

Fine Woodworking

Jan./Feb. 1989, No. 74, \$4.50

Building A Wardrobe

Bird's-Eye Maple

Scroll-Saw Test

Carved Boxes

Secret Compartments

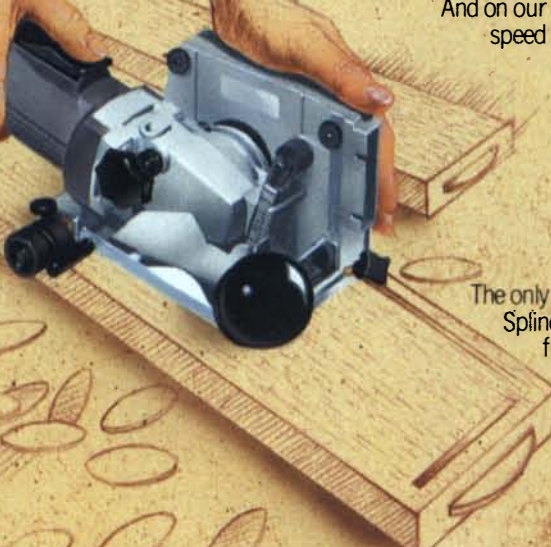


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Modern scroll saws are precision machines capable of accurate work in thick hardwoods. Greg Bover tests eight current models on p. 50. Cover: Scott Dickerson shapes a leg on his foursquare chair, a chair built without angled joinery (see article, p. 36).

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New signs of the turning tide

Woodworkers are not snobs—I'm upset by the letter in *FWW* #72 stating "woodworkers are egotistical, pompous snobs." If the author had preceded his statement with the word "occasionally," I might not have taken offense. But when he implied that all woodworkers are in that category, he should be forced to swallow those words. I have met many woodworkers from all over the United States and from a few foreign countries, and among them all, I have found only one that fits his description, and he wasn't even a fair amateur. In my town, we have the Parsons Amateur Woodworkers Society with 35 members. I must say I've never associated with a finer bunch of men, who are always willing to help each other. When beginners feel they can't compete with the work being done by more experienced workers, we encourage them to keep trying and remind them of these lines that I once read, "Use your talents to the best of your ability. Remember, the woods would be very quiet if the only birds that sang were those that sang best."

—Myer S. Freshman, Parsons, Kans.

Praise for authentic Chinese joinery—Allan Smith's article in *FWW* #73 on Chinese furniture was not only good reading, but a delightful change of pace. For many years, I've been excited by the Chinese style and curious about the joinery. I've made two coffee tables similar to Smith's horsefoot design, to showcase some antique tiles my wife inherited. The results were spectacular. But, I used classical European joinery methods, because I didn't know any better. It wasn't until I read Gustav Ecke's book *Chinese Domestic Furniture* that I discovered the authentic Chinese joinery. (Smith recommended this book, and it is available from Charles E. Tuttle Co. Inc., Box 410, Rutland, VT 05701-0410.) I've made a third table following Ecke's faultless drawings. All the components interlock, and the structure would be perfectly stable without glue. However, I'm not a total purist and did glue things together at final assembly. This table will last forever and need never be taken apart. —Thomas A. Sharp, Sanibel, Fla.

The old resaw joke—A man came to our store and bought several thousand dollars of woodworking equipment. After a three-day class in the fundamentals of woodworking, he put an ad in the paper that claimed his shop could do any kind of woodworking. His first caller asked if they resawed wood, to which this entrepreneur answered, "We don't have to; we saw it right the first time." He later came back to the store and prefaced his story with the question, "Hey, what does resaw mean?" —Jimmy Reina, Indianapolis, Ind.

More hints on rubbing out finishes—Many thanks to Michael Dresdner for his fine article on rubbing out finishes (*FWW* #72). But I would like to make a few suggestions that might be helpful, especially to those who do a lot of commercial refinishing and finish restoration.

When spraying lacquer, add fish-eye remover rather than retarder to increase flow-out and gloss. Add the fish-eye remover anyway when working with previously finished furniture that might be contaminated by silicone. The fish-eye remover won't

slow the drying/curing process as it improves flow-out and gloss.

Also, here's how to rub out a dining table to a beautiful gloss in an hour or less: First, level the surface with 600-grit steared paper. Remove any sanding scratches and remaining orange peel with a power buffer and Ditzler #16 rubbing compound, which is available from auto-body supply stores. If you've never used a power buffer, practice on something expendable first—buffers can be tricky. Finally, remove the residue with naphtha and a soft rag, then buff to a diamond gloss with a clean lamb's wool pad on your power buffer. —Scott Laurence, Redmond, Wash.

Clean water for eye safety—Dr. Paul Vinger's eye-safety article (*FWW* #72) is fine as far as it goes, but I have some concerns about his recommendations on using water as eye wash. The water in Lexington, Mass., must be better than here in central Ohio. Tap water here is so hard it's an irritant. For this reason, I keep sterile solution close to my first-aid kits. Sterile saline is commonly available at drug and grocery stores in the contact-lens care sections. I recommend the types labeled "for sensitive eyes."

—Douglas Campbell, Clintonville, Ohio

More warnings on eye injuries—In addition to Dr. Vinger's warnings (*FWW* #72), I'd like to mention two other specific injuries I've seen as an ophthalmologist. Catastrophic eye injury can occur when someone is reaching under a surface to drive in a screw and looking from above. A slipped screwdriver can be a dangerous stabbing tool. I've seen three such injuries in the past two years, and each one resulted in an eye lost.

All forms of hammering can be dangerous, but hitting steel on steel is by far the most dangerous, as tiny particles can fly off the face of the tool at tremendous speed. These tiny particles can puncture the eye quite easily, and they are very difficult to locate and remove. Observers are just as vulnerable as the tool operator to injury, too. Unfortunately, many times the injury may not even be recognized as serious, and the person may not seek a doctor. This could lead to potentially disastrous complications.

Dr. Nick Strong, Cambridge, England

Lye for apple—Some time back, *Fine Woodworking* had an article on using lye to enhance the color of cherry. I tried the idea and was totally satisfied. Perhaps the finest piece of furniture I have yet made is a cherry side table colored with lye and finished with an oil finish. I've since used lye to enhance the color of apple and have had equally impressive results. Apple heartwood takes a rich, deep color, whereas sapwood is affected only slightly. The results can be quite dramatic.

—Keith Hacker, Scandia, Minn.

Kids do have a place in the shop—I don't agree with recent letters (*FWW* #71 and #73) that say kids don't belong in the workshop. The first reason being that my father was a carpenter, and if he hadn't allowed me in the shop, I would never have become so involved with woodworking. Secondly, my 8-year-old son now works with me in my shop. He knows how to safely operate the bandsaw, drill press, jigsaw, sander and lathe. He has

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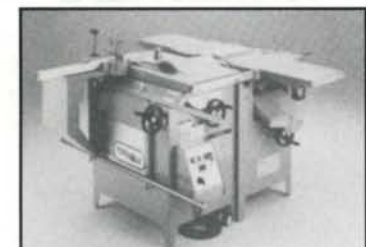
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never hurt himself, except for a bruised thumb from his hammer. I believe that if kids aren't allowed in the shop, they will never learn, and I don't want my son to be afraid of the equipment. Children need to participate in, as well as watch, what is going on. Telling children they're not allowed in the shop only arouses their curiosity; then, you have problems.

—Scott J. Cornelius Sr., Amherst, Ohio

Substituting catalpa for butternut—I was pleased to read Jon Arno's article on catalpa (FWW #72). Like Arno, I find catalpa has properties quite similar to butternut, which is my favorite and most-used carving wood. But as far as I can determine, butternut is disappearing from the commercial market in many parts of the country, as existing stands are wiped out by disease. In the future, many carvers and other woodworkers will probably be looking for catalpa as a substitute for butternut.

—Walter F. Grether, Dayton, Ohio

PEG and refractory wood—Regarding comments on using polyethylene glycol (PEG) for drying almond wood, PEG does not work well with almond or any other wood that has a low permeability to liquids (including PEG solutions). Low permeability can result naturally, as in Douglas-fir heartwood, or it can result from a tree injury. Orchard trees, such as almond, would be full of impermeable wood due to frequent pruning of the trees.

Air drying is also not suitable for this wood or any other refractory (prone to splitting, cracking) wood. The uncontrolled exposure to hot, dry weather and then rainy weather will damage all but the most tolerant species. The best drying method for refractory woods is a partially closed shed, which will protect the wood from rain and sun and help control drying. During especially dry weather, the shed's walls may have to be closed fully with burlap to retard airflow. Also, when sawing refractory wood, always leave the bark edge on to minimized warpage. Edge the lumber after drying. —Eugene M. Wengert, Blacksburg, Virg.

Hardness not the only factor in tool quality—A recent item in "Question and Answer" (FWW #71) stated that a high-quality chisel blade might have a Rockwell hardness of 60, while a poor-quality tool might be around 52. These words echo an apparently widespread assumption that regardless of other factors, the harder the steel, the higher its quality. The fact is that whatever its quality, the steel in a wood chisel or plane iron is not made as hard as it could be. The reason is based on the nature of steel and the process by which it is hardened.

At the risk of oversimplifying things, most woodworking cutting tools are made from "high carbon" or "tool steel," which contains from .5% up to 1.5% carbon. The deliberate, as well as unwelcome presence of other elements, in quite small amounts, gives the steel other qualities, but the presence of carbon permits hardening.

Hardening is done by heating the steel between 1,350°F and 1,480°F, which changes the crystalline structure of the metal to make it hardenable. If the steel is allowed to cool slowly, it reverts pretty much to its former state. If the steel cools quickly, the new structure is "frozen," and the steel hardens dead hard.

In this dead-hard state, the steel is brittle. If you made a chisel out of it, it would be tough to shape and sharpen, and the edge would chip and crack. To achieve a better balance between hardness and utility, the steel is softened. This is done by reheating it, but to a lower temperature than before, to change the crystalline structure. This is called tempering. At about 430°F, quite hard steel will result, suitable for machinist's scrapers, scribers and burnishers. At 600°F, the steel is too soft for much except wood saws, screwdrivers and springs. Wood chisels and plane irons come in at or near 500°F.

There is, of course, a lot more to say, but the point is that there is a good deal more than hardness to deal with if a high-

quality tool is to be made. These factors include toughness, malleability, heat resistance, stability and grain size. The right mix begins with the right steel alloy and runs through the whole heat-treating process. Steel doesn't lend itself cheerfully to all this. Given half a chance, it oxidizes, cracks, distorts, pits, scales, heats unevenly, carburizes or decarburizes. And in other ways, it just doesn't go along with your plans. High-quality steel is the result of dealing successfully with all of these factors, and there is no one nonsubjective criterion that can be applied to gauge quality. In the end, as a steel user, you have to accept what the man says and find out if he's right later. —Henry T. Kramer, Somerville, N.J.

