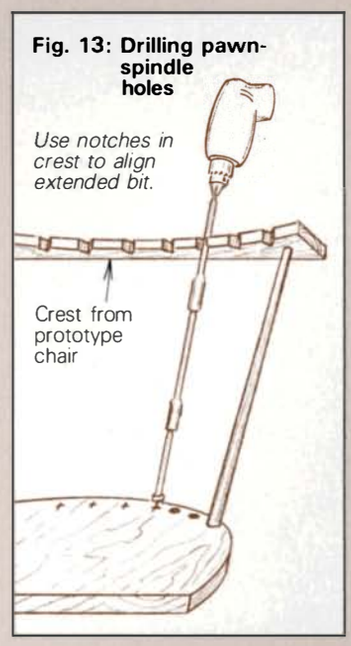


Fig. 13: Drilling pawn-spindle holes

Ideas Go Further Than Technique

Two California shows highlight a new direction

by Lewis Buchner

Two concurrent shows in Mendocino last autumn underscored the coming of age of designer-built furniture. The emphasis has shifted from displays of technical prowess to a growing sensitivity to line, form and philosophical implication. In this maturing work, technique serves as a means to showcase the maker's statements and ideas, instead of being an awe-inspiring end in itself.

A musician who has the technical ability to play a thousand notes in a solo may still fail to create the impact that another musician can achieve with just ten soulful notes. It can be the same with furniture. A friend commented that some of the pieces in the recent Mendocino shows seemed crude. Three years ago the same pieces would have been admired for their flawless dovetails and technical expertise; today that is not enough. What a piece says, what its soul is, goes far beyond a critique of its craftsmanship. To quote a letter to the editor by Gail Smith, from *FWW* #40, "Woodworking will not come of age until woodworkers stop thinking of technique and wood as ends in themselves, and start producing pieces of aesthetic value and conceptual substance."

We cannot avoid the impact that the college-level woodworking programs are having on our field. Woodworkers now comprise a rich assortment of personalities, from rugged individuals who are self-taught in both technique and aesthetics, to graduates of university programs who have been tutored in both craftsmanship and design. These people have been taught to probe for understanding and meaning in their work, no matter how obtuse their ideas may seem to others. The self-taught designer-craftsman seems to work in a more intuitive, nonverbalized and less intellectualized way. The schooled woodworker, however, is likely to be more comfortable with verbal concepts and reasoned attempts at solving

Photo: Ralph Gentet

Facing page: *'Pod' coffee table, by Alan P. Radebaugh, is 20 in. high and made of padauk, maple and polished aluminum. Radebaugh, of Albuquerque, N.Mex., was educated in liberal arts and music, and is self-taught as a woodworker. Though his work has high-tech aspects, he also strives for an animalistic feeling, by way of such details as this table's elephantine foot-pads.*

Above: *Wall shelf, by Roy Jenuine, is 48 in. long and made of rosewood and padauk. Jenuine is college-trained, having studied sculpture, painting and woodworking at San Diego State University. Says he, 'In this piece I had in mind a feeling of tension and balance. I worked it out intuitively on paper, my concept finally evolving in the form of a wall shelf.'*

Below: *Bureau, by Roger Heitzman, is 40 in. high and made of Peruvian walnut. Heitzman, of Los Gatos, Calif., is an architectural draftsman who has studied woodworking technique but not art or design. He says that this piece is an experiment in style, 'my own interpretation of some classic lines and proportions, evolving from an antique bow-front.'*

aesthetic and philosophical issues. The work produced by the schooled and non-schooled groups can vary widely, and this diversity is having an important and stimulating effect on all of us—regardless of which camp we hail from ourselves. The message is plain: technique is no longer enough; a piece must justify its aesthetic existence as well. Not only must we construct our pieces in ways that are strong, durable, and in accord with the nature of our material, but we must also create objects that are visually and tactilely strong, durable, and sensitive to our personal philosophical visions.

The other striking aspect of these two shows was the scarcity of representation from the Mendocino Woodworkers Association. The core members of that group, who were responsible for putting Mendocino on the map as a center for designer-built furniture, have become better established over the years and no longer rely as heavily on the gallery shows. In place of the usual list of Northern California woodworkers were names from as far away as San Diego, Albuquerque and Seattle.

It seems strange at first that the small town of Mendocino, perched by itself on the rugged coastline, would attract so many woodworkers and so many buyers. Yet Mendocino is

Blanket chest, by David Eck of North Bend, Wash., is 29 in. high and made of alder, maple and cedar. Eck, who has had formal training as an artist and as a furniture craftsman, says that 'blanket chests typically set hard and heavy on the floor—ironic when one considers the soft, warm contents inside. I chose quilted maple for the top panel not only because its figure evokes the soft, puffy qualities of fabric, but also because its black lines of mineral deposits seem to suggest stitching. It's as if the lid were transparent, revealing the contents.'

Photos: ©1983 Jos. Felzman

Lewis Buchner

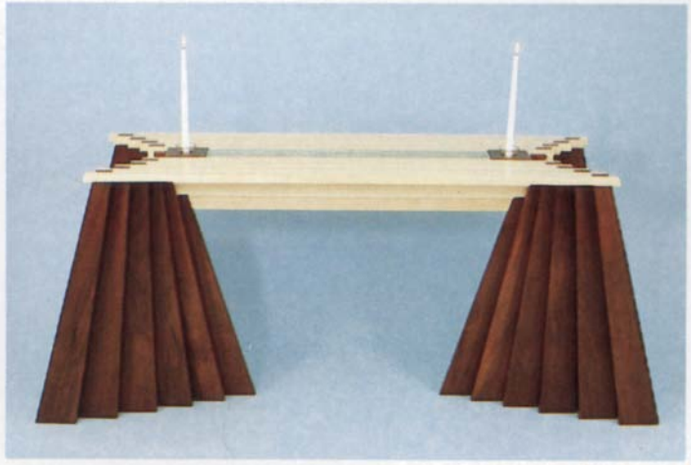
'Eternal Voyage,' by John Boomer, a self-taught sculptor who lives on a Navajo reservation in New Mexico, is carved from walnut and ebony and is 17 in. long. Says Boomer, 'The bowl implies a mystical story but does not complete it—that is up to the viewer. For me, it evokes an eternal voyage, a funeral urn, a boat, a voyage to beyond. The pointed sticks are lines of energy shooting past. The bowl also explores the technical limits of carving a partially closed form as thin as possible.'

Dennis Hearne

Mirror, 32 in. by 26 in., by Tom Bouchard of San Francisco, is of purpleheart with ebony accents. Bouchard studied at Rhode Island School of Design, and his design background is evident in the mirror's crisp economy. The glass has already broken through its frame and seems poised to extend itself into a full circle.

unique in its association with fine woodwork. The craftspeople who had retreated to a rural life in that area came together seven years ago to hold twice-yearly shows. Their success drew upon the town's existing tourist and art gallery clientele. As an outgrowth of these efforts, author-teacher Jim Krenov was attracted, and set up his school nearby. The Artisan's Guild Store and then Gallery Fair both became active retail outlets for a growing number of furnituremakers and wood artisans. For the recent shows, both galleries reported respectable sales and a number of commissions taken. □

Lewis Buchner is a furniture designer in San Francisco.



Altar table, by Sandor Nagyszalanczy, is 60 in. by 30 in. and is made of rock maple, Peruvian walnut and glass. Nagyszalanczy, of Santa Cruz, Calif., attended design school and worked as a sculptor before turning to furniture because, he says, 'of its possibility of being a transforming influence as it is used in daily life.' As the viewer moves around this altar table, slits of light appear and disappear between the slats, which seem to be more or less curved, though they are all straight pieces of wood.

Photos: Nicholas Wilson

Water-Gilding

How to match the golden age's incomparable shine

by Nancy Russo

This girandole from about 1820, designed by H.H. Richardson, holds candles that reflect light into the room and bathe its own water-gilt profusion with dancing beams.

Period furnituremakers who don't work with gold are missing out on some of the most passionate furniture ever made. It's true that gold leaf, misused, can be garish. But at its best, burnished gold has visual qualities that pull a design together, bringing order to elements that, finished in another way, would be incomprehensible. A woodworker, furniture designer or frame maker today can incorporate bright or antiqued gold into his work in much the same way that he might use inlaying, marquetry or carving.

There are two fundamentally different ways to apply gold leaf, and each has its place. Water-gilding was once the principal method for ornamenting objects of real value—panel paintings, clocks, furniture, architectural members, and picture and mirror frames. It was used as far back as ancient Egypt and has remained virtually unchanged since the Middle Ages. Water-gilding is crucial to many period styles, but it has become obscure in the last eighty years or so. Few people outside the trade recognize a water-gilt surface, much less understand how it's done.

Nowadays, oil-gilding (*FWW* #36, pp. 77-79) is much more common. It is an ancient and durable method of attaching leaf to wood, glass, metal or just about any surface that can be made nonporous with a sealer. The leaf, either real gold or imitation, is pressed onto a coat of high-quality varnish that has been allowed to dry to a particular tack. Today, oil-gilding with 23-karat gold leaf is used primarily for outdoor work, from signs to state capitol domes. Because gold does not tarnish, the surface can be left unsealed, and the shine will last as long as the support and varnish remain intact. Most picture-frame moldings are oil-gilded these days, too, but with aluminum leaf or gold-colored "metal leaf" which is then distressed and antiqued with glazes. Oil-gilding is quick, and if you use imitation leaf, it's relatively cheap.

Water-gilding, in contrast, is rare to-

Photo this page: David Caras

Candy Russo

Leaf can be cut on a leather pad with a smooth-edged knife, whose handle here rests on some sheets of rabbit-skin glue. Also shown are agate burnishers, boxes of leaf, and a pestle for grinding lump clay, a piece of which sits at the back of the pad.

day, partly due to the cost of gold but also because of the time and labor involved. The leaf is laid on a many-layered ground of gesso and clay, both with hide glue as a binder. Then the surface—actually the ground itself, under the gold—can be polished by rubbing it with an agate burnisher. The tops of moldings and carvings can be burnished to a mirror-like reflection, and the hollows left with a matte, metallic luster, creating an incomparable richness of surface.

Antique water-gilt items slowly dull with age, mostly from environmental pollution, which eventually becomes difficult if not impossible to remove. These pieces were rarely protected with a finish and can be ruined by water, a fate many have suffered from careless cleaning. In many cases, although the gold is gone, the surface beneath may be reactivated and gilded again. But gesso that's been exposed to dampness for any length of time decomposes, softens irreparably, and must be replaced.

Small repairs are best done by patching. My feeling about complete re-gilding of antiques is, don't if you don't have to, but if you do, stick to the original gilding technique and burnishing patterns, and don't artificially age or "antique." The gold will mellow in its own time, whereas the various finishes used in antiquing are apt to change rapidly, drastically altering the effect.

Materials and tools—Today, most gold leaf is machine-beaten to a thinness of 0.00003 in., thinner than any piece of paper. If laid on a dry surface, a sheet of gold will sail off with the slightest puff of air. If crumbled in the hand, it disintegrates and all but disappears. Machine-beaten leaf is four times thinner than its medieval counterpart, and so thin that it is virtually transparent, which allows any color beneath it to shine through, especially when the gold has been partly worn through. Oil-gilded surfaces, toned to imitate this effect, never have the brilliance and depth of a burnished surface.

Pure gold is called 24K (karat). Gold leaf, which is 23K, is alloyed with 1K silver or copper, or a combination of the two. The other metals color the gold slightly warmer or cooler.

The standard leaf today is 3⅜ in. square and comes in "books" containing 25 leaves. There are 20 books to a pack, the wholesale unit, enough for an experienced gilder to cover 30 sq. ft. One manufacturer, M. Swift and Sons, 10 Love La., Hartford, Conn. 06141, currently charges about $275 per pack.

The two main types of gold leaf are loose leaf and patent leaf. Loose leaf is sold in two commercial grades: surface gold and glass gold. Surface gold may have small holes or imperfections, but these will be backed up in the book by a smaller piece of leaf for patching the gaps. Glass gold has no irregularities, because patches would show through when gilding on glass. Patent, or transfer, gold is leaf slightly adhered to a piece of tissue in the book. The tissue extends beyond the edges of the gold, so you can pick up each leaf by hand, which is especially helpful when gilding outside on a windy day.