More on myrtle wood—It is high time to put the old myth of myrtle wood only growing in Southern Oregon and in the Holy Land aside for good. In the first place, the tree is not a myrtle tree, but it is in the bay or laurel family. The scientific name is *Umbellularia californica*. I have used the leaves in cooking for years, collecting only the new tender leaves and drying them.

The tree grows all the way from Southern Oregon to the southern border of California, and the largest tree is to be found in San Leandro, Calif. It is a monster and should be seen by anyone interested in that species. Contrary to belief, myrtle wood does not grow in the Holy Land.

Anyone who ever works myrtle wood will fall in love with it. I put myrtle wood up there with black walnut and mahogany in terms of both its beauty and working qualities.

—Fran Hall, Boulder, Colo.

...*Myrtus communis*, the myrtle found in the Holy Land and cited in the Bible (Isaiah 55:13) belongs to a different family (*Myrtaceae*). It is not related to Oregon myrtle, aka California laurel (*Umbellularia californica*, family *Lauraceae*).

—Robert Pinney, Rutherford, Calif.

...The talk about Oregon myrtle wood growing only in Oregon and the Holy Land is a myth perpetrated by the companies that make and sell "myrtle wood" souvenirs.

—Charles Slay, Belmont, Calif.

Twig-whistle poetry—In reference to Denis Foster's search for the poem his grandfather used to recite as he made twig whistles (FWW #73), here is one I learned from my mother. I don't know if it's the poem Denis remembers, but it comes to mind now and then, and gives me a chuckle: I've always been a sucker for sophisticated humor.

—Roy Deppa, Brookeville, Md.

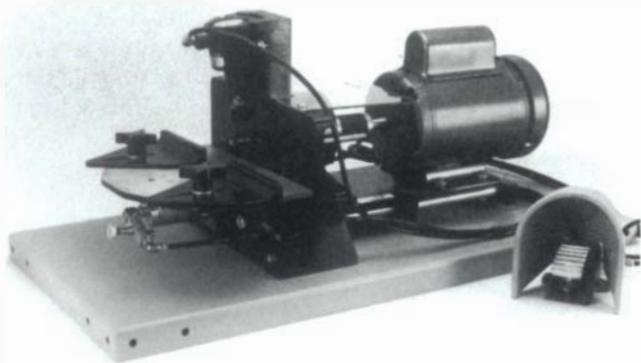
(We also received a copy of the same poem from Richard A. Fisher of Cleves, Ohio, who points out that the "tin" in the last line was interpreted as a toddler's word for "can.")

I made a wooden whistle,
But it wooden whistle.
So I bought a steel whistle,
Bit it steel wooden whistle.
Then I bought a lead whistle,
But it steel wooden lead me whistle.
Then I got a tin whistle.
Now I tin whistle.

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—John Lively, associate publisher



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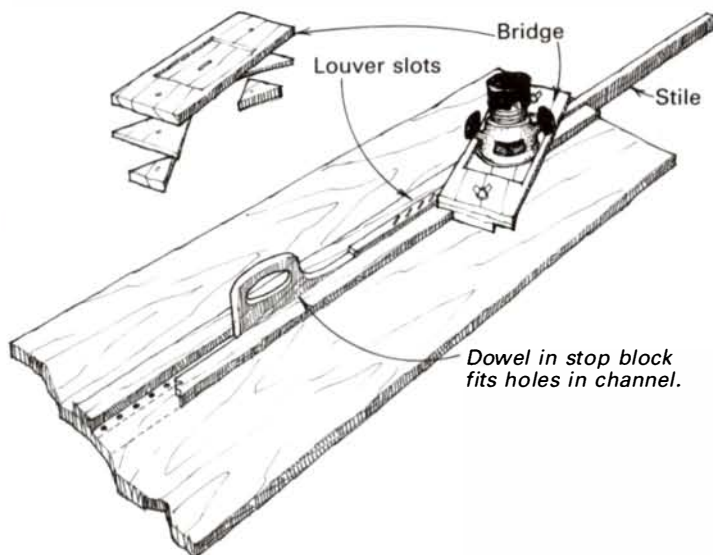
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Making fixed-louver shutters



Exterior wood really takes a beating in the subtropical climate of Key West, Fla., where I work. So when a client hired our company to replace his deteriorated pine shutters with longer-lasting redwood, we developed this quick, easy and inexpensive method for building the shutters right on the job site.

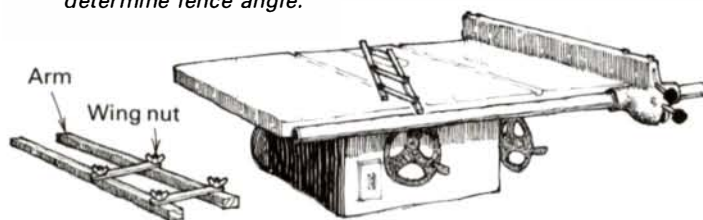
A tedious but critical part of shutter construction is routing slots in the stiles for louvers. For this operation, we devised a jig, as shown in the sketch above, that holds the stile in a channel and allows it to be moved in steps as each louver slot is routed. Accurate spacing is ensured by using a stop block and a series of holes 1½ in. apart in the channel. A dowel in the bottom of the stop block fits the holes. The jig is also fitted with a bridge that holds the router above and at 18° to the stile. The bridge may be unfastened and repositioned to cut mirror-image slots in the mating stile. A recess in the top of the bridge allows the router to travel back and forth the precise distance needed to cut each slot.

To rout louver slots in a stile, we first mark off 6 in. at the top and bottom to allow enough room for the rails and waste. We also mark off the center of the stile where we skip two slots to leave room for the middle rail. Then, with the stile located in the jig's channel, we begin routing slots, tipping back the router to start the cut (a plunge router would be great for this job). After repositioning the bridge, we rout slots in the opposite stile. To complete the shutters, we mortise the stiles, cut tenons on the rails and glue up with epoxy and pipe clamps.

—Barb M. Kamm, Key West, Fla.

Angle finder for cutting coves

Set parallelogram jig to desired cove width; place astride blade to determine fence angle.



To accurately cut coves on the tablesaw, you must clamp the fence to the table at the correct angle, because the angle determines the shape of the cove. This simple parallelogram device makes finding the correct fence angle easy.

To use the device, simply move the arms apart a distance equal to the desired width of the cove and tighten the wing nuts

to lock the arms at this distance. With the sawblade set as high as the cove will be deep, place the device over the blade and rotate it until the arms contact the tips of the teeth at front and back. The device is now at the correct fence angle. All that remains is to clamp a fence to the saw at the same angle, and taking about ⅛ in. at a pass, begin making incremental cove cuts until the final depth is reached.

—Joe Hardy, Des Moines, Iowa

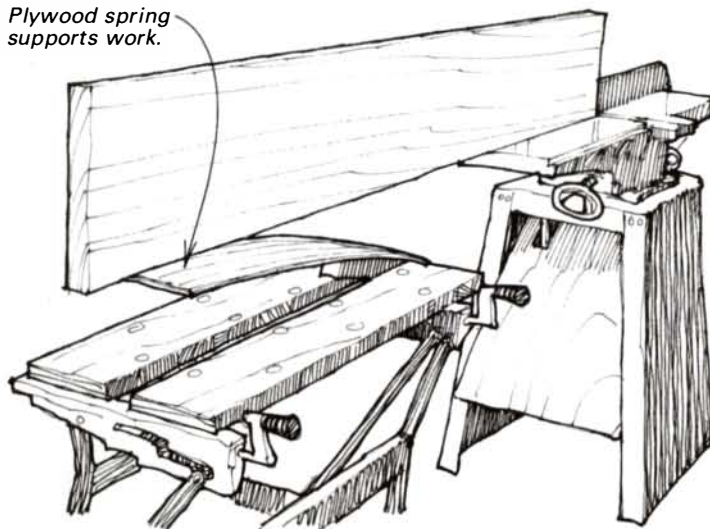
Quick tip: Recently I was assembling some sliding dovetail joints. As might be expected, they stuck. To find the tight spots, I rubbed the dovetail with chalk. Where the joint was binding, the chalk was rubbed off, indicating high spots that needed to be pared down.

—Dennis Sweeney, Upper St. Clair, Penn.

Wooden spring for outfeed support

I tried using a roller work-support while joining the edges of long, heavy boards, but no matter how carefully I adjusted the height, invariably the work would be marked when the end of the board bumped the roller. What I really needed was a more flexible support that simply helped hold up the front of the

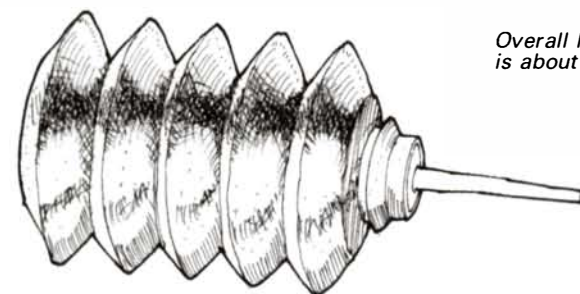
Plywood spring supports work.



board. The arrangement I came up with consists of a 2-ft.-long, ¼-in. plywood spring screwed to a 6-in.-long 2x4 clamping spline. I clamp the spring in a portable vise and adjust it so it balances the weight of the work and requires only a slight downward pressure to keep the work flat on the outfeed table.

—Jack Jerome, Nokomis, Fla.

Glue injector



Overall length is about 3 in.

Ask your veterinarian to save you a few of these little accordion squeeze bottles that come filled with an antiseptic used to irrigate puncture wounds. The bottles make great glue or oil applicators in tight places.

—Steve Allard, Carbondale, Ill.

Quick tip: It's long been the rule to buy two rechargeable batteries for a portable electric tool: One battery can sit charging while the other one works. A neighbor recently shared another

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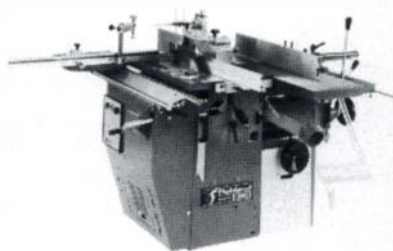
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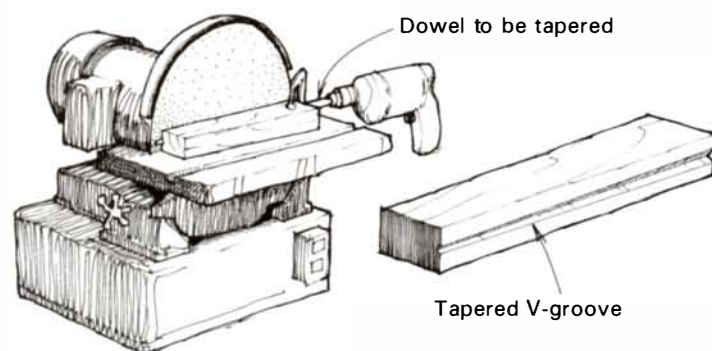
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example of the "buy two" rule with me. If you have two filters for your shop vacuum, you can use the fresh one to clean the embedded dust out of the old one, thus avoiding a typically miserable job.