Silver leaf is about three times thicker than gold leaf. Many Victorian picture frames were leafed with silver, then sealed with an alcohol-based, transparent, amber-colored lacquer to make them look like gold. In most cases, the silver has begun to tarnish—black spots can be seen beneath the gold lacquer. Some Victorian frames were deliberately tarnished in decorative patterns before being gold-lacquered.

"Dutch metal" refers to what is now called gold "metal leaf." It is made of copper and zinc, and is larger than gold leaf and thick enough to handle. The same is true of aluminum leaf, which came into use in the 19th century.

Because of the increasing thinness of gold leaf, by the 17th century a tool was needed to handle loose leaf, and the gilders' tip came into use. It's a wide, flat brush of badger or squirrel hair, 2 in. long, with a cardboard handle. The tip transfers the gold from the book to a pad or directly to the work. The gilder rubs the tip over her hair or face to collect a minute amount of oil (not to

Candy Russo

The gilders' tip picks up and transfers the gold from its padded book. A beginner may instead opt to use 'patent gold' (where each leaf comes lightly adhered to a sheet of paper), or to press waxed paper over the leaf for easier handling. The piece here, part of a table by Sam Bush, is shown as it would look being patched after burnishing.

create static, as is sometimes thought), and the oil provides just enough stick for the gold leaf to adhere to the tip for transferring.

If a full sheet of gold is not needed, it can be cut to size with a gilders' knife. The knife is not sharp and has no rough edges to catch and tear the gold. Gold leaf can be cut and transferred directly from the book with the aid of a piece of cardboard for stiffening and a piece of leather padding inserted between the last two pages, as shown in the photo above.

After the gold has been laid and the proper amount of time has elapsed, the gold can be burnished. The burnishers used today are made of polished agate fitted into a ferrule with a paintbrush-type handle. The common agate has a slightly crooked shape and a smooth, rounded point. This shape is in imitation of a dog's tooth, such as those used by Renaissance gilders, and remains the most practical for all-around use.

Procedure—The wood to be water-gilded is first sanded to remove sharp edges and corners, and then many coats of gesso are applied, forming a "bed" for the gold. Gesso is a mixture of whiting (calcium carbonate, ground very fine and washed) and rabbit-skin glue, with the consistency of heavy cream. It is kept hot to maintain brushability, because rabbit-skin glue congeals just like other hot hide glues when cooled to room temperature. Usually six or seven coats of gesso are sufficient, especially if the wood is a fine-textured one such as poplar or basswood. The gesso and its application are extremely important for a good gild and burnish.

You can either use a pre-mixed, packaged gesso, or make it from scratch. The packaged type, Grumbacher's Dry Ground Gesso, is a mixture of whiting and glue pellets. For large jobs, it's cheaper to make your own gesso: Mix 1 oz. by weight of rabbit-skin glue to 4 fl. oz. of water. Allow the glue to completely swell and soften at room temperature, which can take from 15 minutes to several hours, depending on its particle size. Sift 3 to 4 cups of whiting through a wire strainer. Measure 4 fl. oz. of water into a metal container, and slowly add the sifted whiting until the mixture mounds on the spoon and begins to look just slightly less smooth and glossy. To make sure that the whiting is completely absorbed, I shake it into the can from a spoon, slowly, until the water won't absorb any more, then I add more, stirring out any lumps, until the mixture mounds. Heat the glue mixture in a double boiler over low heat until it melts. Add 3 fl. oz. of the melted glue all at once to the whiting mixture. Using a good brush with no loose hairs, slowly stir from the bottom in one direction until the gesso is well mixed.

Both kinds of gesso will keep for a few weeks if refrigerated, but will gradually break down. If the gesso begins to look a little watery on top, it may be too soft to use. Don't take chances with gesso. If in doubt, make a new batch.

For use, heat the gesso in a double boiler, adding a few drops of water each time you heat it to compensate for evaporation. Overheating, either too often or too hot, can break down the glue and can also cause pinholes, the bane of a gilder's existence. If pinholes develop in the first full-strength coat of gesso, they will telegraph through the successive coats, and even the top coat of clay will have pinholes. To avoid them, work in a warm, dry room and keep the gesso from cooling in the pot as you work. If small bubbles develop while you're making the gesso, and some always do, agitate the container, letting them rise to the surface. Then when the gesso cools and skins over, just peel off the skin. You can also add a wetting agent, such as oxgall (available from an art supply store), which will help the bubbles rise to the surface. If in the end your final dry coat of gesso shows pinholes, try wetting your finger and rubbing over the gesso until the sludge fills the holes.

After the gesso is heated, apply it first as a primer coat. Dilute the gesso to half strength with water, brush it on and let it dry. The first full-strength coat is scrubbed on quickly for good adhesion, especially important if the wood is open-textured. A good-quality, ¾-in. wide, square-end sable brush is the right choice for all stages of gilding. Wet the brush with water and squeeze it dry, then apply the gesso, working quickly and with the brush fairly well loaded. Avoid over-brushing, or the surface will become lumpy. Each coat can be applied as soon as the previous coat has dulled, until you've built up the thickness to as much as 1/16 in.

When the gesso is dry, surface it absolutely smooth with sandpaper, either wet or dry, or scrapers. I usually start with 320-grit aluminum oxide paper and work down to as fine a paper as necessary to eliminate all sandpaper marks without actually putting a polish on the gessoed surface, because if this happens, the clay will resist bonding to the gesso. It's important not to sand the gesso into sharp edges or corners which could be knocked off or chipped. Shallow, ornamental carving can be done with regular carving tools after final-sanding. Gesso carves crisply and cleanly.

Next comes the gilders' clay. This is the red coating sometimes seen peeking through worn gold leaf. It's a very fine-textured, unctuous material that takes a polish when rubbed with the agate bur-

nisher. Red clay looks best under gold leaf when rub-through antiquing effects are used. Blue-gray, white, black and yellow clays are also common, the color of the clay affecting the tone—warm or cool—of the final gold finish. Dark clays are used under silver leaf, while yellow clay helps to hide breaks in the gold in the matte areas. Commonly, the whole object will be given several coats of ochre clay over the gesso, then the areas to be burnished will be given a few additional coats of red clay or dark gray clay.

Clay is sold in solid lump form from Europe, or as a thick pre-ground paste packed in small jars. Gilders' clay formulas are a closely guarded secret of the makers. Modern gilders' clay probably contains some additives such as glycerin, whiting and dyes, which are meant to extend and improve the clay.

The clay must be ground in water to a smooth-as-silk consistency, rabbit-skin glue (or gelatin) and water added, and several coats of the mixture brushed over the surfaced gesso. The recipe I use makes about ¼ cup. I like to make only as much as I need for a given job. If you are working with lump clay, first grind it to a powder. I have a piece of fine steel screen, which I bought at a hardware store, stapled over a deep wooden box. Holding the clay as if I were grating cheese, I rub it over the screen to pulverize it. Grate about two rounded tablespoons' worth, put it into a clean metal container, such as a tuna can, then add water to form a paste. Now strain the clay to remove any grit. I force it through an extremely fine piece of brass mesh soldered onto a copper cylinder; some people use several layers of fine nylon stocking. Jarred clays, which you might expect to be grit-free, are sometimes not. At best, gritty clay will make the gold less bright. At worst, grit can ruin your burnisher and cause it to scratch the gold on future jobs. After straining, add water, stirring with a pointed sable brush until the clay mixture is thin enough to drop off the brush one drop at a time. Before the mixture reaches this point, it will be necessary to add the water very slowly, drop by drop, or the clay will be too thin.

Now make up the rabbit-skin glue, using the same proportions as for gesso. Melt the glue in a double boiler and add it to the clay/water mixture by dribbling it down the side of the can in a thin, steady stream, stirring all the time. Almost immediately, the clay will begin to clabber, or curdle. Sometimes it suddenly gets quite thick, almost stiff, and other times a slight thickening is barely discernible. Keep adding the glue steadily. Just after the clabbering stage, the clay will begin to thin out again. You want to bring it back to the point where it drops off the brush one drop at a time. As the glue is added, the clay goes through these stages very quickly, from thin to clabber to thin again, so go slowly and carefully.

To be on the safe side, I always test each batch of clay on a gessoed sample piece. Apply a little clay, leaf over it, and test how it burnishes. After testing the clay, brush it on the surfaced gesso. Several coats are needed before the clay looks opaque and covers the gesso completely. Keep the clay warm while you work, as you did for the gesso, and try not to let it pool in the hollows, or pinholes may develop.

The clay mixture has very little body, and even five or six coats will not hide defects in the gesso. The clay should not need to be surfaced, but if you notice any grittiness when it has dried, you can smooth it with a worn piece of 400-grit or 600-grit sandpaper and polish out with a piece of linen or a white Scotch-Brite scrubbing pad. Avoid steel wool—it leaves particles behind, and some brands are protected from rusting with oil, which can ruin the clay surface.

Now the gold leaf can be applied. The clay surface where the first pieces of gold leaf are to be laid is first flooded with a solution of water and alcohol. This activates the glue in the clay, creating adhesion. The proportion of alcohol doesn't matter too much. I use about 1 part methyl alcohol to 3 parts water. When gilding with silver leaf, which is heavier than gold, or if the leaf didn't adhere perfectly on the test piece, I add a tiny pea-sized piece of rabbit-skin glue to the solution. Be careful, though—too much glue will dull the burnish.

Really flood the surface, because the layers of gesso and clay will absorb the water like a sponge. If the clay looks dull instead of wet and shiny, the gold will not stick. Using the gilders' tip, quickly pick up the gold and with a smooth motion transfer it to the work. I rub a dab of Chapstick on my wrist and pass the tip over it occasionally so that the gold will adhere. You'll find that using the gilders' tip takes a little practice. The larger the pieces of gold needed, the more practice it takes to lift and transfer the leaf smoothly, without the gold folding up before it reaches the surface. Don't be intimidated by the fact that it is gold and is so fragile. A few wasted pieces amount to only a few cents, and you will waste some. After most of the water has been absorbed and the gold flattens out, tamp it down lightly with cotton and lay the next few pieces, overlapping the edges slightly.

When the whole piece has been gilded in this manner, the matte areas are burnished with cotton to ensure good contact and to bring up a rich luster. The "skewings," loose pieces of gold at the overlaps, come off at the same time. With a clean piece of cotton, lightly rub over the gold in a circular motion, applying more pressure as the skewings are removed. The gold will look like solid, polished metal. This is a matte gild.

Highlights can now be burnished mirror-bright. The areas to be burnished should not be bone-dry, but they shouldn't be too damp, or the burnisher will tear through the gold. Glide the burnisher back and forth over the gold, and if everything is just the way it should be, you'll find you can apply quite a bit of pressure. Burnishing is one of the craftsman's real rewards for preparation of the ground. The Latin word *brunir,* from which "burnish" is derived, means brown, and aptly describes the gold as it changes from a pale color to dark, metallic reflections. The burnisher presses folds and overlaps into each other; these double-thick areas appear as more solid areas in worn, antique pieces.