—Dan Miller, Elgin, Ill.

Spindle tapering jig



Recently I needed a quantity of tapered wood rods to make drop spindles for spinning wool. The spindles' diameter had to taper from 1/2 in. to 1/4 in. evenly along their 12-in. length. Rather than attempt to turn these tiny spindles on the lathe, I designed the jig shown above, which worked perfectly.

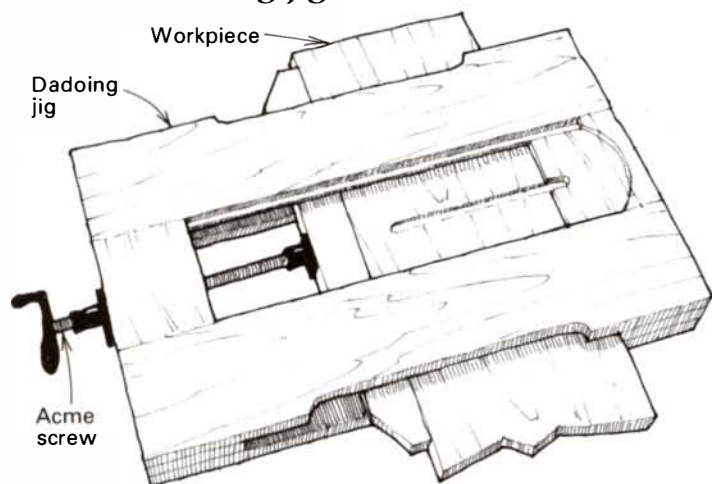
First I selected a 12-in.-long chunk of 1 1/2-in.-thick hardwood for the sanding guide and sawed a 1/2-in.-deep V-groove into one edge. After cutting the groove, I ripped the guide at a slight taper so the groove was only 1/4 in. deep at one end. To use the guide, I clamped it to the worktable of a disc sander, with the grooved edge almost flush against the disc. Then I chucked a length of dowel in an electric drill, and with the drill at slow speed, guided the dowel into the V-groove. After a little practice and some trial-and-error setting of the guide, I was able to make perfect tapers every time.

—Bert G. Whitcomb, Hemet, Calif.

Quick tip: I have finally found the perfect spot to keep my steel carpenter's square: It hangs on the molding around the door to my shop.

—A.E. Waterhouse, Redding, Conn.

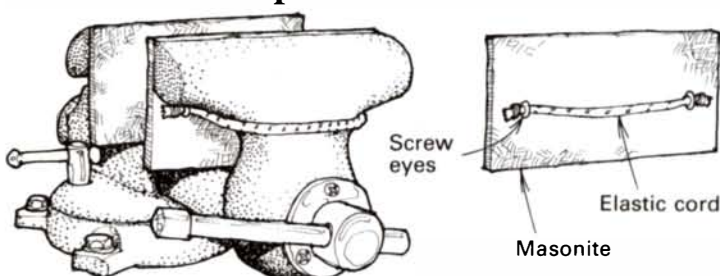
Carcase dadoing jig



The homemade dadoing jig illustrated in Christian Becksvoort's article "Building a Chest of Drawers" (*FWW* #68) is similar to the one I made several years ago. Mine differs in one respect that I think improves the jig. I purchased an Acme screw, which is often used in constructing book, cheese or juice presses and is available through many tool catalogs. I installed the screw as shown to make the positioning and clamping of the jig quick and accurate—certainly better than using C-clamps.

—Charles Leik, Great Falls, Va.

Detachable vise pads



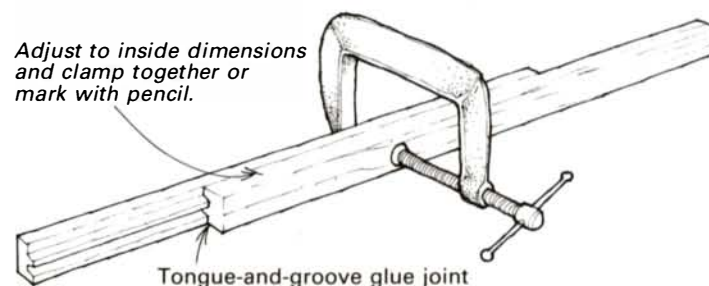
These easy-to-make jaw pads enable me to adapt my machinist's vise for woodworking, and just as quickly, to switch it back to metalworking. To make the pads, cut two 1/4-in.-thick Masonite or hardwood blocks as wide as the vise jaws and as tall as the distance from the top of the jaws to the vise screw housing. Thread a short length of 3/16-in. elastic cord through two screw eyes on the back of the pads to hold them to the jaws. Secure the ends of the elastic cord by wrapping them with 20-gauge steel wire.

—George A. Ferrell, Huntsville, Ala.

Quick tip: If you do not have a round slipstone to fit the flute of a gouge, wrap some 600-grit wet-or-dry sandpaper around a dowel of the correct diameter. This makes a very handy hone.

—William E. Richie, Mechanicsburg, Penn.

Sliding measuring sticks



The next time you're running tongue-and-groove glue joints, rip off some sticks about 3/4 in. thick, with the joint profile on one side. Put the two sticks together to make a sliding measuring stick that can take inside measurements accurately. The measurements can be registered by marking across both sticks with a pencil or by clamping the two sticks together with a small C-clamp. The measuring stick is especially useful for checking a door opening for consistent width from top to bottom.

—Robert M. Vaughan, Roanoke, Va.

Perfect half-lap joints

The half-lap joint is a strong, useful joint for cabinet frames, but setting up the saw so it cuts away exactly half from each piece can be frustrating. Here's a method for setting the blade height that's fast and foolproof, and it doesn't require jigs or measuring. Grab a waste piece of the frame stock, and with your tablesaw's blade height elevated to less than half the stock thickness, pass the stock over the saw on both sides to leave a thin center section. Raise the blade a little and make a second pass. Continue raising the blade, taking cuts on both sides, until only the slightest membrane of wood remains in the center. You have now achieved the perfect blade-elevation setting. I waste the lap area with repeated passes, then clean up any small ridges and saw marks with a rasp.

—Duane Waskow, Cedar Rapids, Iowa.

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 return only those contributions that include an SASE.

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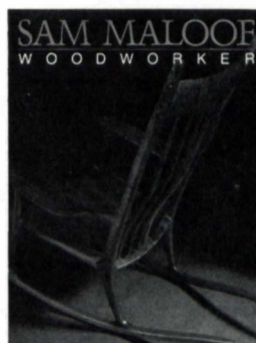
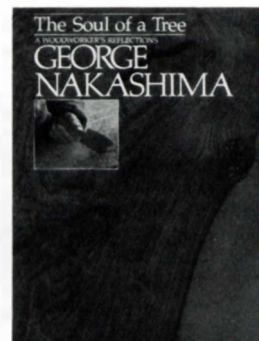
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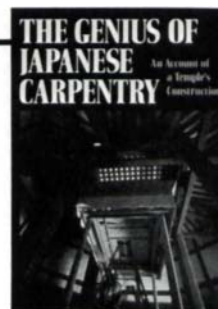
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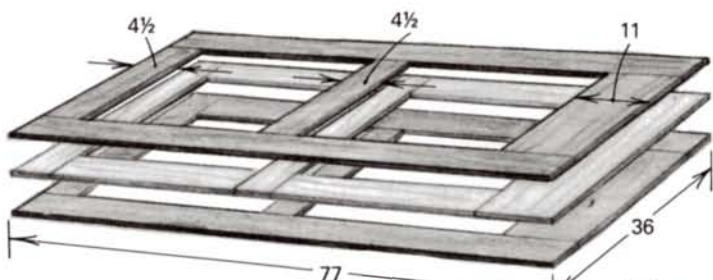
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Making a door sandwich

I intend to make a heavy front door, 2¼ in. thick, 36 in. wide and 77 in. tall, with two glass panels. Rather than construct it of solid stock, with conventional mortise-and-tenon joints, could I make it a three-layer sandwich of ¾-in. plywood, as shown below, glued together with epoxy?

—Paul Carson, Minneapolis, Minn.



Layers are glued together with epoxy glue.

John Birchard replies: Making an extra-thick door like the one you describe by laminating three layers of ¾-in. material is a viable approach, as long as you are careful to use good-quality plywood that is very dry and of a uniform thickness. You are smart to use an epoxy glue for this type of lamination, because it will hold well even if your joints are not perfectly tight. I recommend System Three Quick-Cure epoxy, available from System Three Resins, Box 70436, Seattle, Wash., 98107; (206) 782-7976.

Your main problem will probably be finding enough C-clamps for the glue-up. You might want to use as many as 100—two every 6 in. all the way around. If you can't get that many clamps together, you could use finish nails, which can be set and puttied. You might also consider doweling the frames together before you laminate them so you don't have to worry about getting the rail-to-stile butt joints tight while you're laminating. You could even make the window holes a little bigger on one of the frames so you won't have to rout out a rabbet for the glass after the lamination is together.

[John Birchard is a professional woodworker in Mendocino, Calif.]

Oil bleeding problems

I was oiling several raised-panel mahogany doors with clear Watco oil. After the oil dried overnight, there was a thick sludge of oil that couldn't be removed from the surface. The manufacturer's instructions say to reoil and wipe immediately, but this didn't help. I called Watco and was told the oil works its way out of the pores and that lacquer thinner will clean it up. This does work, but very slowly. Is there anything else I can do?

—Tim Tomaselli, Salt Point, N.Y.

Bob Flexner replies: Varnishes and sealing oils, such as linseed, tung and Watco Danish oil, cure and harden through a process of solvent release and polymerization. As the turpentine, mineral spirits or other solvents evaporate, the resin molecules link up and form a hard film that can no longer be dissolved by these solvents. When you spread one of these oils onto a porous wood, such as oak, walnut or mahogany, the oil penetrates fairly deeply into the pores and remains there even after the surface excess is wiped off. Even though the oil immediately begins to polymerize over any surface exposed to air, the resins will have trouble linking-up over the pores, because the solvents continue to break through as they evaporate. As the solvents come to the surface, they carry along resins that spread out around the pores. If these resins are not wiped off in time, they polymerize on the surface, forming hard shiny spots, much like scabs over wounds. The problem is worse on warm days or when the wood is moved to a warmer atmosphere, which excites the molecules of the trapped solvents. But, as you have probably experienced, it occurs even on cold days.

I don't know of any way to prevent oil from bleeding, but I have found that I can avoid the problem if I apply the oil early in the day and wipe the surface every hour or two before the resins have a chance to harden. The bleeding usually stops by the end of the day. The next coat causes fewer problems, because the pores are now partially or fully sealed. You are correct that neither the application of more oil nor lacquer thinner will remove fully cured spots. These spots should be abraded off with fine steel wool or sandpaper, possibly using some more oil as a lubricant. As a last resort, the finish should be removed with paint and varnish remover, and you should start over.

[Bob Flexner is a professional finisher and restorer in Norman, Okla. His videos "Repairing Furniture" and "Refinishing Furniture" are available from The Taunton Press, Box 355, Newtown, Conn. 06470.]

Two glue problems

For some time I have been having problems with yellow glue. The glue seems to grow out of the joint after the project has been finished, so I have to resand and refinish the piece. I usually finish with Watco oil. How can I solve the problem?

—Ray Allen, Yuma, Ariz.

I've been using epoxy for gluing furniture for some time now. It works very well for restoring old splintered joints, but I hesitate to use it too much, because I've heard epoxy is too rigid to accommodate normal wood movement. I've also heard that you should not use it, because it is impossible to disassemble to make repairs.

—Colin Conolly, Corvallis, Oreg.

George Mustoe replies: After years of listening to woodworkers worry about "which glue is the strongest," it's refreshing to receive two letters that illustrate that strength alone doesn't always determine whether an adhesive performs adequately. The experiences of Allen and Conolly can both be traced to the great range of rigidity among various types of adhesives. Soft-setting glues include contact cement, hot-melt thermoplastic sticks and both the white and yellow varieties of polyvinyl acetate (PVA) glue. These adhesives produce a rubber-like glue film that can creep under load. For this reason, they are not recommended for heavy-duty applications, such as laminated structural beams, where intense stress may cause the joints to deform or rupture. As Allen discovered, soft-body glues may bulge or shrink as the surrounding wood undergoes changes in its moisture content. This is particularly common when a thick glue layer is present. Yellow glue sets to a harder consistency than white glue, and it shouldn't cause problems if it's used on well-mated surfaces. Make sure to use just enough adhesive to coat the surfaces; applying a thick layer is asking for trouble.

At the other end of the spectrum, Conolly is worried about epoxy being too rigid an adhesive. Excessive rigidity is not a problem with epoxy. In fact, epoxy's hard, but not brittle, durability is one of its best features. In contrast, hide glue and urea-formaldehyde plastic resin glue both form brittle films that sometimes fail due to internal fracturing within the glass-hard layer of cured adhesive. The inherent brittleness of these adhesives usually causes no difficulties, as long as the glue film is kept thin. Although Conolly is correct in his statement that epoxied wood joints are virtually impossible to disassemble, the same can be said of most other adhesives. Synthetic thermoplastic resins can be softened using heat, but even with these glues, taking apart a joint is always a tricky procedure.

With any type of woodworking adhesive, maximum performance characteristics are obtained when the glue line is kept as thin as possible. This means close-fitting surfaces; uniform adhesive application using a brush, roller or spreading stick; and firm, evenly-distributed pressure during curing. If you have to use glue to fill up the voids of a poorly fit joint, make the best

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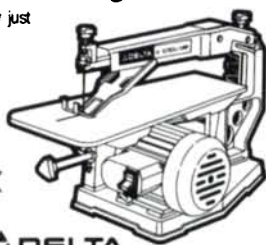
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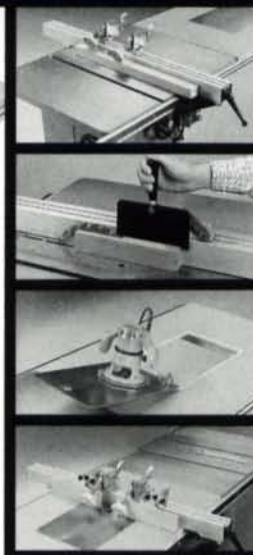
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of a bad situation by using epoxy. It's about the only glue that displays an acceptable degree of gap-filling ability without sacrificing other physical properties.

[George Mustoe is a geochemistry research technician at Western Washington University in Bellingham, Wash.]

Japan-finishing a plane

I have several old Stanley planes that I would like to refurbish. I have no difficulty cleaning and tuning the planes, but I don't know how to japan the parts that are in bad shape. Is there some home process available that will allow me to duplicate the original finish?

—Harold Shipley, Memphis, Tenn.

Graham Blackburn replies: The japan finish used on old Stanley planes was a tough, durable coating composed of pigments and synthetic resin varnish, dipped or sprayed on, then baked at temperatures ranging from 250°F to 350°F. In short, japanning is baking on enamel. Duplicating this process isn't practical at home and can be extremely dangerous. An alternative is to use a modern air-drying enamel. These enamels are less resistant to wear, but they are easy to apply and capable of producing results that look just like the plane's original finish. The air-drying enamels formulated for household use are sometimes called "liquid enamels," because they closely resemble porcelain or vitreous enamels—like japan. Avoid using lacquer-base enamels on your planes: They are cheap and fast drying, but less durable than the air-drying enamels.

[Graham Blackburn is a contributing editor to *Fine Woodworking* and has written numerous books on woodworking and tools. His shop is in Santa Cruz, Calif.]

Braces and ball-bearing chucks

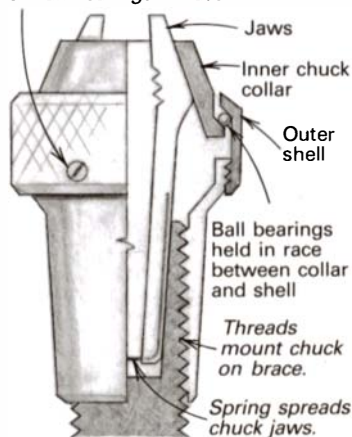
I was thrilled to find an old brace with a 14-in. swing, but unfortunately, I'm unable to make it work. Someone has replaced the original jaws with newer ones that are apparently too small. Also, the chuck appears to be designed for ball bearings, but they're missing. Can you help me repair my chuck?

—Bob Clark, Collinsville, Va.

Richard Starr replies: It's good that your brace has a ball-bearing chuck. The ball bearings reduce friction, making it easy to snug up any bit with just a little twist on the chuck shell. This isn't so important when chucking an auger bit with a tapered, square shank, but it tremendously improves the chuck's ability to firmly hold round-shank bits, which are more prone to slipping.

Most brace chucks have an outer shell that rotates around the jaws to tighten them against the bit, and there's considerable friction between the shell and jaws as the collar tightens. As the outer shell on a ball-bearing chuck turns, however, a free-floating inner collar bears against the jaws and closes them. The outer surface of each jaw is flat (instead of round as on nonball-bearing chucks) and slides in a groove milled in the inner collar, to keep it aligned as it closes. To minimize friction, the outer shell and inner collar bear against ball bearings that roll freely in a race or groove that's formed between them (see the drawing above). To replace the missing ball bearings, first loosen the small setscrew on the outer shell, then unscrew the shell to remove it. You can get replacement balls by scrounging them from another ball-bearing chuck on a junker brace, or

Loosening setscrew allows adjustment of shell, to set tightness of ball bearings in race.



you can take the chuck to a good bicycle repair shop and ask for the kind of loose balls used in bicycle hubs. Loosely assemble the outer shell and inner collar, then dribble in balls until you form a ring of balls in the race. Screw the shell back on the chuck until there's just a little play and the ball bearings roll freely without rattling.

Fixing the jaws on your brace might be more difficult. Jaws are seldom interchangeable between braces, and finding a pair that would fit is unlikely. Some chucks are designed with a spring to hold the jaws apart; on others, the jaws flop around loosely, separated at the bottom by a protruding tab in the jaws. You could make a pair of jaws yourself, but because you don't have a pattern, this could be tedious trial-and-error work with a hacksaw and file. You'd have to use a blank of tool steel soft enough to work, then temper it to a color between blue and straw, so the jaws would be hard enough to resist galling, yet not be brittle.

There are lots of good old braces out there, but few with a 14-in. swing. As a last resort to save yours, you may end up having another chuck welded on—not a pretty solution, but functional. [Richard Starr is a teacher and the author of *Woodworking with Kids*, The Taunton Press, Box 355, Newtown, Conn. 06470.]

Northwest red alder

Red alder is very plentiful here in the Pacific Northwest, and I have been considering using it for some custom bathroom cabinets. Is it dimensionally stable, and how should it be sealed to prevent moisture damage in a bathroom? The wood seems rather brittle, and when left in the weather, it rots to mush in only a year's time. Am I asking for trouble?

—Robert Moen-Starr, Raymond, Wash.

Jon Arno replies: I certainly don't see any tragedy in using red alder for interior cabinets. In fact, because it is readily available and inexpensive in your area, it is probably the best choice you could make. If it was equally available here in the Midwest, I would prefer it to birch, even though birch is one of the primary woods for commercial cabinets.

Coincidentally, red alder (*Alnus rubra*) is a member of the birch family (*Betulaceae*), and I would choose this wood as the pick of the litter. With an average specific gravity of only 0.37 (oven-dry weight/green volume), it is much softer and easier to work than yellow birch, which has an average specific gravity of 0.55. Red-alder heartwood has a beautiful rose-pink color, and because it produces a fibrous layer of cells along the annual rings, its tangential figure is more like cherry than it is like its cousin birch. Red alder is also more stable than birch: Its average volumetric shrinkage is only 12.6%, versus 16.8% for yellow birch.

If the stock you use for the cabinets is thoroughly seasoned, you shouldn't have any trouble. Red alder holds nails and screws well, accepts glues and sealers without difficulty, and because it is a diffuse-porous wood, polishes down to a smooth finish without requiring fillers. As for finishing alder, or any other cabinetwood, I recommend first applying a penetrating oil stain to achieve the desired color, then follow this with at least three coats of satin polyurethane varnish. Polyurethane may not rub down as well as other varnishes—I don't use them on fine furniture—but for your purpose, you want the most impervious moisture barrier you can achieve. The polyurethane will prevent raised grain and water spotting when the wood gets that inevitable splash from the sink or the shower stall. Although neither alder nor birch are known for their durable weathering properties, normal interior humidity levels are low enough so this should not be a problem. [Jon Arno is a woodworker and amateur wood technologist in Schaumburg, Ill.]

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

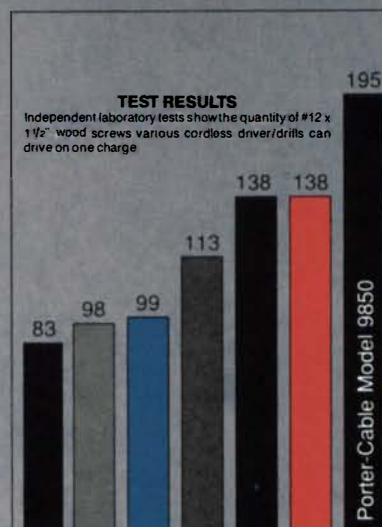


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More on tool reviews—We have been regularly publishing articles evaluating hand and power tools, like the review on scroll saws in this issue (see pp. 50-54). Judging from the telephone calls and mail we receive, most readers enjoy the reviews and want more. But, these articles are difficult to produce, requiring a great deal of research. They also provoke a good bit of controversy among readers and manufacturers.

Manufacturers often are concerned that the tools do not show up as well in our tests as they do in their factory tests. The factory tests are often more scientific than our reviews, but we feel obligated to test the tools in actual workshops under typical job situations, rather than in laboratories under ideal conditions. We see more value in determining how many holes a cordless drill can bore on a single charge than hooking it up to an instrument to get a digital readout of its torque or RPM. After all, our readers are primarily woodworkers and must decide how the tool will operate in their shop situation.