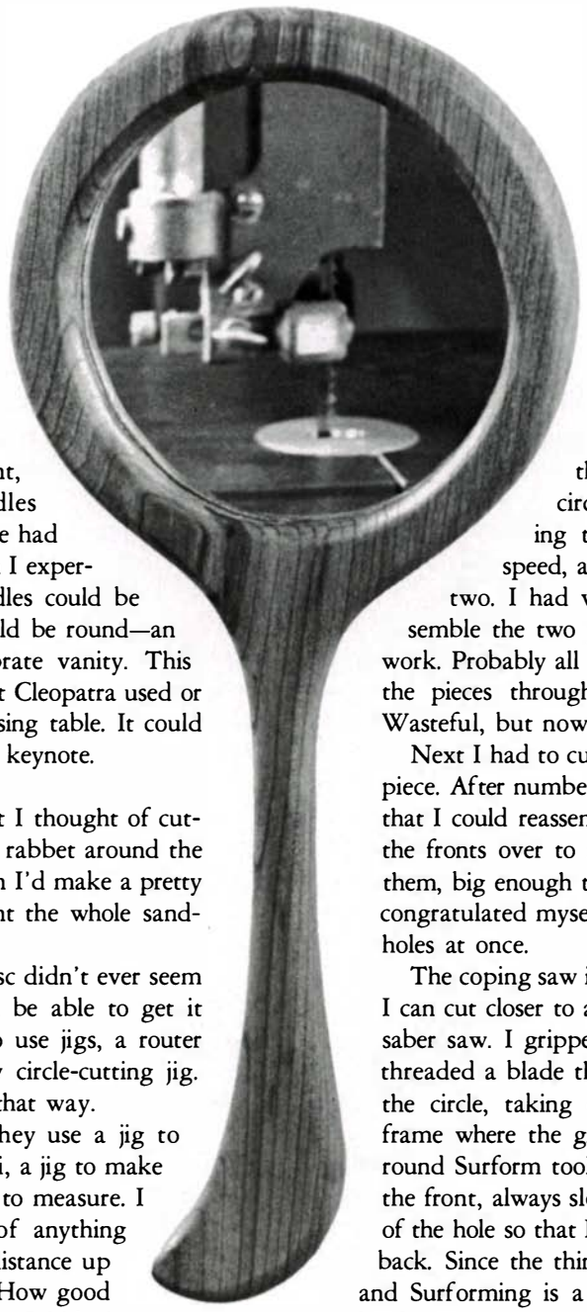
The whole job can now be left as is, antiqued, or given a protective finish. Any finish will dull the gold, and for this reason many old pieces were never sealed at all. Nitrocellulose lacquer, sprayed or brushed, dulls the gold less than other finishes. Orange shellac is often used instead, to warm the color. Don't worry if the finish coat blooms (whitens slightly) as you apply it. It will dry bright and clear. □

Nancy Russo has been gilding and restoring since 1971, and now has her own shop, Gold Leaf Restorations, in Portland, Ore. Gilding materials can be obtained from H. Behlen & Bros. (call 518-843-1380 for a local distributor); from Art Essentials, Box 260, Monsey, N.Y. 10952; and from sign painters' suppliers and good local art-supply stores.

Mass-Producing Cleopatra's Mirror

Making a living without jigs or a tape measure

by Robin Kelsey



I make a living doing short-run production woodworking and wanted to make a gift item, pure and simple—something romantic, something people would buy for a loved one. I decided to try making a hand mirror.

First I had to figure out what a hand mirror looks like. "Designing," they call that. I began with a few free-form shapes, as is my wont, with ovoid glass and short handles shaped to feel good in a hand. These had a certain amount of charm, but then I experienced a design breakthrough: handles could be long and elegant, and the glass could be round—an intrinsically elegant object to celebrate vanity. This could be the sort of hand mirror that Cleopatra used or that Helen of Troy had on her dressing table. It could be a classic. Elegance would be the keynote.

But how to mount the glass? First I thought of cutting through a board and routing a rabbet around the back of the cutout for the glass; then I'd make a pretty disc of contrasting wood and cement the whole sandwich together.

But when I tried it, the pretty disc didn't ever seem to fit very well. The only way I'd be able to get it accurate enough to fit would be to use jigs, a router template probably, and a bandsaw circle-cutting jig. But I just didn't feel like doing it that way.

Some workers delight in jigs. They use a jig to cut bread, a jig to measure spaghetti, a jig to make popcorn. Not me. I don't even like to measure. I figure I can eyeball the middle of anything small, up to about 6 in., and any distance up to an inch. I have to ask myself, "How good does this really have to be?"; "Can I hide it if it's wrong?"; "How much am I going to get for this?"; and finally, "Can I really do it?"

I decided that eyeballing was okay. I'd resaw the blank in half, glue the glass into a routed recess, and put the halves back together. If I did it well enough, it would look like one piece of wood with a mirror magically stuck inside, and be pleasing and intriguing to discriminating woodwork browsers.

I drew a prototype on paper, using a compass for the perfect circle, and tried making the first mirror. Immediately I discovered a technical snag: my bandsaw can resaw only 6 in. and the prototype was 6½ in. Who cares? Cleopatra's mirror was probably only 6 in. wide anyway. I redrew the thing and went back to make a few hundred. If you're going to make one, you might as well make a bunch. Then you'll get good at it. Welcome to the reckless world of production woodworking.

I surfaced some cherry to about ¾ in. and traced my elegant shapes all over the board. I cut six hand mirrors out of the board, that first day of the Trojan mirror wars. I resawed them all in half, starting from the handle end. The saw whisked through the handles but slowed down at the circles. Undaunted, I persevered, rocking the work gently for the illusion of speed, and soon my six mirrors were split in two. I had vaguely imagined that I could reassemble the two pieces on the sawcuts, but it didn't work. Probably all that rocking didn't help. So I ran all the pieces through my planer until they were flat. Wasteful, but now they had to fit.

Next I had to cut out the circular shape in each front piece. After numbering the two halves of the mirrors so that I could reassemble the respective pairs later, I took the fronts over to my drill press and drilled a hole in them, big enough to slip a coping-saw blade through. I congratulated myself on saving time by drilling all the holes at once.

The coping saw is a quick way to cut thin pieces, and I can cut closer to a line with a coping saw than with a saber saw. I gripped the front of a mirror in the vise, threaded a blade through the hole, and started cutting the circle, taking care not to break the 5/16-in. thick frame where the grain was short. Then I took a half-round Surform tool and rasped almost to the line from the front, always sloping the Surform toward the center of the hole so that I wouldn't break out the grain on the back. Since the thin wooden ring was perilously fragile and Surforming is a fairly violent process, I moved the work often to support it close to the vise. Then I flipped the piece around and used a half-round file to cut straight across from the back, even closer to the line. That trued the circle, making it almost as round as the eye can tell. Round enough.

I took my pattern and traced the hole onto all the back pieces with a pencil. While I was at it, I traced the same round shape onto some mirror glass, using a felt pen. I planned to rout the place for the glass quite a bit bigger than the front cutout, and to cut the glass bigger too, but less big; then it should all fit together easily, and all the approximations would be buried inside a neat mirrorburger.

I routed the glass's future home with a ½-in. straight bit, clamping the mirror handle to my bench. I cut *outside* the line, so the recess would be about ½ in. bigger than the traced outline. I set the router bit's depth a touch more than the

thickness of the glass and routed away freehand—I didn't care if the bit wandered a little.

I tried different routing patterns—a spiral from the center; outline first, then the middle; middle first, then the outline. No pattern was superior, but varying them prevented battle fatigue in this noisy and tedious skirmish in the mirror wars.

When all the backs were routed, I turned to the glass. It's easy to cut glass. You just get an inexpensive glass cutter at the hardware store and dip it in kerosene before every cut. Score the front of the glass, keeping firm pressure and listening for the continuous gritty sound, then snap it off. Don't try to cut a whole circle at once. It can't be done, except in crime movies. Approach the circle in big arcs. I must admit that eventually I got a glass circle-cutter, sort of a compass with a suction cup in the middle and a glass cutter on the other end. It's a wonderful device, but you can do without it.

Since the routed recess was ½ in. bigger than necessary, I figured I could cut the glass ¼ in. bigger than its frame and it would fit. Anybody can eyeball ¼ in., so off I went, rough-cutting the glass circles about ¼ in. outside my felt-pen lines. Most of the circles fit. I trimmed the ones that didn't, then put contact cement on the backs of the glass discs and on the routed recesses. While the cement was drying, I worked on the fronts.

The fronts were pretty nearly circular, after all that Surforming and filing, but they had no elegant profile, so I chucked a ¼-in. rounding-over bit in my router and clamped the router upside down in a vise. I ran the inside circumference of every cutout over the bit, then sanded them with 100-grit garnet paper until they were pretty smooth. A once-over with 220-grit made them nice. By now the contact cement was dry, so I put all the mirrors into their rabbets and squeezed them in with my fingers.

To reassemble these Cleopatran objects, I spread some yellow glue on the fronts and mated them with their respective backs, then I clamped everything in some odd vises I have around my shop. I snugged up the round part of the mirror in a vise, then put clamps all over the handle until each mirror was bristling with them. Since I had taken out a sawkerf and planed, too, I couldn't get a perfect grain match; but I was still seeking the illusion of one piece of wood with a mirror stuck magically, romantically, inside.

I was so eager to finish a mirror that I couldn't let the glue dry as long as the directions on the bottle said it should. But in joining flat grain to flat grain, you can get away with as little as 15 minutes in the clamps. Just remove one and take a chance.

So I took the first rough mirror-sandwich over to my Sears 6-in. by 48-in. stationary belt sander. I sanded the outside edges to the line on the disc-sander part, as far as I could, then knelt down and got the handle and the shoulder with the front roller. Some sanders have rollers too big to be useful. Get a Sears.

Knowing that I was fixing the shape of each mirror for all time, I tried to get a true circle and a graceful handle. The belt sander with a medium (80-grit) belt cuts fast, and I made some new design decisions at this time, shaping a thicker or thinner handle, changing the shoulder profile—whatever came to mind. I think I'm as good a designer on the tool as I am with a pencil, just the same guy after all. And the excitement of the sawdust flying can bring out the best in me. Sometimes it brings out the worst, but that's workmanship of risk for you. Almost everything sells eventually. I give the dogs away for Christmas, or keep them myself. My home is furnished in early dog.

I then went back to the router, which was still upside down in the vise with its ¼-in. rounding-over bit, and I rounded everything. That left a burnished strip where the pilot rubbed, so I gave the edges another quick once-over on the sander.

Next I took up a half-round file. Files do almost the same job as coarse sandpaper does, but they hardly ever wear out, so I figure they're cheaper. I filed the rounded-over edge sections torn by the router; I filed the handle to a more congenial form. I sanded the edges with 100-grit garnet, then 220-grit, then 400-grit, until the whole thing was very elegant and smooth. I used my hands and fingers, no block. It was pleasant work to do while listening to the radio.

Sometime in there I took the mirror back to the belt sander and made the front and back surfaces smooth. Like the telling of it, it was almost an afterthought. As far as resistance to getting smooth goes, the front and back were nothing compared to the edges.

I oiled the mirrors and put them in my store. Sure enough, lots of men (my special target group) bought them, sometimes pounced on them, with smug looks on their mugs, as if they'd solved the old birthday problem one more time. Sometimes women buy mirrors for themselves (I think), and they usually choose the short-handled ones, hefting them all for the best fit. But men always get the elegant, long-handled ones, dreaming of Cleopatra. Men, who don't use a hand mirror much, are more romantic about it than women are. I've made both kinds of mirrors now. I'm an equal-opportunity woodworker.

Many shoppers who look at the mirrors notice that they appear to be one piece of wood with a mirror magically stuck inside. This pleases them, so they look for the seam, find it, and tell their friend, "Look, you can hardly see the seam. That's nice." While I can't eat compliments, I can't grow on bucks alone, and it pleases me to hear that sort of thing.

A timed production run showed that it took about 30 minutes to make one mirror, and I figured the materials cost, at most, $1.50. I like to make $20 an hour on production work—that covers trips to the lumberyard, the rent and other bills—so I knew I had it made with the hand mirrors. In fact, I thought they were too cheap by the $20-an-hour formula, so I stuck $18 price tags on them. Most people seem to think that's about right. You can get change from a $20 bill, and, after all, this is Cleopatra's mirror.

Getting decent money for something I make tends to make me feel guilty, and I need to remind myself about all the things that pay next to nothing and are made for love, or just to practice my dovetails.

So hand mirrors proved to be a happy marriage of romance and economics, machine work and handwork. I liked making them, the first couple of hundred anyway, until I got good at it. Then it was boring and I had to make something else for a while. When I go back to hand mirrors they'll be fun again. And that's the way I get along. □

Robin Kelsey lives in Maynooth, Ont.

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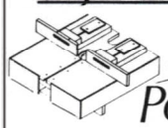

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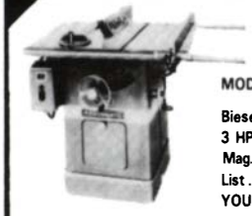

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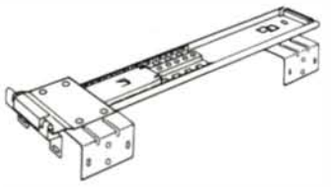

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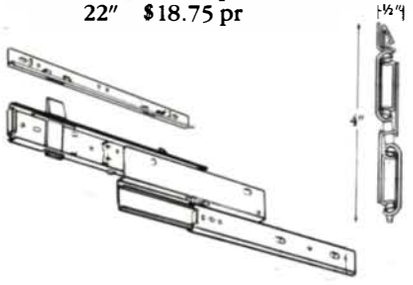

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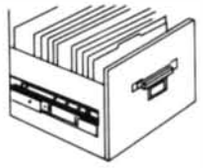

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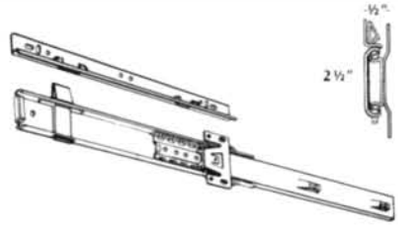


C1029 Center Mount

A precision three-quarter extension slide. Mounts to existing drawer bottoms and cabinet frames. No adjustments are necessary. This slide is center-mounted so the available side space between drawer and cabinet plays no part in installation. It eliminates wooden guides, supporting members and brackets. You're assured precision smooth drawer movement.

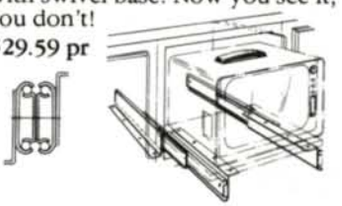
#12 $4.10 ea
#14 $4.10 ea
#16 $4.16 ea
#18 $4.37 ea
#20 $4.54 ea
#22 $4.79 ea
#24 $5.06 ea
#26 $5.40 ea

Slide Number	Fits Drawer Lengths	Fits Cabinet Depths	Drawer Extension
12	10⅝" – 12½"	13" – 14½"	8½"
14	12⅝" – 14½"	15" – 16½"	10½"
16	14⅝" – 16½"	17" – 18½"	12"
18	16⅝" – 18½"	19" – 20½"	12½"
20	18⅝" – 20½"	21" – 22½"	14½"
22	20⅝" – 22½"	23" – 24½"	16½"
24	22⅝" – 24½"	25" – 26½"	17½"
26	24⅝" – 26½"	27" – 28½"	19½"

301-1590 TV Shelf Slide

Heavy duty, holds up to 120 lbs per pair. Positive stop at full extension — which is 3/4" more than length. Easily used with swivel base. Now you see it, now you don't!

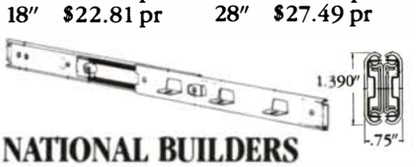
16" $29.59 pr



C-322 Pull-Out Shelf Slide

Designed for heavy duty shelf and drawer applications. Features full extension, rated up to 120 pounds load capacity. Noise abatement felt pads included. Mounting tabs are formed out of the drawer member for simple mounting or removal. Minimum side space required is 3/4".

10" $19.64 pr
12" $19.80 pr
14" $20.45 pr
16" $21.59 pr
18" $22.81 pr
20" $23.35 pr
22" $24.19 pr
24" $25.07 pr
26" $26.44 pr
28" $27.49 pr



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Quality REDWOOD PLANTER business. Inventory plus machinery. Since 1969. Sales in 4 states. Tubs shown page 37, #19 *Fine Homebuilding*. 1765 Old Stage Rd., Medford, OR 97502.

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APPRENTICE VIOLIN MAKERS and restorers: Positions available with finest rare violin shop in the country. Good salary and benefits, excellent training program. Professional woodworking experience required. Must be willing and able to learn. Bein & Fushi Inc., 410 S. Michigan Ave., Chicago, IL 60605.

CABINETMAKER WANTED—extensive experience with hand and power tools. One-of-a-kind project-oriented furniture shop. Apply Kramer and Eiland Woodworking, PO Box 221, Washington, VA 22747. (703) 675-3882.

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APPRENTICESHIP for custom cabinet shop in central Massachusetts. Unique opportunity to work with master craftsmen and teacher leading to partnership. Send resume to 307 W. Boylston St., W. Boylston, MA 01583.

Instruction

CANADIAN SCHOOL OF WOODTURNING (family woodturners since 1830). Basic training or full journeyman course. Bert Thompson, 1069 Southdown Rd., Mississauga, Ont. L5J 2Y7.

New England TRADE & TECHNICAL INSTITUTE, a nationally accredited post-secondary institution offering 1950 hours of finish woodworking and cabinetmaking, and construction technology. Financial aid, dormitory facilities, and part-time job assistance available. Write to N.E.T.I., 750 Massabesic St., Manchester, NH 03103.

Two-day intensive TURNING COURSE with Deryk Jones. Brochure, $1. Box 484, Merrickville, Ont., Canada K0G 1N0.

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WEEKLONG WORKSHOPS with noted designer/craftsman Alan Peters, starting August 19th and 26th. For amateurs who would benefit from experience in a professional shop. Accommodation in 17th-century farmhouse. Please write Aller Studios, Kentisbeare, Cullompton, Devon, England EX15 2BU.

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Finisher seeks challenge with custom shop or small maker in Connecticut or New York. Wood and painted finishes. 10 years experience. Box 48, So. Ryegate, VT 05069.

Los Angeles. Responsible woodworkers wanted to share well-equipped shop on westside. $125/month. John Houck, (213) 553-3939 days or (213) 472-7009 eves.

Publications

American Furniture, 1620 to the Present. Fairbanks and Bates. Out-of-print definitive work. Originally published at $50. Now $16 plus $3.50 for shipping/handling. Limited stock available. An essential reference: Over 1300 illustrations with bibliography, glossary and construction drawings. Includes contemporary woodworking. To order: send check for $19.50 to Arts Americana, PO Box 464, Dedham, MA 02026.

Getting the Most Out of Your Shaper. Now available from Linden Publishing, 3845 N. Blackstone, Fresno, CA 93726. Reprint of 1954 edition. Paper. 108 pp. $8.60 ppd.

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CARBIDE SAW BLADES. Tsumura Custom Track are the thinnest, easiest-cutting carbide blades available in the U.S. 7¼ in. to 16 in. $14.50 to $88. Call or write The Beall Tool Co. for catalog. 541 Swans Rd. N.E., Newark, OH 43055.

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LOCAL LUMBER DEALERS

For National dealers see "Wood"

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California hardwoods: California black oak, white oak, Pacific madrone, Fremont cottonwood, black walnut. Burls and more. Cal Oak Lumber Co., California's largest hardwood lumber producer. PO Box 689, Oroville, CA 95965. (916) 534-1426.

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Excellent selection kiln-dried hardwoods, softwoods. Also cabinet plywoods. Harris Hardwoods, 260 Tolland Turnpike, Manchester, CT 06040. (203) 649-4663.

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The Hardwood Connection, 420 Oak St., DeKalb, IL 60115. (815) 758-6009. A complete woodworking store staffed by woodworkers serving northern Illinois. Native and imported hardwoods. Millwork, plywood, veneer.

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Fine domestic and exotic woods for turners, carvers, instrument and cabinetmakers. No minimum. Semler Hardwood Co., RR4, Perth, Ontario, K7H 3C6. (613) 267-4630.

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Wide walnut lumber—FAS $3/bd. ft. Quantity discounts apply. Call Gerry Grant, Gettysburg, PA. (717) 528-4496.

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San Antonio and South Texas' hardwood store. Austin Hardwoods, San Antonio, 10841 Hillpoint, San Antonio 78217. (512) 822-8833 or 8323.

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BRANDING IRONS for craftsmen. Heat mark your products. Initial, signature, address, logo. Heat Mark Co., Rt. 6, Box 828, Mooresville, NC 28115.

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BANJO-MANDOLIN-GUITAR plans, kits and parts. Free catalog. Stewart-MacDonald, 21 N. Shafer, Box 900F, Athens, OH 45701. (800) 848-2273.

HARPSICHORD AND ORGAN PLANS. Send self-addressed envelope for free price list. R.K. Lee, 353F School St., Watertown, MA 02172.

GUITAR, BANJO, violin, mandolin-making materials, accessories, books. Piano-tuning kits. Catalog, $1. International Luthiers Supply, Box 15444, Tulsa, OK 74112.

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RESTORED MACHINERY—Finest woodworking machines ever made. Oliver, Yates, Northfield. Bandsaws, tablesaws, wood lathes, etc. Puget Sound Machinery. (206) 627-0802.

SILVO Hardware, 188-page Hand & Power Tool Catalog, $1. Dept FW-4-6, 2205 Richmond St., Philadelphia, PA 19125.

MAKITA/JET TOOLS. We'll not be undersold. Price quotes, call nationwide (800) 331-TOOL. Calif. (707) 964-6661. Write AES, Box 1790, Ft. Bragg, CA 95437. Catalogs, $1. Prices include delivery.

GENERAL WOODWORKING MACHINERY. Catalog, $3, refundable. John Gorrell Woodworking, 7188 Whitfield Dr., Riverdale, GA 30296.

FREE CABINETMAKER SCREWDRIVER or chisel offer. Send today for free details. Master Craftsman Co., Box 307B, Xenia, OH 45385.

BEST DEAL. References: see Jan./Feb. article STETON-GRIGGIO-others. $3 for 2 brochures. Henry Wiegand Corp., Claremont, NH 03743.

TOOLS—ANTIQUE & USED—STANLEY. Send SASE and 20¢ for current list. Bob Kaune, 511 W. 11th, Port Angeles, WA 98362.

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EBONY, ROSEWOOD and curly maple for musical instruments, inlaying, knife handles and pool cues. Contact PO Box 32, Haddon Hts., NJ 08034, or call (609) 546-2903.

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BIRD'S-EYE MAPLE, curly maple, $2 to $12/ft. Shipment anywhere. List, $1. Cornucopia, Harvard, MA 01451-0044.

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OREGON'S largest all around woodworking headquarters. Over 60 species in stock, domestic, foreign, exotic; including cocobolo, kingwood, quilted maple, hardwood plywoods. Tools by Inca, Hegner, Japanese, Henry Taylor, Stanley, Buck. Finishes by Penofin, Fabulon, Watco. Oak moldings and hand rail systems. Woodworking books of all description. Toy parts and much more. Woodcrafters Lumber Sales, 212 N.E. 6th Ave., Portland, OR 97232. (503) 231-0226.

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Wesflex 501 inverted pin router. Excellent condition, $1,000. F. See, 359 Whitman, Leavenworth, WA 98826. (509) 548-4265.

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12-in. DeWalt radial-arm saw, 18-in. Root tablesaw, Inca bandsaw, Stanley planes, compressors, blacksmith tools, etc. Send SASE for list & prices. Jeff Neil, 27 Hillcrest Ave., Ossining, NY 10562.

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Inca 259 10-in. saw and 510 jointer/planer. 20 or so hours on the saw, 40 or so on the j/p. $2,350 for the two. Call me re: free delivery and other details, or write Felix Marti, Rt. 2, Box 173M, Monroe, OR 97456. (503) 424-2139.

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Cemco 1-in. industrial shaper, 3HP, 3,450 RPM, 3PH, rev. cont., $325. G. Hanson, 1515 Laurel Ct., Dundee, IL 60118.

Bowl turning blanks, walnut stumpwood, crotchwood; spalted oak, pecan and ash; much more. Mark Potter, PO Box 973, Columbus, TX 78934. (409) 732-5288.

Powermatic 90 gap-bed lathe. Excellent condition, many extras. $1,500 O.B.O. Phone (716) 334-9494. Habbersett, West Henrietta, NY 14586.

10-in. Inca tablesaw with 2HP motor, carbide blade and most accessories, $1,375. #45 plane, $190. #55 plane, $290. Shipping extra. Jim Mack, (404) 873-4460 or (404) 373-3991 evenings.

Wanted To Buy

4,000 bd. ft. of oak, ash, walnut, cherry and elm. AD or log from mill or landowner west of Mississippi River preferred. S. Brink, Box 152, Monarch, Alberta, Canada T0L 1M0.

Pneumatic sander in good condition. Siferd, 1530 Wendell Ave., Lima, OH 45805.

Stanley Everlast wood chisels. Call (502) 228-3113 or write N. K. Ford, 6902 U.S. 42, Louisville, KY 40222.

Must have: Sears Craftsman single-cutter molding head for tablesaw. (207) 926-4608 eves.

Catalogs and owner's manuals, originals or copies, 1930 to 1978. Delta, Rockwell, Walker T, Sears, etc. Send cost, condition, and phone number to A. Lutz, 17941 Bigelow, Tustin, CA 92680.

Stanley chute board #52 and cutter heads for Stanley dowel-making machine #77. Ted Satori, 1732 Payne St., Louisville, KY 40206.