This need for real-shop situations is one reason why the authors we recruit to test tools are people who have worked with the particular tool for years. This work experience is essential to separate the gimmicks from the real innovations. It is also invaluable when evaluating such things as balance, power, ease of operation, performance versus price, and the other somewhat subjective factors that determine whether or not a tool can get the job done accurately, efficiently and safely.

In addition to actual testing, we often talk with manufacturing representatives and engineers to clear up problems with the tools, have them answer technical questions and obtain their views on what they see as their tools' strong points. We also welcome letters from readers about their experiences with the tools, and we will try to present as many letters as possible in the "Follow-up" or "Letters" columns.

Skil's cordless drill—The Skil Corporation is disappointed with our review of their cordless drill in the September issue (*FWW* #72). They say they don't feel the review is accurate or objective.

First of all, Skil disagrees with some of the general statements on the drills. The company says we are describing old-style nickle-cadmium batteries when we state that the batteries have a memory and you should let the battery drain completely before charging. Our research indicates that if you charge a partially drained battery often, you can reduce the battery's capacity. Skil says we are wrong.

"The batteries we have been putting into our tools for the last few years have virtually no measureable memory," Skil says. "The effect is still there, but it requires some very accurate laboratory instruments and a complex test procedure in order to measure.... At least in the case of our supplier, which also supplies batteries to some of our competitors, the memory effect phenomenon no longer exists." Skil also maintains that draining a battery before recharging could damage the battery under some conditions, so be sure to read the owner's manual for your particular tool.

Skil's letter also offered some good advice on the care of batteries. They say that generally you should avoid excessively high or low temperatures when charging batteries. Also, avoid prolonged exposure to high temperatures: A car trunk or a metal storage shed would be a particularly bad place to store a ni-cad battery. In another temperature-related problem, Skil disputed our claim that we had killed one of their batteries by recharging it before it cooled down. They say the battery would have been okay if charged after it cooled. But, that doesn't match our experience. Again, check your owner's manual for the specifics on your tool.

Ryobi radial-saw and planer modifications—Ryobi America Corp. has asked its dealers to stop sales of the RA-200 radial-arm saw until the company can change the carriage center component that joins the motor/blade assembly to the saw arm. Under

certain conditions, the component could break, the company says, which would affect accuracy and might even cause operator injury. Anyone who owns one of these saws and has not been contacted by a company representative should call their customer-service department at the number listed below.

Ryobi is also offering a free upgrade kit to owners of early models of the AP-10 planer (bearing serial numbers lower than and including #064155) and the Sears/Craftsman Portable 10-in. Thickness Planer, model #351.23372. The kits are designed to eliminate the space between the main body of the planer and the rear feed-support roller. This upgrade will prevent an operator's fingers from being caught between the emerging board and the rear feed-support roller, which could cause serious injury.

For more information on the radial-arm saw or planer, contact Ryobi America Corp., 1433 Hamilton Parkway, Itasca, Illinois 60143; (800) 323-4615, ext. 235 (in Illinois, 312-350-7999, ext 235).

Inca 810 radial-arm saw—The Austrian-made Inca radial-arm saw, which we reviewed in *FWW* #73, will probably not be available for much longer in the United States. The manufacturer has decided it will no longer sell the machine outside of Austria, because of insurance considerations. Inca dealers will still sell the models they have in stock and intend to continue to provide parts and service for the models already sold.

Safety and photography—Safety is a prime concern whenever we describe or picture any woodworking operation. Woodworking is, by nature, a dangerous activity, and caution is essential. Sometimes things can appear to be worse than they actually are, but even these incidents are good reminders of what could happen. One recent case involved the cover of *FWW* #73, which showed a cut being made on a radial-arm saw.

Doug Smith of Miami, Fla., wrote, "The photographer sure forgot the tree-coming-out-of-the-person's-head lesson. It appears as though a thumb is just about to be lost. A well-composed, beautiful cover picture, but that blade is sure to get that thumb."

Actually, the thumb was a safe distance from the blade all during the operation, and the operator was very conscious of the position at all times. I have this on good authority, because I was the operator. On my own saw, I've followed Frank Klausz's advice and painted a red strip on the crosscut area of the saw table as a warning of the potential danger.

Tools-To-Go—We have been contacted by several readers who say they have ordered and paid for tools from Tools-To-Go Inc. (15935 N.W. 57th Ave., Hialeah, Fla. 33014) and have never received their merchandise. We have been unable to contact the company ourselves and unfortunately have not yet been able to identify any avenue for readers who wish to file a claim. We will publish that information as soon as it is available.

Antique tool association—The Crescent Universal Association has changed its name and broadened its scope to include machines other than its classic namesake. The Universal Wood-Worker is a do-everything combination machine, which was produced from the late 1890s to the early 1940s. The machine tipped the scales at 1,700 to 5,200 lbs., depending on the model, and included a bandsaw, jointer, shaper, tablesaw and horizontal borer.

The two-year-old organization is now called the Antique Woodworking Power Tool Association. According to president Walter S. Vinoski, the group provides members with advice on the acquisition, restoration, preservation and operation of classic woodworking machinery. The group also publishes a bimonthly journal. For more information, write the organization at Box 1027, Connellsville, Penn. 15425. □

Dick Burrows is managing editor at FWW.

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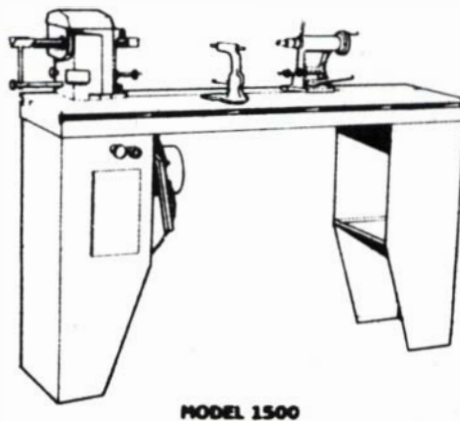


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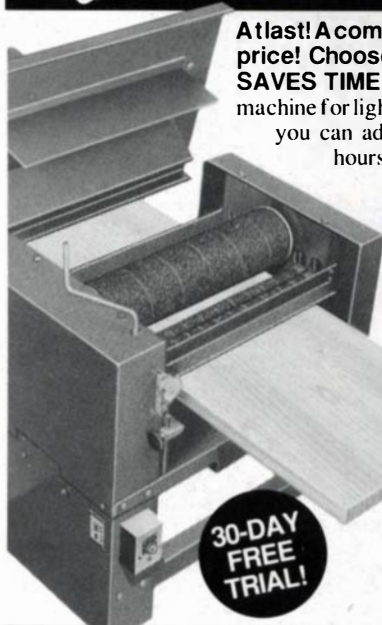
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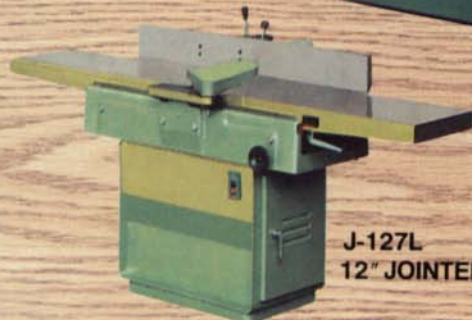
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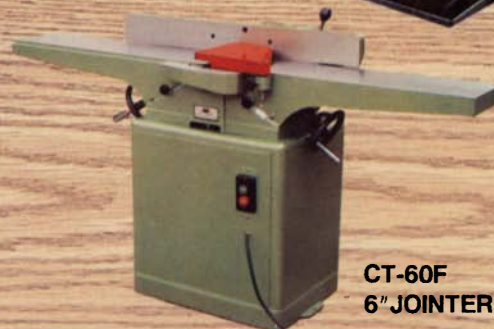
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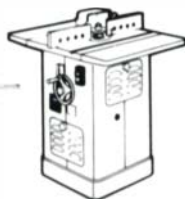
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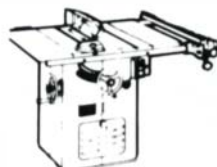


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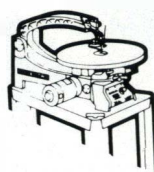
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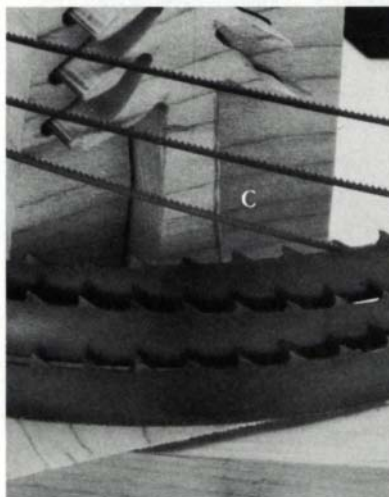
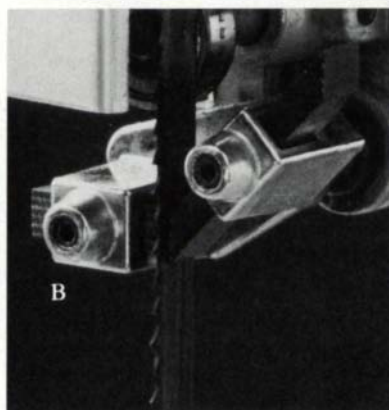
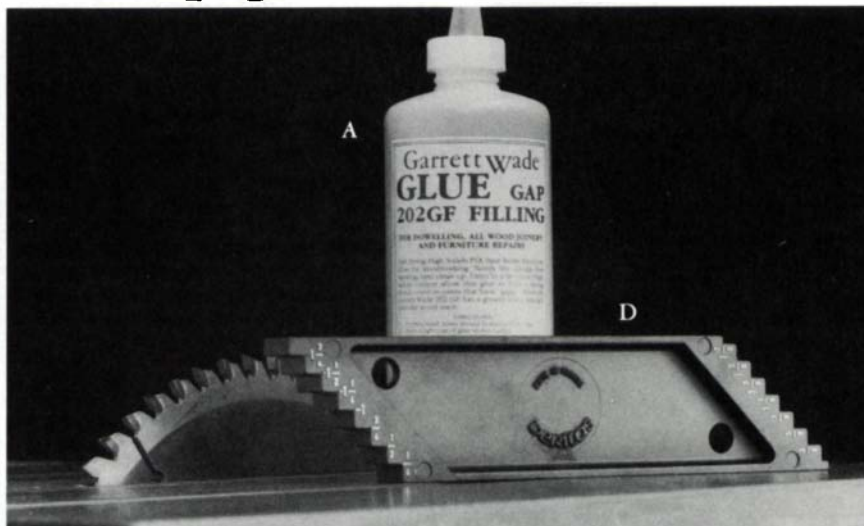
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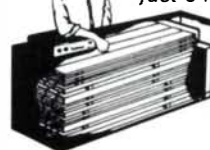
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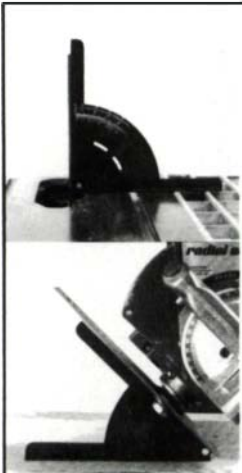
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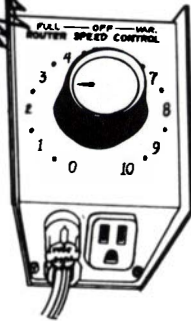
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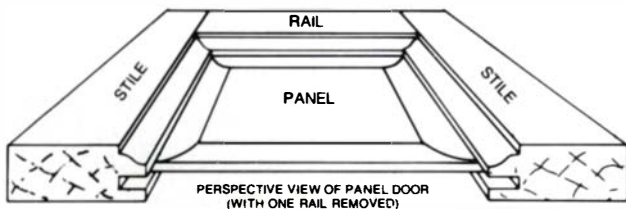
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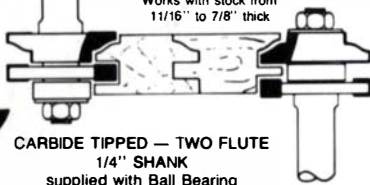
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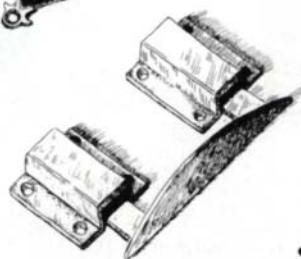