Events

Listings are free, but restricted to happenings of direct interest to woodworkers. Our July/Aug. issue will list events between June 15 and Sept. 15; deadline May 15. Our Sept./Oct. issue will list events between Aug. 15 and Nov. 15; deadline July 15.

ALABAMA: **Show**—Panoply of the Arts, May 10–13. Big Spring Park, Huntsville. (205) 533-6565.

ARIZONA: **Show**—Bowls, Ed Moulthrop. One day only, May 5. Hand and Spirit Gallery, Scottsdale. (602) 949-1262.

CALIFORNIA: **Workshops/seminars/lectures/exhibits**—Numerous events at Cutting Edge stores. Berkeley, (415) 548-6011: Rocking horse carving, children's toymaking, children's woodcut printing, wood lamination, chair design, wooden xylophones, cold-molded boat construction, Japanese tools, Garry Bennett, woodcut printing, decoy carving demo. Los Angeles, (213) 390-9723: Sam Maloof, Toshio Odate. San Diego, (619) 695-3990: Regulator clock, Queen Anne table, turning.
Juried show—3rd Annual Design in Wood, June 14–July 1. Fairgrounds, DelMar. (619) 297-0338.
Seminar—How to Set Up a Shop, Baulines Craftman's Guild, June 2–10. Contact Guild at 55 Sunnyside Ave., Mill Valley, 94941.
Exhibit—The Woodworker West, 130 exhibitors, Aug. 17–19. Civic Center, Santa Monica.
Craft fair—Trade: Sept. 19–20; public: Sept. 21–23. Showplace Square/Trade Show Center, San Francisco.
Workshop/seminar—Tools and Techniques, July 2–28, Aug. 6–Sept. 1; James Krenov, Sept. 7–8. College of the Redwoods, 440 Alger St., Ft. Bragg, 95437. (707) 964-7056.
Juried exhibit—Artistry in Wood '84, May 19–June 3. Burbank Center for the Arts, Hwy. 101 & Mark West Springs Rd., Santa Rosa. (707) 823-2822.
Exhibits—Krenov students from the College of the Redwoods, May 18–June 3. Lathe work, June 30–July 29, deadline June 25. Artisans Guild, 45050 Main St., Mendocino, 95460. (707) 937-5300.
Exhibition/competition—California Works, Calif. State Fair, Aug. 17–Sept. 3, slide deadline June 1. Contact Calif. State Fair, Calif. Works, PO Box 15649, Sacramento, 95852. (916) 924-2015.

COLORADO: **Juried show**—Colorado Woodworkers, Century Bank, 3300 East 1st St., Denver. June, deadline May 30. Contact Tony Brazzalle, (303) 733-3569.
Exhibit—1st national juried craft show, Denver Art Museum, Aug. 24–26. (303) 575-2793.

CONNECTICUT: **Show**—Decorator's Show House, 200 Scarborough St., Hartford, May 1–20. Contact Woodworker's Guild of Conn., 91 Tunxis Ave., Bloomfield, 06002.
Workshops—Spring: Tage Frid, Toshio Odate, Alan Stirt. Summer: Boatbuilding. Brookfield Craft Ctr., Box 122, Brookfield, 06804. (203) 775-4526.
Exhibit—Conn. Ind. Arts Assn. conference, May 10–11. Central Conn. State University, New Britain. Contact Cheryl Reynolds, (203) 526-9303.
Shows—Connecticut Crafts Expo, June 8–10. Fairgrounds, Berlin. Write for other shows to come. American Crafts Expo's, Box 368, Canton, 06019. (203) 693-6311.

WASHINGTON, D.C.: **Craft show**—Apr. 27–29. Departmental Auditorium, 1301 Constitution Ave.

DELAWARE: **Craft fair**—Winterthur in Odessa Spring Festival, Apr. 29. Call (302) 378-2681.

GEORGIA: **Workshops**—Ian Kirby, Apr. 30–June 17. Kirby Studios, 811 Atlanta Rd., Cumming, 30130. (404) 889-9823.
Exhibit—19th-century furniture, through June 10. Atlanta Historical Society, (404) 261-1837.

IDAHO: **Workshop**—Musical instruments, John Taye, July 9–13. Boise State University, 1910 University Dr., Boise, 83725. (208) 385-3295.

ILLINOIS: **Show**—Chicago Contemporary Furniture, to May 6. Evanston Art Center, 2603 Sheridan Rd., Evanston, 60201. (312) 475-0079.
Juried show—Arts/crafts, June 30–July 1. Church St., downtown Evanston. (312) 328-1500.
Seminar—Health Hazards in the Arts, May 2–4. Blackstone Hotel, Chicago. Call (312) 996-8025.

INDIANA: **Juried show**—15th Annual Chautauqua of the Arts, Sept. 29–30, deadline Aug. 1. Contact Dixie McDonough, 1119 W. Main St., Madison, 47250. (812) 265-5080.

IOWA: **Exhibitions**—Internat'l Woodcarvers Congress, June 28–July 1, deadline June 7; Internat'l Decoy Contest, Aug. 3–5, deadline July 15. Contact Box 406, Davenport, 52805. (319) 332-7484.
Festival—Pioneer Exposition of arts and crafts, Aug. 31–Sept. 1, deadline Aug. 1. Pottawattamie County Fairgrounds, Avoca. Contact 106 Navajo, Council Bluffs, 51501. (712) 366-1136.

KANSAS: **Show**—Apr. 1–30. Topeka Library, 1515 W. 10th, Topeka, 66604. (913) 233-2040.

KENTUCKY: **Symposium**—Turning, Rude Osolnik, Dale Nish, Ersal Kindel, June 14–16. Berea College, Berea, 40404. (606) 986-9341, ext. 347.
Exhibits—Kentucky Woodworkers Assn., Apr. 25–28, Lexington Civic Ctr.; Kentucky Woodworkers and Quilts, May 10–June 14, Living Arts & Science Ctr., 362 Walnut St., Lexington. Contact PO Box 22018, Lexington, 40508.
Workshops/seminars/exhibits—Annual Craft Council/Southeast Program, May 30–June 2. University of Kentucky, Lexington. (606) 257-3294.

MAINE: **Workshops**—Teenagers, summer. New England Craft Program, Kent Hills School, Kent Hills. Contact J. Sinauer, 374 Old Montague Rd., Amherst, Mass. 01002. (413) 549-4841.
Summer courses—Stephen Proctor, Don McKinley, Jon Brooks. Haystack Mountain School of Crafts, Deer Isle, 04627. (207) 348-6946.

MARYLAND: **Show**—Knockdown furniture, to May 6. Appalachiana, Georgetown Square Mall, Bethesda. (301) 530-6770.
Show—7th Annual Spring Crafts Festival, May 4–6. Maryland State Fairgrounds, Timonium. For future events, write to Sugarloaf Mountain Works, Ijamsville, 21754. (301) 831-9191.
Show—14th annual world championship wildfowl carving, Apr. 27–29. Convention Hall, Ocean City.

MASSACHUSETTS: **Shows**—Juried furniture: Interiors I, II & III, Feb.–June. Society of Arts & Crafts, 175 Newbury St., Boston, 02116. (617) 266-1810.
Exhibit—Leeds Design Workshop, May 19–26. Thorne's Marketplace, Northampton.
Fair—Springfield Craft Festival, June 22–24. Downtown, Springfield.

D. Allen

Michael Fortune (see Tennessee listings) made this black walnut dining set.

Workshop/craft fair/exhibits—Toshio Odate, Apr. 28; annual fair, May 18–20; student work, May 18–June 1. Worcester Craft Ctr., 25 Sagamore Rd., Worcester, 01605. (617) 753-8183.
Craft fair—Trade: June 19–20; public: June 22–24. Eastern States Expo Center, West Springfield.
Course—Basic furniture restoration, repair and refinishing, July 9–27. New England School of Furniture Restoration, Box 672, Northampton, 01061.
Workshops—Cabinetmaking, May 21–25 and May 28–June 1; timber framing, July 16–20. Heartwood, Johnson Rd., Washington, 01235. (413) 623-6677.
Show—Summerfest '84, July 27–29, Topsfield. Contact Today's Art & Crafts Promotion, 20 Montford St., Springfield, 01109.
Seminars—Veneering, sharpening, finishing, joinery, marquetry, turning. The Woodworkers' Store, 2154 Mass. Ave., Cambridge, 02140. (617) 497-1136.
Fair—Trad. crafts, Nov. 3-4, deadline June 1. Old Sturbridge, Sturbridge, 01566. (617) 347-3362.

MICHIGAN: **Courses**—Timber framing: Elk Rapids, June 11–17; Haslett, June 25–July 1; Evansville, Ind., July 9–15; Ottawa Lake, Aug. 6–12. Also, Riverbend Annual Energy Expo and Timber Frame Reunion, July 14–15, Blissfield. Contact PO Box 26, Blissfield, 49228.

MINNESOTA: **Fair**—12th annual crafts festival, June 23–24, College of St. Catherine, St. Paul.
Workshop—Carving, Aug. 5–11. Villa Maria Retreat Center, Old Frontenac. Contact PO Box 37051, Minneapolis, 55437.
Show—Minnesota Woodworkers Guild, deadline July 15. Write Box 8372, Minneapolis, 55408.

MISSOURI: **Seminar/juried show**—James Krenov, June 2; Midwest Wood Furniture Show and Competition, June 3–9, prizes, judged by James Krenov, slides by May 1. Hibdon Hardwood, 1539 Chouteau Ave., St. Louis, 63103. (314) 621-7711.

MONTANA: **Seminars**—Hand-tool joinery and designing, June 11–17 and July 9–15. Primrose Center, 401 West Railroad St., Missoula, 59802. Contact Steve Voorheis, (406) 728-5911.

NEVADA: **Juried show**—Las Vegas, Oct. 27–28, deadline June 30. Contact Craftworks, 5151 Boulder Hwy., Las Vegas, 89122. (702) 456-6695.

NEW HAMPSHIRE: **Workshops**—Violin, June–Aug., Univ. of N.H. Contact Div. of Cont. Ed., 24 Rosemary La., Durham, 03824. (603) 862-1088.

NEW JERSEY: **Workshop**—Tage Frid, May 5. Brookdale College, Lincroft. Contact Gabe Longo, (201) 842-1900, ext. 586.
Workshops—James Hutchinson, June 24–30; Peter Touhey, July 9–13; Mark Cramer, July 15. Peters Valley Craftsmen, Layton, 07851. (201) 948-5200.

NEW YORK: **Show**—National Working With Wood, May 11–13. New York Penta Hotel, New York.
Exhibits—Colorcore, Apr. 12–May 27; work from RISD, June 7–July 7. Gallery at Workbench, 470 Park Avenue S. at 32nd St., New York, 10016.
Festival—Crafts, June 30–July 1 and July 7–8, Lincoln Center. Contact Brenda Brigham, ACAC, Box 3221, Hoboken, N.J. 07030. (201) 798-0220.
Juried crafts—Croton-on-Hudson, June 16–17.
Exhibit—7th annual carving, May 5–6. Grange Hall Bldg., Erie County Fairgrounds, Hamburg.
Workshops—Violin set-up, Kevin Jackson; Japanese tools, Robert Meadow; English joinery and carving, Graham Blackburn. The Luthierie, 2449 W. Saugerties Rd., Saugerties, 12477. (914) 246-5207.
Fairs—Crafts, May 25–28; arts & crafts, Aug. 31–Sept. 3. Both at Ulster County Fairgrounds, New Paltz. Contact Scott Rubinstein, (914) 679-8087.
Juried festival—Arts and crafts, July 6–8, Aug. 10–12, deadline May 1. Bestor Plaza, Chautauqua. Contact Chautauqua Crafts Festivals, RD 2, Portage Hill Rd., Westfield, 14787.
Exhibit—Old tools and things, through July 1. SASE for catalog, DeWitt Historical Society, 116 N. Cayuga St., Ithaca, 14850. (607) 273-8284.
Shows—Contemporary crafts, May 6, Old Village, Great Neck; June 16–17 & July 28–Sept. 9, Sterling Forest, Tuxedo. Contact Creative Faires, Box 1688, Westhampton Beach, 11978. (516) 288-5225.
Exhibit—Jamestown Artisans Ctr., Apr. 30–May 11, Municipal Bldg., Jamestown. (716) 484-9920.
Show—Artforms in Wood, to June 16. Verbena Galleries, 16 W. 56 St., New York. (212) 586-3606.
Show/juried show—Four Woodworkers, to May 5; Contemporary N.Y. Crafts, July 6–Aug. 18, slides by June 2. SASE to 15 Steps, 407 West Seneca, Ithaca, 14850. (607) 272-4902.
Workshop—Business, May 11–12. Register by May 1. Memorial Art Gallery, Rochester. Contact Margaret Daiss, (716) 546-5602.