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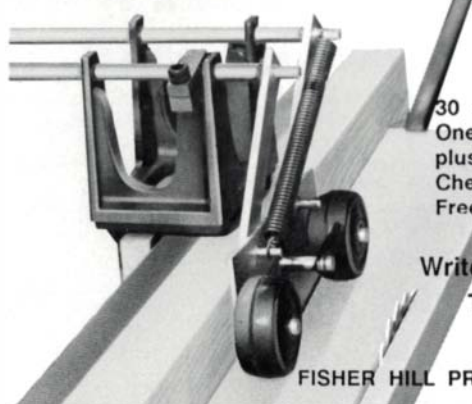
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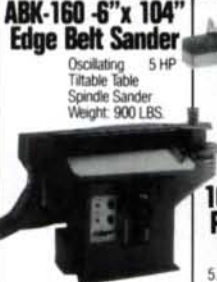
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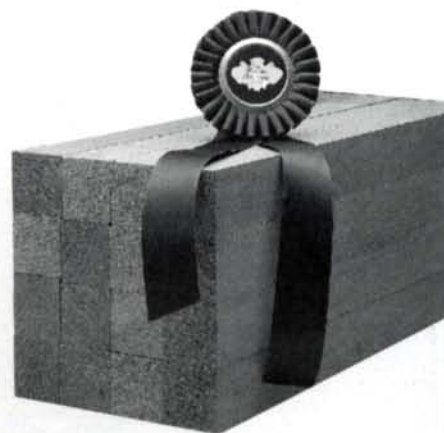
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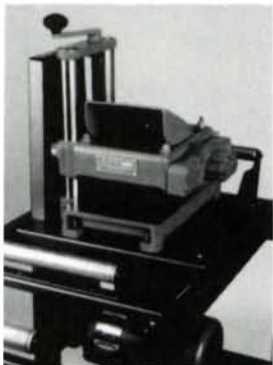
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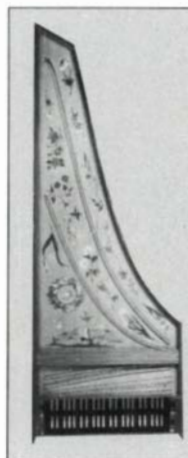
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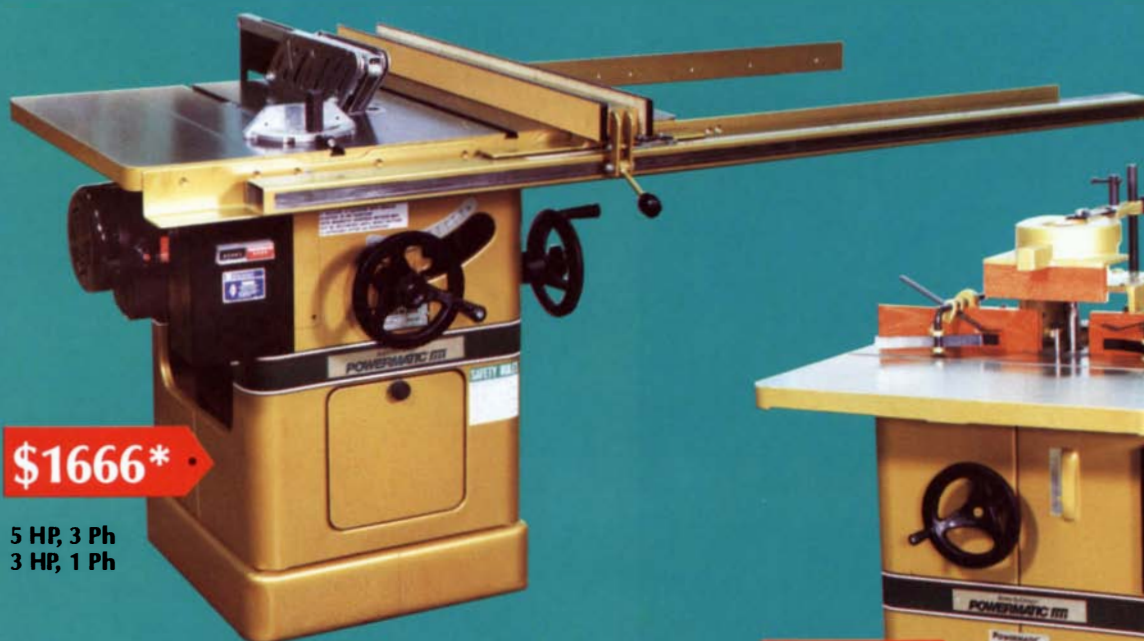
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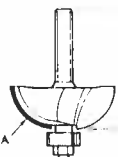
PART NO.	D	PRICE
802	3/8	\$7
804	1/2	\$7
804-1/2	1/2	\$7
806	9/16	\$8
810	3/4	\$9
810-1/2	3/4	\$9
812-1/2	1	\$12

Flush Trimming



PART NO.	A	PRICE
S8012Y	3/8	\$7
S8016Y	1/2	\$8
S8016Y 1/2	1/2	\$8
S8020	5/8	\$10
S8020 1/2	5/8	\$10

Cove Bits



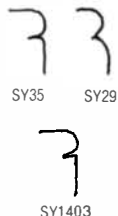
PART NO.	A	PRICE
S702Y	1/16	\$12
S704Y	1/8	\$12
S706Y	3/16	\$12
S708Y	1/4	\$13
S710Y	5/16	\$13
S712Y	3/8	\$13
S716Y	1/2	\$14
S716Y-1/2	1/2	\$14
S724Y-1/2	3/4	\$28

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SY-1225-1	SY-1225-4
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SY-1225-2	SY-1225-5
3/8" R \$26.95	1" R \$49.95
SY-1225-3	SY-1225-6
1/2" R \$28.95	1 1/4" R \$49.95

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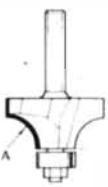
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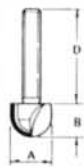
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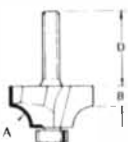
PART NO.	A	PRICE
S502Y	1/16R	\$11
S504Y	1/8R	\$11
S506Y	3/16R	\$11
S508Y	1/4R	\$11
S510Y	5/16R	\$12
S512Y	3/8R	\$14
S516Y	1/2R	\$16
S516Y-1/2	1/2R	\$16
S520Y-1/2	5/8R	\$20
S524Y-1/2	3/4R	\$20
S528Y-1/2	7/8R	\$34
S532Y-1/2	1R	\$34
S536Y-1/2	1-1/4R	\$40

Core Box



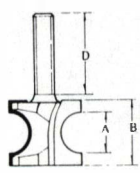
PART NO.	A	PRICE
S408	1/4	\$10
S412	3/8	\$10
S416	1/2	\$12
S420	5/8	\$14
S424	3/4	\$15
S424-1/2	3/4	\$15
S432-1/2	1	\$18
S450-1/2	1-1/2	\$30

Beading



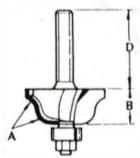
PART NO.	A	PRICE
S602Y	1/16R	\$11
S604Y	1/8R	\$11
S606Y	3/16R	\$11
S608Y	1/4R	\$12
S610Y	5/16R	\$13
S612Y	3/8R	\$15
S616Y	1/2R	\$16
S616Y-1/2	1/2R	\$16
S624-1/2	3/4R	\$20

Bull Nose



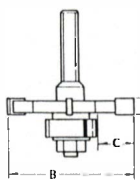
PART NO.	A	PRICE
SY9-1	1/4	\$14
SY9-1 1/2	1/4	\$14
SY9-3	3/8	\$15
SY9-3 1/2	3/8	\$15
SY9-4	1/2	\$15
SY9-4 1/2	1/2	\$15
SY9-5	5/8	\$16
SY9-5 1/2	5/8	\$16
SY9-6	3/4	\$16
SY9-6 1/2	3/4	\$16
SY9-8 1/2	1	\$18
SY9-9 1/2	1-1/8	\$30
SY9-10 1/2	1-1/4	\$35
SY9-11 1/2	1-3/8	\$38
SY9-12 1/2	1-1/2	\$40

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PART NO.	A	PRICE
S5705Y	5/32	\$16
S5705Y 1/2	5/32	\$16
S5708Y	1/4	\$17
S5708Y 1/2	1/4	\$17

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SY7002 1/2	1/8	\$24
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SY7004 1/2	5/32 (4mm)	\$24
SY7006	3/16	\$24
SY7006 1/2	3/16	\$24
SY7008	1/4	\$24
SY7008 1/2	1/4	\$24