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Show—Hudson Valley Carvers, June 9, Arlington North Campus, Poughkeepsie. (914) 452-1737.
Classes/demo—Craft Student League, 12-week series from June 4; Maurice Fraser, May 17 & May 21. 610 Lex. Ave. (53rd), New York. (212) 755-2700.
Show—Made in Chicago and Dakota Jackson, May 5–June 5. Louis Meisel, 141 Prince, New York.
Show—Wendell Castle, school and shops, May 19–June 30. Alexander Milliken, 98 Prince St., New York.
Show—Dunnigan, Newman, Ebner, May 5–June 17. Gallery Henoch, 80 Wooster, New York.

NORTH CAROLINA: **Courses**—Numerous subjects, Apr.–Sept. John C. Campbell Folk School, Rt. 1, Brasstown, 28902. (704) 837-2775.
Juried shows—High Country Crafters. Sapphire: June 29–July 1, July 20–22, Aug. 17–19. Scaly Mountain: July 6–8, Aug. 3–5. Asheville: Aug. 9–11. Contact Elizabeth Kdan, 29 Haywood St., Asheville, 28801. (704) 254-0070.
Workshops—Green woodworking, cooperage, Japanese woodworking, chairmaking. July–Aug. Country Workshops, Rt. 3, Box 262, Marshall, 28753. (704) 656-2280.
Shows—Southern Furniture Market, Apr. 26–May 4, Oct. 18–26. Contact Southern Furn. Mkt. Ctr., Box 828, Highpoint, 27261. (919) 889-6144. Daphne Awards at Oct. show, deadline extended to June 15. Contact Hardwood Inst., 230 Park Ave., Suite 1920, New York, N.Y. 10169. (212) 867-6800.

OHIO: **Workshops**—Spray finishing, May 14–18; equipment maintenance, June 18–23. Bowling Green State University, Bowling Green, 43403. (410) 372-2436.
Seminar—Dovetails, Mark Duginske, June 23–24. University of Akron. (216) 375-7826.

OKLAHOMA: **Show**—Carving, June 9–10. Heritage Park Mall, Midwest City. Contact Jim Crist, 2000 N. Purdue, Oklahoma City, 73127.
Show—8th national woodcarving show, July 27–29, Woodland Hills Mall, Tulsa.

OREGON: Numerous events throughout the year at Western Forestry Ctr., 4033 SW Canyon Rd., Portland, 97221. Contact Linda Smeltzer, (503) 228-1367.
Show—Office interiors, to May 10. The Real Mother Goose, 901 SW Yamhill, Portland, 97205.
Lectures/workshops/classes—June through July. Oregon School of Arts and Crafts, 8245 SW Barnes Rd., Portland, 97225. (503) 297-5544.
Show—Southern Cascade Guild, June 1–3. Shasta Plaza Mall, Klamath Falls. (503) 884-1531.

PENNSYLVANIA: **Seminar**—Japanese tools, Robt. Meadow, May 19–20. W. Pa. Woodworkers Club, Box 8558, Pittsburgh, 15220. (412) 281-9961.
Festival—Crafts, May 12–13. Mercer Museum, Pine St., Doylestown. (215) 348-8083.
Show—Central Pennsylvania Festival, July 8–31. Zoller Gallery, Penn State, University Park.
Shows—Mixed media sculpture, Apr. 8–29; furniture, Robert Kopf, June 10–July 3. The Works Gallery, 319 South St., Philadelphia, 19147.
Show—Lancaster County Woodcarvers 11th annual, May 5–6, Lititz Community Center, Lititz.
Workshops/classes—Apr. through May. Market House Craft Center Workshops, Box 552, Lancaster.

RHODE ISLAND: **Shows**—Bent wood and lamination, to Apr. 29; furniture, to June 27. RISD Museum, 224 Benefit St., Providence. For hours, call (401) 331-3511, ext. 131.

TENNESSEE: **Show**—18th-century reproductions by Robert Emmett, July 19–29. Dulin Gallery, 3100 Kingston Park, Knoxville. (615) 525-6101.
Workshops—Thomas Hill, June 18–29; Drew Langsner, June 25–29; Gail Fredell Smith, July 2–13; Michael Fortune, July 16–27. Appalachian Center for Crafts, Rt. Box 347-A-1, Smithville, 37166.
Tours—Tennessee Hardwood Factory. Daily M–F, 800 Main St., Woodbury, (615) 563-2223.
Workshops—Turning, June 4–8, Aug. 6–10, Aug. 13–17; furniture, June 11–22. Scholarships available. Arrowmont School of Arts and Crafts, Box 567, Gatlinburg, 37738. (615) 436-5860.

TEXAS: **Show**—Furniture, old and new, May 17–30. Dougherty Cultural Center, Austin.
Show—Texas crafts, Nov. 2–31. Deadline May 15. Contact Barbara Metyko, 1634 Branard, Houston, 77006. (713) 526-6493.

UTAH: **Workshops**—Turning: Alan Stirt, Dale Nish, Mel Lindquist, David Ellsworth, May–July. Contact Craft Supplies USA, Provo. (801) 373-0917.

VERMONT: **Exhibits/workshops**—Series of craft exhibitions. For brochure, write Vermont State Craft Center at Frog Hollow, Middlebury, 05753.
Workshop—Wood and canvas canoes, May 12–20, Sept. 2–10. Sterling College, PO Box 200, Craftsbury Common, 05827. (802) 586-2561.

VIRGINIA: **Juried fair**—9th Annual Richmond Craft Fair, Nov. 8–11. Deadline June 1. Contact Jan Detter, Hand Workshop, 1001 E. Clay St., Richmond, 23219. (804) 649-0674.
Fair—Lynchburg, Nov. 2–4. Deadline June 15. Contact Fall Craft Fair, Fine Arts Center, 1815 Thomson Dr., Lynchburg, 24501. (804) 846-8451.

WASHINGTON: **Seminars/workshops**—Apr.–Aug. Northwest School of Wooden Boatbuilding, 251 Otto St., Port Townsend, 98368. Contact Barbara Purdue, (206) 385-4948.
Seminars/workshops—Through May. The Center for Wooden Boats, 1010 Valley Street, Seattle, 98109. (206) 382-2628.

WEST VIRGINIA: **Exhibit**—Woodworking 1984, June 24–Aug. 25. Stifel Fine Arts Center, 1330 National Road, Wheeling, 26003. (304) 242-7700.
Workshops—Turning, July 11–15; basic joinery, July 18–22. The Crafts Center, Ripley, 25271.

WISCONSIN: **Workshop**—Festival of Wood, June 29–July 1. Office of Continuing Education, Univ. of Wisconsin-Stout, Menomonie, 54751. Contact Kathy Mork, (800) 457-8686.

BRITISH COLUMBIA: **Exhibition**—British Columbia woodworkers, May 14–June 24. Langley Museum, Mavis and King Sts., Fort Langley.
Juried exhibit—Fourth Celebration of Wood, July 30–Aug. 11, deadline Apr. 30. Send SASE to Circle Craft, 348 Water St., Vancouver V6B 1B6.

ONTARIO: **Competition**—Handcrafted furniture, sculpture, instruments, $1500 prizes. Aug. 10–12, deadline June 1. Contact Durham Art Gallery, Box 1021, Durham, N0G 1R0. (519) 369-3692.
Exhibition/conference—Out of the Woods 1984, May 21–June 16, Library & Gallery, Cambridge; Ont. Woodworkers' Assn. 1984 Conference, June 15–17. Contact Eric Dewdney, (519) 621-0460.

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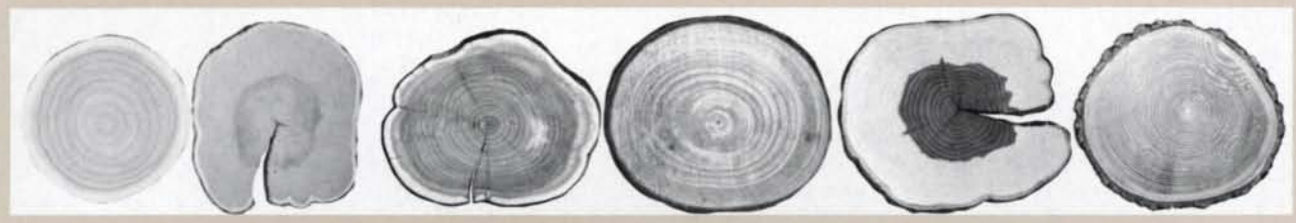
John D. Alexander is a Baltimore attorney who modestly considers himself an "informed amateur" on the subject of making wooden chairs by hand. But this is one amateur who has been splitting green wood and shaping it into light, rugged chairs for almost 20 years. In fact, Alexander wrote a book on the subject, *Make a Chair from a Tree: An Introduction to Working Green Wood* (softcover, $9.00). We first published the book in 1978, and it's now in its third printing.

If you delight in the challenge of starting a woodworking project at the very beginning, with freshly cut green wood, this is a book you'll treasure. It's a wonderfully readable treatise on the making of traditional-style post-and-rung chairs from "tree-wet" wood. Starting with a brief but thorough discussion of design and measurement, Alexander tells how he selects and fells a tree, splits and shapes the parts, and joins them together with mortise-and-tenon joints that tighten as the wood dries. He even shows how to weave a herringbone-pattern seat from a tree's inner bark. And all his explanations are fully illustrated with photos, charts and drawings.

Alexander's method is the result of years of backyard and basement experimentation. He first got hooked on old chairs as a novice woodworker and decided to find out how to "make them like they used to." He spoke with other craftsmen, examined existing chairs, and learned as much as he could about the tools and techniques involved in green woodworking. Alexander even studied the behavior of the wood itself, and his book explains technical details such as moisture content, shrinkage and fiber elasticity in a way that every backporch craftsman can understand and put to use.

If the old ways of working wood appeal to you, *Make a Chair from a Tree* will bring you hours of enjoyment—and at least a few comfortable, sturdy chairs.

To order: Use the insert opposite, or send your order and payment to The Taunton Press, 52 Church Hill Rd., Newtown CT 06470. Or call toll-free **1-800-243-7252** and use your credit card.



A woodworker's guide to wood

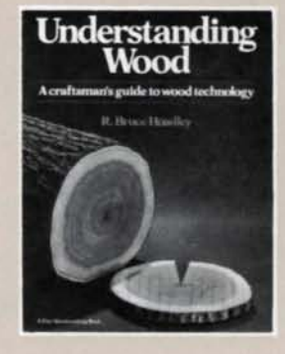
When John Alexander wanted professional assistance for his research on green wood, he called on R. Bruce Hoadley, a professor of wood technology at the University of Massachusetts, and the author of *Understanding Wood: A craftsman's guide to wood technology* (hardcover, $20), published by The Taunton Press in 1980.

In his book, Hoadley tells woodworkers what they need to know about wood. It's a subject he understands both scientifically and artistically. As a scientist, he continually explores wood's properties; as a woodcarver, he puts that information to use in improving his skills.

Understanding Wood covers all aspects of working with wood intelligently, efficiently and respectfully. Hoadley explains how a tree's life and growth affects the wood's figure and appearance. He explores the interaction of water and wood and discusses ways to cope with wood movement. He also investigates such commonplace woodworking operations as machining, bending, joining and fastening, and even explains how to identify 54 common domestic and imported woods. Along the way, he debunks some of the common myths and misconceptions, such as the theory that "wood has to breathe." (Hoadley points out that it doesn't breathe, and it doesn't have to be fed, either.)

Throughout, Hoadley uses clear, lively writing and a host of charts, photos and drawings to make his points. He doesn't oversimplify his material, but instead presents and explains the standard terminology as he goes along and includes a detailed glossary.

Any woodworker who has ever been frustrated by boards that cup and check, glue joints that loosen, and miters that open up—or has just been curious about why wood acts the way it does—will find this book to be an invaluable resource.



In Progress:
Fine Homebuilding Construction Techniques
Available: July 1984

Our first home building book is now in the works. It includes 55 articles from the first 15 issues of *Fine Homebuilding* magazine. Among the subjects covered are: roof shingling, superinsulation, flashing, putting down a brick floor, rammed earth, building a block foundation, nail guns, rafter squares, portable power planes, acrylic glazing, small batch concrete, kitchen cabinets, cornices and stair repair.

Selected by the editors, these articles embody all the strengths of the magazine: expert authors who pay close attention to the details of their work, color photos and technical illustrations that let you see what the author is telling you about, and a refreshing preoccupation with quality construction—whether the job involves new construction or creative renovation.

This kind of hands-on information is hard to come by, but at least it will be easy to keep once *Fine Homebuilding Construction Techniques* comes out in July.

NOTES AND COMMENT

A sculptural happening

A tiny Canadian town whose main industry is woodcarving will be the site this summer of a major international event designed to examine the nature of sculpture and the roles of artists and craftsmen in modern society.

"Rendez-vous International Sculpture 1984" is expected to attract carvers and sculptors from all over the world to St.-Jean Port-Joli, on the St. Lawrence River in Quebec, from June 14 to July 15.

It's not surprising that St.-Jean Port-Joli (Pretty Port Saint John) was picked as the site for this ambitious project, which is sponsored by several Canadian national and provincial government agencies and has a budget of nearly one million dollars. As many as a hundred artisans make their living here by carving, most of them chipping out small wooden figurines of folk characters, animals and boats. The carving industry began here during the Depression, and the tradition grew until most of Canada now recognizes the town as the nation's center for wood sculpture. It has become a mecca for tourists on their way to Canada's lovely Gaspé region. And it's a crafts market so successful that the community has become home to workers in clay, fiber and metal as well as wood. The town also hosts a highly rated, state-funded wood sculpture school.

While most of the day-to-day work in St.-Jean Port-Joli is production-line-repetitive, the town has produced several carvers who do museum-quality work on a larger scale. In planning the event, the community realized that the so-called craft/art dichotomy is reflected in their own village. That's why the event's theme, "From Hand to Verb," was chosen to celebrate the flow of ideas from concrete to abstract, from the material to the mind. Indeed, townsfolk say that the arbitrary labels "craftsman" and "artist" were created by modern industrial society. The hazy distinction between these terms will be the central theme of discussions at the event's culminating convention, July 12-15.

Because wood is the region's most important resource, it will be emphasized, but the medium is considered less important than the sculptural ideas—woodcarvers will be able to learn from stonecutters and so forth. Every style of sculpture will be represented, from Canadian folk carving and Native American work to modern international styles.

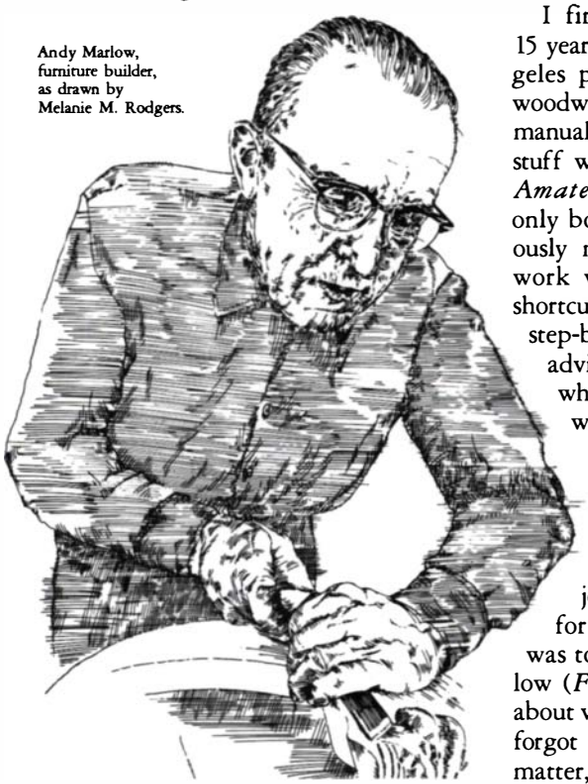
Besides hands-on workshops during *(continued on p. 102)*

Richard Starr

Carvings for sale in St.-Jean Port-Joli.

A.W. Marlow, 1904-1984

A.W. Marlow, builder of fine furniture, died Feb. 21 at age 80. Marlow, of York, Pa., had emphysema and had been in failing health for some time.



Andy Marlow, furniture builder, as drawn by Melanie M. Rodgers.

For more than fifty years, Marlow designed and made period furniture, and his work attracted a national clientele. He also became widely known for his four books about furnituremaking, as well as for being a consulting editor and contributor to *Fine Woodworking*.

I first encountered Andy Marlow 15 years ago, while searching a Los Angeles public library for books about woodworking. Among the tattered shop manuals and nail-'em-up handy home stuff was his *Fine Furniture for the Amateur Cabinetmaker*. It was the only book I could find that took seriously my interest in learning how to work with wood: no platitudes, no shortcuts; just solid information, careful step-by-step photography, and straight advice from a writer who understood what I wanted to know, and who was willing to help me get there.

We became friends that day, Marlow and I, yet it was another seven years before I could meet the man in person, when circumstance led me to a writing job with this shaky new magazine for woodworkers. My assignment was to prepare a short profile of Marlow (*FWW* #4), but I was so tickled about visiting this hero in his shop that I forgot most of my questions. It didn't matter, though—Andy let me pick up the pieces over the telephone, later on.

Marlow's constant willingness to help made it easy to turn to him a year later, when the magazine started its Questions & Answers column. When he knew the answer to a reader's question, Andy was always willing to share it. When he didn't know, he'd say so. When he thought you had messed up, he'd say that, though always in a kindly way. Besides all the other things he was, Andy Marlow was a good friend to a great many woodworkers.

Marlow is survived by his wife of 54 years, the former Gertrude Ruler, and a daughter and two grandchildren.

• • •

A.W. Marlow's four books are *Fine Furniture for the Amateur Cabinetmaker* (1955) and *Classic Furniture Projects* (1977), both published by Stein and Day, Scarborough House, Briarcliff Manor, N.Y. 10510; and *Good Furniture You Can Make Yourself* (1952) and *The Early American Furnituremaker's Manual* (1973), both published by Macmillan, 866 Third Ave., New York, N.Y. 10022. His magazine articles include "Carving Ball-and-Claw Feet" (*FWW* #10, pp. 58-59), "Setting Up a Small Shop" (*FWW* #24, p. 51), and "Building a Wooden-Drum Stroke Sander" (*FWW* #29, pp. 47-51). *—John Kelsey*

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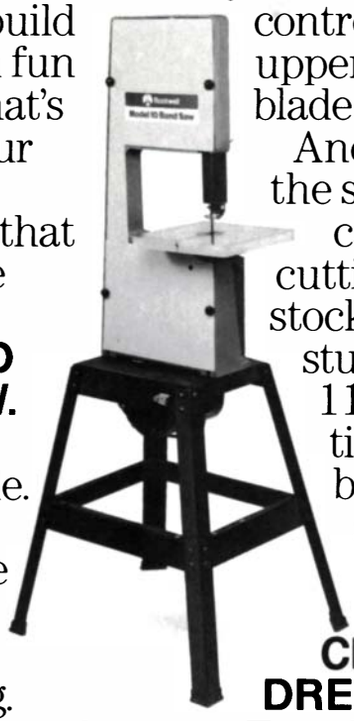

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Rockwell International

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the month-long event, there will be conferences on current work, open-air theaters, and carnival-like entertainment provided by folk dancers and musicians. A competition for Canadian sculptors is also expected to lead to the production of several important works during Rendez-vous. The seven Canadian sculptors selected as finalists in this competition, along with five prominent international sculptors, will be working outdoors on platforms overlooking the river. Visitors will be encouraged to visit and talk with these sculptors as they work. The international participants include Americans Carl Andre and Mrs. Harmony Hammond, Italian sculptor Pistoletto, and sculptors from Africa and from Great Britain.

For details, write to Rendez-vous International Sculpture 1984, C.P. 220, St.-Jean Port-Joli, Que. G0R 3G0.

—Richard Starr

Notes and Comment

So there's a terrific exhibition of woodworking going on in your town? Just finishing some unusual project? Got a theory you'd like to try on the woodworking world, a beef you want to air, some news to share? Send text and photographs (preferably with negatives) to Notes and Comment, Fine Woodworking, *Box 355, Newtown, CT 06470.*

Knotty names

EDITOR'S NOTE: It seems that every time we publish the Latin names of wood species in an article, we get letters telling us that the names were wrong. One of the kindest letters came from Dr. Robert Pinney, who, in the course of correspondence, volunteered that he was compiling a complete list of the world's timbers, with common names, Latin names, and countries of origin. We've begun to use Dr. Pinney's list to check what we print, and we couldn't resist asking him why he'd embarked on such a chore. Here's his answer:

In March 1980, while living in California's lower Colorado Desert, I often watched men clearing land, piling up mature mesquite and desert ironwood trees to burn along with the sagebrush. I'd been educated as a plant pathologist-entomologist, after growing up in a family of nurserymen, and I recalled that wood dealers list mesquite (*Prosopis juliflora*) as "rare," and that harvesting of ironwood (*Olneya tesota*) is not allowed in desert conservation areas. These woods are beautiful, and are prized for gunstocks, pistol grips and carvings. I knew, too, that orchardists in central California continually grub out declining walnut trees to make room for new ones, relegating the slash and logs to the woodpile.

I realized that this timber could be salvaged, cured and used. Being from the Midwest, where these trees are not seen, I felt a need for greater knowledge of their botany. Consequently, I began to visit libraries and take notes. Restricting my records to only a few details, however, seemed too lifeless, so I began to investigate the history, natural distribution, physical characteristics, accepted binomials (Latin scientific names) and common names of every tree with even the slightest economic importance. Without realizing it, I had opened a Pandora's box. The last attempt (a courageous one) to produce a list of standardized plant names was in 1942. Meantime, there have been many changes, some welcome, others less so.

I soon found that common names of trees, some of them euphonious and beautiful to pronounce (e.g., mussacossa, kevazingo, palo santo) are less useful than a water pistol against a charging elephant. At least 35 genera of trees or large shrubs are called ironwood, a meaningless and unimaginative term. In Oregon, chauvinists proclaim the merits of *Umbellularia californica,* calling it Oregon myrtle, while across their southern border it becomes California laurel. I've found at least 24 other common names for the same tree.

Common names can be useful locally, but not in commerce. When timber

(continued on p. 104)

$21,000 whaler

On display at the Mystic Maritime Gallery is a 7-in. model of the whaling ship *Charles W. Morgan.* Built by 34-year-old Lloyd McCaffery of Madison, Conn., and recently sold for $21,000, the model will be exhibited at the Mystic, Conn., museum through August.

McCaffery says that the miniature *Morgan* is a definitive reference work on the last of the wooden whalers. It contains information gathered during recent years while the original ship was being reconstructed. The starboard side shows the finished ship, with coppered bottom, planked and painted topsides, and two narrow white stripes. The cutaway port side reveals the framing structure and cask-storage hold. A crew of 21 men, each about ⅜ in. high, is busily performing various tasks throughout the ship. The model is made from a variety of woods, including apple and boxwood, and the rigging is copper wire.

McCaffery has been making ship models for 25 years, professionally for the past 12. He wrote about model-making in *FWW* #42, pp. 79-81. □

tradesmen cannot agree on a specific name, and no other, for each wood, the customer can be misled—he gets some kind of wood, but perhaps not what he thought. It would be better if the trade used only Latin binomials.

Any magazine article or book that calls wood only by a common name fosters confusion. "Mahogany," for instance, can be almost anything. A craftsman who wants to make a reproduction of an 18th-century mahogany highboy should be told that the mahogany of the 18th century is just about extinct and rarely available today. Also, when a furnituremaker reads that a piece is inlaid with "sycamore," it's not much help unless he knows where the piece comes from. In England, sycamore is most likely sycamore-maple, a wood with bird's-eyes and fiddleback figure much like our own sugar maple. In America, sycamore is likely to be buttonwood, which has a lacy ray figure more like eucalyptus than any maple. Sadly, one of the best books on world timbers has no binomials in its index. If you are using it to learn more about a wood but have only a binomial in hand, you've struck out unless you search each page.