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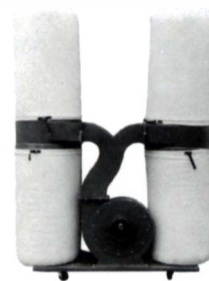
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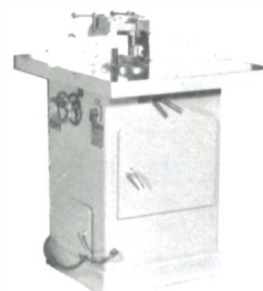
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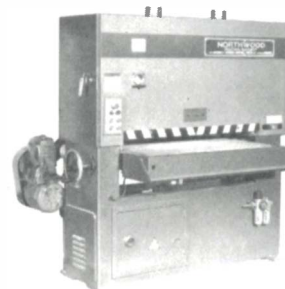
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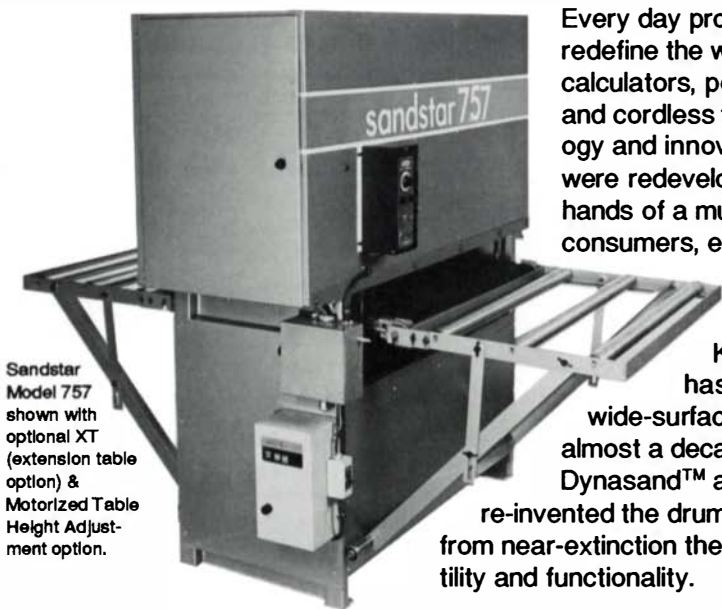
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We would like you to submit photographs of the very best work you've done in wood during the past two years. The editors of *Fine Woodworking* magazine will select about 250 photographs for publication in *New Work in Wood 90*. Every spring, we'll reissue the invitation and publish a new book each fall.

New Work in Wood 90 will be a photographic survey of good design and sound craftsmanship. It's the successor to *Fine Woodworking's* Design Book series. In addition to photographs entered by readers, each annual will contain a fully illustrated essay about the woodworking of a particular region or about some specialized segment of the craft, such as architectural woodworking, turning or student work. A separate section will feature photographic profiles of individual makers discussed in the essay.

SEND US YOUR BEST WORK

Rules

—An entry may consist of up to ten color transparencies of wooden objects made by an individual woodworker or woodworking partnership. You can submit ten photos of a single object, photos of ten different objects or any combination that totals no more than ten.

—If you enter slides of more than one object, you must enclose an entry blank for each object. Code the photos and the entry blank with matching identifying letters (A, B, C, etc.).

—Photographs must be good-quality color slides (transparencies). The photo background should be featureless and of a neutral color that doesn't interfere with the object. All slide formats are acceptable, including 35mm, 2¼ in., 4x5, 6x7 and 8x10. Please protect each slide with a plastic sleeve, not paper or cellophane. Your name and address must be legibly printed directly on each 35mm slide mount or on a label attached to the protective sleeve of large-format slides. *We cannot accept or judge unlabeled slides.*

—Snapshots, color negatives, color prints, Polaroids and black-and-white prints cannot be published, so they will not be judged.

—Work submitted must be of original design and completed since 1986. The primary material must be wood. There are no restrictions on species, tools or techniques. If it's mostly wood and you made it, you can enter it.

—If you want your photos returned, please include a self-addressed stamped envelope. Otherwise, photos will not be returned. If you wish us to acknowledge receipt of your photos, please include a self-addressed stamped postcard that lists the photos submitted. We'll check it off and send it back to you.

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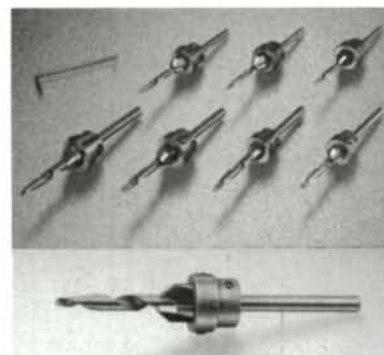
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0228-1	3/8" drill 3.5A 0-1000 rpm	154 85
0375-1	3/8" close quarter drill	208 115
0379-1	1/2" close quarter drill	243 139
0212-1	3/8" cordless drill v/spd	263 149
6539-1	Cordless screwdriver 190 rpm	108 62
6540-1	Cdless screwdriver w/bts & cse	137 89
6546-1	Cdless screwdriver 200 & 400 rpm	120 72
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6405	8 1/4" circle saw	209 120
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6012	Orbital sander 3 1/2"x7 1/2"	179 100
6014	Orbital sander 4 1/2"x9 1/2"	189 110
6305	6V 4" cordless circle saw	284 155
6753-1	Drywall gun 0-4000 3.5A	129 77
8977	Vap temp heat gun	109 70
0214-1	3/8" v. spd. cordless drill	220 125
5397-1	1/2" v. spd. hammer drill kit	227 145
5371-1	1/2" v. spd. hammer drill kit	313 199
3107-1	1/2" v. spd. rt angle drill kit	305 180
6754-1	Drywall gun 0-4000 4.5A	179 115
6232	4 1/4" bandsaw w/case	432 275
6747-1	Drywall driver-0-2500	149 87
0230-1	3/8" drill 0-1700 rpm	169 99
3300-1	1/2" v. spd. magnum rt angle kit	289 180
5620	Router 1 H.P.-8 amp	289 169
5660	Router 1 1/2 H.P.-10 amp	299 180
5680	Router 2 H.P.-12 amp	350 205
5455	3/8" polisher 1750 rpm	199 125
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6366	7 1/4" circular saw	198 112
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L085M010	Super Cut-off	10"	80	126.50	50
L072M010	Ripping	10"	24	74.22	31
L073M010	Cut off	10"	60	91.16	37
PS203	Gen'l Purp	7 1/4"	24	31.42	16
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WC106	6 pc chisel set w/cse 1 1/4"x1"			52	36
WC110	10 pc chisel set w/cse 1 1/4"x1"			88	59
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56000W	6 1/4" circular saw	317 167
60100W	3/8" cordless drill kit	155 89
60105DW	3/8" cordless drill	103 58
0A3000DW	3/8" angle drill	238 130
43900W	9.6 volt cdls. recip saw kit	218 122
60100L	3/8" drill w/flashlight	198 113
60120W	2 spd. driver drill	
	w/clutch & case	224 109
67100W	Cordless screwdrvr kit	176 103
60920W	V/spd & case	237 117
60930W	V/spd w/clutch & case	248 119
68300W	Drywall gun 0-1400	225 120
DK1001	6010 DWK drill kit comp. & 4071D vac. cleaner	178 115
63200T-4	9.6 volt battery	49 28
63200T-2	7.2 volt battery	42 27

5007N8A	7 1/4" saw w/elec. brake	219 127
5008N8A	8 1/4" saw w/elec. brake	257 145
804510	Sander	97 46
99008	3"x21" belt sander w/bag	254 139
992408	3"x24" belt sander w/bag	260 145
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90458	1/2 sheet finish sander	204 116
9045N	1/4 shft fin sand w/bag	206 117
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36128R	3 H.P. plunge router	354 179
9401	4"x24" belt sander w/bag	302 162
3620	1 1/4 H.P. plunge router w/cse	180 97
4302C	V/spd orb. jg saw	272 155
50778	7 1/4" Hypoid saw	254 145
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5865	(825) 8 1/4" worm saw	250 149
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1810	10" Mitre saw	263 189
595	3"x21" sander w/bag 5.5A	197 125
7565	1 1/4" palm sander	52 34
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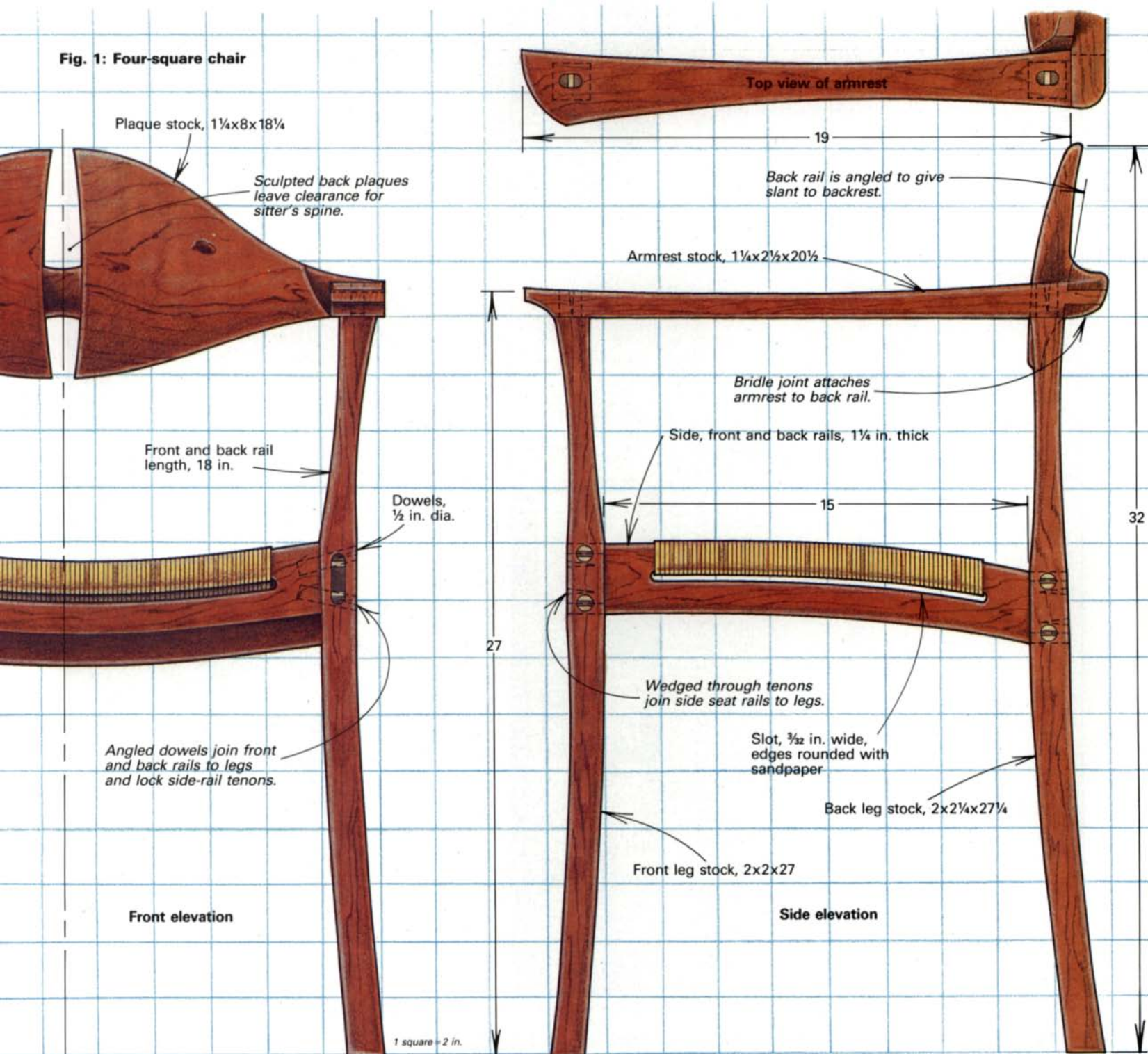
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Making A Foursquare Chair

Comfortable seating with right-angle joinery

by Scott Dickerson

Fig. 1: Four-square chair



My client said he didn't know what he liked until he saw it, but added he had seen enough of my work to know he'd like me to design and build for him a dozen dining chairs with arms. I took this to mean I had freedom of expression, but being wiser from years of calluses and tendonitis, I knew better than to proceed with wild abandon. After years of making chairs with steam-bent or laminated parts, I've grown tired of the many rigors connected with these methods of chairmaking: breathing sawdust from sawing boards into thin strips for lamination, fooling around with the complex joinery of curved chair parts, and tightening and loosening an endless array of clamps during glue-ups. This commission appeared a good time for me to return to a style of chairmaking I'd worked in years ago and to create a simple, practical design I call a "foursquare chair."