Another problem concerns the vicissitudes of geopolitics. Most price lists and catalogs tell where the wood comes from as an aid to identification. It is confusing, however, when one wood is listed as coming from Surinam and another from Dutch Guiana—the woods may be different, but the countries are the same. Names of many timber-producing countries have been in a state of flux in the past few decades. Firms that put out price lists and catalogs ought to equip their copy editors with an up-to-date atlas.

In a few instances, it wouldn't help much to change the name of a wood long used and well known. Ceylon satinwood would lose a little if we started calling it Sri Lanka satinwood. On the other hand, if you go by its accepted binomial (*Chloroxylon swietenia*), you can't go wrong.

When I began to compile a comprehensive list of the world's best timbers, I intended to cross-index common names to binomials (and vice versa), and to list families, natural ranges, and a few pertinent physical features such as a description of the wood, its grain, texture, color, taste, smell and weight. What began as a minor private project has burgeoned as my interest in fine timbers has grown. I expect to finish, and hope to publish, my work only after considerably more diligent and serious research.

—Robert Pinney, Fresno, Calif.

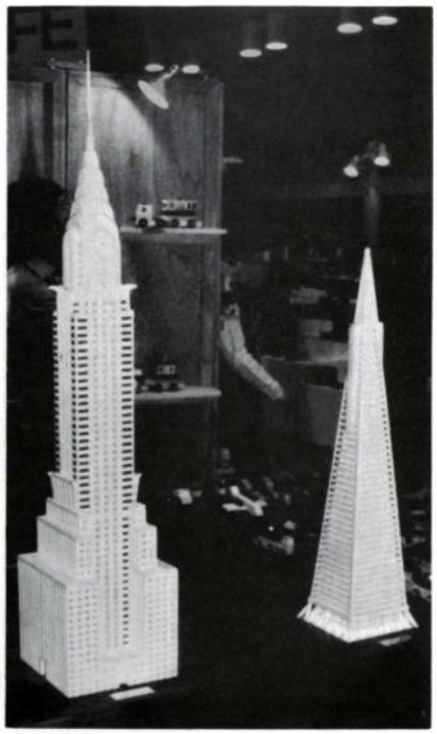
"Wintermarket" 1984

About 50 woodworkers were among the 505 artisans exhibiting at the American Craft Council's 8th annual Baltimore Craft Fair in February. Woodworking displays at the fair, commonly called Wintermarket, included toys, accessories, turnings, sculpture and furniture, with the smaller items predominating.

Among the exhibitors was Dan Furlong of Fairfax, Vt., who made a 43-in. high model of New York City's Chrysler Building and a 28-in. model of San Francisco's Transamerica Pyramid (photo, right). Furlong sold both white pine models: the Chrysler Building for $1200 and the Pyramid for $800.

Like its larger, warm-weather counterpart, Rhinebeck (which moves to West Springfield, Mass., in June 1984), the ACC Baltimore show is a juried event. Artisans submit slides of their work, and those approved by the jury—about one in four—can exhibit. A standard 10-ft. by 10-ft. booth, the smallest at this show, cost $390.

The first two days were reserved for wholesalers, and 4,900 showed up, representing 2,000 galleries, museums and retail businesses—wood sales amounted to $326,550. On the last three days, when the doors were opened to the public, more than 30,000 people streamed in and spent $122,622 on wooden items.



White pine models of the Chrysler Building, left, and the Transamerica Pyramid.

For information on ACC shows (Dallas, San Francisco, West Springfield, Baltimore), write to American Craft Enterprises, Inc., PO Box 10, 256 Main St., New Paltz, N.Y. 12561. □

Gaggle of gouges

No matter how completely it's lost in the swirl of scratching out a daily existence, Georganna Malloff believes that a bit of the sculptor lurks in all of us. "A lot of people think about carving or sculpting," she says, "but there's usually no convenient way for them to try it."

Malloff, a Caspar, Calif., carver and sculptor, gets around this barrier by undertaking whole-tree carving projects, inviting any and all to take up mallet and gouge to help out. Since the mid 1970s, Malloff has overseen five pole carvings, from the 20-ft. Mendocino pole shown on the back cover to a 76-footer erected in New Westminster, B.C., in 1976. All but one have been raised, totem-like, as permanent examples of participatory public art.

Though Malloff explains that her poles, which she calls creation or cosmic maypoles, aren't totems, you can see a not-so-nebulous connection between her work and the art of the Pacific Northwest Indians. These traditional totems commemorate the lineage of the carver's patron, celebrate a marriage, or perhaps mark the passing spiritual milestones of the changing seasons. Some serve as graves, their exteriors carved with the family crest of the Indian interred inside the hollowed-out log. But much of the rich imagery of the dwindling number of surviving Indian poles is incomprehensible to the modern mind.

Malloff's poles also mark events of importance or the collective spiritual musings of the carvers, but the images reflect a contemporary, even technological mythology. In the College of Arts and Crafts pole, the students carved likenesses of the school's four founders, the puffed cheeks of a glass blower's face and a pair of hands holding a movie camera—all images that lucidly connect the pole to what goes on at the college.

Imposing as the pole was when I saw it, half-completed in a college parking lot (it was 29 in. in diameter and weighed 4½ tons), Malloff told me that enormous-scale carving isn't as difficult as it might seem. She overcomes a major technical problem—layout—by blocking out sections of the log from which material must be removed. Once that's done, she steps aside, allowing the carvers to create imagery consistent with the pole's theme but still distinctive enough

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to express their own ideas and experiences. Malloff instructs participants in the use of gouges and chisels, and suggests ways to connect disparate images in aesthetically pleasing ways.

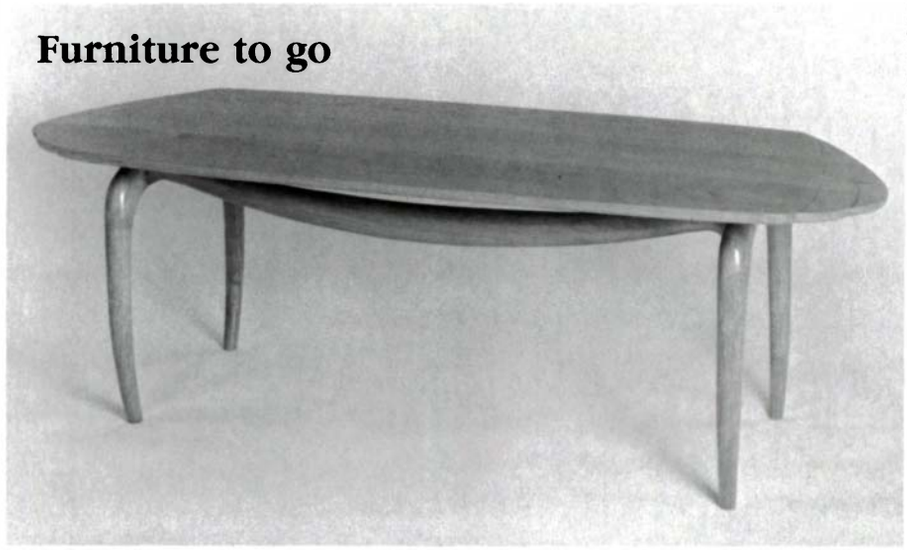
There's an element of risk in working this way. At the craft college, Malloff had to clamber up a nearby building to get far enough away to see how the emerging carving was working, yet seeing a pole in the round has to wait until the raising. "It's hard to make a mistake, really. There's a lot of wood in the log. . . more than enough to work out what isn't right." Work proceeds at a leisurely pace, a bit like a college art project. To keep the green log from checking, Malloff douses it regularly with a mineral-oil-type sealer called Coray-22, made by Exxon.

I found that the most astonishing thing about the poles is not their size or technical finesse, but that Malloff is able to bring the images (and the carvers' egos) together into a cogent whole. "There has to be an abandonment of egos for this to work," Malloff says. "You're not just carving a little image of your own. The subject has to be consistent with the rest of the pole. You've got to be open to what happens without insisting that something won't work because it doesn't fit your own plan.

"The really nice thing," she adds, "is that the collective energy produces a skill that goes beyond what an individual artist would generate."

—Paul Bertorelli

Furniture to go



Rudy E. Duran

Knockdown cherry coffee table by Kimberly Ledford.

The difficulty of transporting handcrafted furniture is nothing new. The problem first hits the artisans who make the furniture. They have to go to shows to sell their work, and may spend hundreds of dollars in transportation costs to get the pieces there. Today's buyers are just as mobile. Having bought a piece at a distant show, they are faced with the problem of shipping it home. Even furniture bought locally is troublesome to move if you don't have a truck or a big car.

One solution to this problem is the theme of the knockdown furniture show this spring at the Appalachiana Gallery in Bethesda, Md. Knockdown used to mean crates and bolts, but today's designs also include beautifully conceived and finished handwork designed to fit into UPS-sized bundles.

The show features the work of more than a dozen artists, including John Marcoux, Curtis Erpelding, Peter Korn, and Kimberly Ledford, whose cherry coffee table is shown above. All of the exhibits are ready for the box and crate. In keeping with the knockdown concept, anyone purchasing a piece will receive it by mail. The gallery plans to continue offering knockdown furniture after the show closes on May 6.

—Nylene L. Singelstad, Bethesda, Md.

Fear of failure and my shaper

Over the years I've come to realize that all sorts of emotional ingredients go into the recipe for pleasure in woodworking. I have known satisfaction and enjoyment, but fear was the first emotion I really had to face.

My wife and I wanted oak raised-panel doors for our kitchen cabinets. Since we had built the rest of the house ourselves, we didn't think there would be any problem. I cut the stiles and rails, but then the shaper devoured the first piece I tried to profile, driving the piece between the cutterhead and the fence. I tried the second piece a bit more cautiously, but . . . wham! The shaper rotated the workpiece and shredded it. My hands stung. I put the project away.

I had never been frightened in the shop before, but the sudden violence and the fear of wasting time and materials made me take a little break. I was forced to tell a friend that the shaper was the only tool I actively feared.

All this time my wife was very understanding. She saw my fear better than I did, and unwilling to become an accessory to the loss of fingers, she patiently let the months pass, rarely referring to the mess caused when dog hair floated from the canine to the crockery.

After two years, a new emotion, embarrassment, surfaced and grew strong enough to overcome fear: I had to build those doors. Once I got back to them, it wasn't so bad. I was careful and tried different techniques.

How much of the delay had been caused by fear, as opposed to lack of tools or boredom? I found my answer parked on the lathe—the big half-dome cockleshell for my four-year-old corner cupboard. I had collected many compliments for the cupboard, but still had to apologize for not having finished the shell. Why?

Sure, I had rigged a router arrangement to hollow the shell, but I couldn't find a bent gouge that would cleanly cut the needed flutes. My pounding threatened to crack the shell. Mentally, I toyed with various die-grinder techniques, but none seemed controllable. Finally, disgusted with myself, I shoved a core-box bit into my router and tore into the shell, freehand. It worked. I can repair the miscuts with filler and a little sanding.

I was stalled by what psychologists call "approach-avoidance conflict"—the desire to do something, simultaneously crippled by an intense fear of failure. Rather than risk failure, we withdraw. After all, you can't fail if you don't start. Only when other pressures—embarrassment, pride, even spousal urging—crowd us over the rim of fear do we even try. And then we may find that the fear was unrealistic. But even if the fear had been real, rethinking the job to find a safer method may have been the salvation of our hands or eyes, a not unworthy fringe benefit.

—W. Davis Smoot, Dallas, Tex.

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COSMIC MAYPOLES

Georganna Malloff calls her whole-tree carvings creation or cosmic maypoles, partly to distinguish them from the traditional Indian totem and partly because the poles express her idea that public art can be the spontaneous, collective effort of many as well as the contemplative work of just one person.

Accordingly, the poles, two of which are shown here, are created by dozens of people, few of whom have touched mallet and chisel before. Malloff rounds up a log and provides enough technical know-how to keep the project perking. The carvers provide ideas, images and enthusiasm.

In the photo above, Malloff (far right) advises a group of neophyte carvers working on a Mendocino maypole which served as a teaching project at the College of the Redwoods. At right, a crane lifts a 4½-ton pole carved a couple of summers ago to commemorate the 75th anniversary of the California College of Arts and Crafts in Oakland. For more about Malloff's carvings, see p. 104.

Photos: Nicholas Wilson; Carlton Brookes