I call my design a foursquare chair because all four legs join the seat rails, chair back and armrests at right angles. Building a chair with basic right-angle mortise-and-tenon joinery simplifies the construction immensely, and it reduces the number of hours it takes to make the chair, and hence, its cost. In this article, I'll discuss how I produced my foursquare chair, pictured at right, and the sidebar on p. 40 will tell you how to make a comfortable and attractive cane seat once the woodwork is done.

Design—I begin by making full-size drawings of the chair I have in mind. I rarely draw reduced-scale sketches, because they don't show much about the actual proportions and feel of the chair. A full-size drawing can be pinned to the wall at floor level. By standing back and giving it the squinty eye, I can tell a great deal about what the actual chair will look like before I begin construction. The most useful drawings for a chair design are side and front elevations, as shown in figure 1 on the facing page. I draw the side elevation first, because the shape and location of the surfaces that support the sitter—the slope of the seat, the profile of the backrest and the elevation of the armrest—are best seen in that view. I don't worry much about the chair's aesthetics until these crucial surfaces have been established. I also draw a top view of the armrest, to define its shape:

I draw on rag-vellum paper that has light blue $\frac{1}{8}$ -in. and 1-in. grid lines (available in rolls 20 yd. by 42 in. from Charrette, 31 Olympia Ave., Woburn, Mass. 01888). The square grid speeds up plotting the contact points, and you can count squares instead of using a ruler to determine the length of chair parts.

Starting with chair dimensions that I know to be comfortable from past chairs I've built, I draw the side rail of the seat 18 in. above the floor at the front and 17 in. at the back. This provides just enough incline to keep the sitter from sliding forward and out of the chair. For comfort, the backrest's surface should be large enough to firmly support the sitter's lower and middle back. In this chair, the backrest's surface should meet the sitter's back at about 10° reclined from the vertical. To support the forearms of most sitters at a comfortable height, I place the top of the armrests 9 in. above the front seat rail. I also make the armrests level and extend them all the way to the backrest.

With all the chair's sitter-support surfaces defined, I still need to plot the points where the legs meet the ground. I like the front leg directly beneath the front of the seat, so the chair cannot tip forward if a sitter perches on the edge of the seat. Likewise, if the back legs meet the floor 2 in. or 3 in. behind the front face of the backrest, the chair will resist any attempt by the sitter to cock the chair back on its hind legs, an abuse that will surely loosen the joinery of any chair.

To draw the front view of the chair, I follow a similar process. I make the seat on my chair 18 in. wide, so all but the largest person will have enough room between the armrests and full support in the seat. Armrests should be wide enough to offer support



The author's foursquare chair with its wrapped cane seat is comfortable and attractive. Though its parts are curved and shapely, the chair is constructed with mostly right-angle joinery, making it relatively easy to build.

for the forearms and hands. The armrests on my chair taper from $2\frac{1}{2}$ in. wide to $1\frac{1}{2}$ in. wide. If the legs meet the floor directly beneath the armrests, the chair won't tip sideways when the sitter leans over to pick up a dropped fork.

I draw the front outline of the backrest to provide the most support along the sitter's dorsal muscles that parallel the spinal column. These muscles cushion the load against the backrest's contoured surface. To prevent the backrest from pressing uncomfortably against the bony ridge of the backbone, I split the backrest vertically, allowing a slot for the spine's vertebrae. Thus, the form of the backrest becomes a pair of sculptured plaques, and I attach them to a rear rail that ties the two back legs together.

I complete both the side- and front-view drawings, much as a child completes the figure of a connect-the-dots puzzle. With the critical support points and surfaces defined, the remaining lines are much a matter of style, though I have to continually be aware of the comfort factor. For instance, the curved front and back seat rails make sitting in the chair more comfortable, and the rounded front ends on the armrests make them more pleasant to grip. I also have to factor in the limitations of my material: Because I wanted to use solid wood for this chair, the curvatures I chose had to be gradual, to avoid short-grain weakness that are inevitable in tighter-curved sections. I prefer the look of slender components, but make them thicker at the joints that need more strength. After refining the shapes and thicknesses of the various components, I am ready to engineer the chair's joinery.

Joinery design—The joinery in my foursquare chair is easy to execute, because so many parts join at 90° angles. Because dining



Once the backrest plaques are joined to the back rail and clamped to the bench, they are roughed to shape with a small motorized block plane. The author then uses spokeshaves and scrapers to refine and smooth the forms.



With a 1/2-in. spiral-fluted straight bit in a plunge router, the author cuts through mortises in the chair's armrests and legs. The chair parts are clamped inside a plywood jig, which guides the router base as it cuts the mortises. Two adjustable stops clamped to the top of the jig's sides act as stops to determine mortise length.

chairs are among the most brutalized furniture in the home, I use interlocking dowel and tenon joinery to help the chairs survive the stress of being sat on, of being dragged and of being balanced on their rear legs. Further, interlocking joints help prevent parts that are joined cross-grain from separating due to differential wood movement caused by humidity changes.

The side seat rails join the four legs with through mortises and tenons. I make the legs thick enough at the joints to prevent racking forces from breaking through the mortises. Also, I wedge the ends of the side-rail through tenons to prevent them from pulling out. Because there isn't enough room to also mortise and tenon the front and back rails to the leg, these rails are joined by angled dowels. The dowels are driven through holes drilled in the side of the legs, penetrating deeply into the ends of the front and back rails. The angle creates a dovetail-like effect that makes the joint inseparable once assembled, and because the dowels pass through the edges of the side-rail tenons, they also lock those joints.

The armrests join the tops of both front and back legs with through tenons rising from the legs. Although the chair doesn't have stretchers bracing the legs below the seat, the armrests reinforce the front-leg to side-rail joint and keep the chair from rack-

ing. The chair's connecting back rail is joined to the armrests with a bridle joint. The tenon is cut on the armrest, leaving more wood on the back rail, which needs the extra stock for strength. The armrests also have shoulders on their inside faces, which buttress against the back rail and keep it from racking. The backrest joins the back rail in a glued long-grain to long-grain joint—the strongest joint possible.

Construction—I start construction by making up a cutting list for the chair parts, specifying the dimensions of the final parts, as drawn on the plans. Next, I make patterns for the parts that will be shaped so I can quickly make identical parts for all 12 chairs. I use 1/8-in.-thick white Marlite (a Masonite-like product used in bath enclosures, which is available from local hardware stores) for the patterns, but its white surface is very slick, so I scrub it lightly with sandpaper to provide some tooth for the pencil lines. I transfer the lines for a part from the full-size plans using carbon paper between the plans and Marlite. The patterns are then bandsawn out, and the edges are smoothed with a rasp and spokeshave.

I decided to use cherry for my chairs to harmonize with the interior of the client's home. First, I joint, thickness-plane and cut all the parts to rough dimensions. At this stage, I make the parts at least 1/4 in. oversize in width and thickness and allow 1 in. extra in length. For maximum efficiency in making a whole set of chairs, I perform each of the operations described in the following paragraphs on all chair parts before moving on to the next step.

I start with the backrests, and following the Marlite pattern, I mark and bandsaw out the shape. Because some of the edges of the backrests are difficult to sand after being glued to the back rail, I spokeshave and sand all edges of the plaques. Next, I dress the back rail to final dimensions and cut the bridle-joint slot on each end with a tablesaw. I then cut a 10° bevel on the rail's front face and glue the backrest plaques in position on the rail. A 1/16-in.-deep rabbet jointed on the back sides of the plaques keeps them from slipping when clamped.

After the glue dries, I'm ready to shape the faces of the backrest plaques. I rough out the shapes with a Porter-Cable motorized block plane (see top photo this page), then use a spokeshave and cabinet scraper to refine the form—a rigorous job, but I've always enjoyed the satisfaction of shaping wood to final form by the judgment of eye and hand. After the plaques are done, I spokeshave, rasp and sand the back rail to final shape.

As with all the other shaped parts, the joints of the armrests should be cut while the armrests are still square pieces, because it's easier to reference a square part to the saw fence. The tenon that joins the back-rail bridle joint is cut on the tablesaw, holding each armrest vertically in a sliding-tenon jig to cut the cheeks, then crosscutting the shoulders using the miter gauge. I also cut the angled shoulder on the inside edge of each armrest on the table-saw. The direction this 10° shoulder slants to meet the angled face of the back rail determines whether an armrest will be a right or left arm. One of the chairmaker neuroses I've developed over the years is the "right-left top-bottom paranoia." To avoid confusion and mistakes, I separate my armrests and other right-left parts into different piles and mark them accordingly.

Next, I cut the mortises that join the armrests with the legs. For this, I use a plunge router fitted with a 1/2-in. straight bit and a mortising fixture (see bottom photo this page), similar to the one Tage Frid wrote about in *FWW* #30, pp. 90-92. The armrest clamps in the fixture, while the top rails of the box-like fixture guide the router base. Two adjustable stops limit router travel to determine the length of each mortise. I cut two mortises in each armrest, one for each leg. This same jig does the mortises in the legs for the



Above: The leg-side rail assembly is secured in a bench vise while the author roughs the leg to shape with a drawknife. The joints for the rails and armrests are cut while the legs are still square and easy to align. Right: Once the chair is assembled and held together with light clamps, the author bores dowel holes to join the legs to the front and back rails. The angles of the slanting holes aren't crucial, so they're eyeballed to speed the job along.



side-rail tenons. The tenons atop the legs are cut on the same tablesaw tenoning setup described earlier. Because router-cut mortises have rounded corners, all tenons must be rounded to match. I do this with a rasp and file, and I think the rounded tenons look better than square-cornered tenons would with the curves of my chair.

Next, I cut out the side profile of each armrest on the bandsaw, following the side elevation, then I refine it with spokeshaves and sandpaper. I cut the top outline to pattern, leaving the front end square to provide a flat clamping surface when I glue the armrest to the back rail. I also leave some extra width on the armrest at the back tenon so I can clamp across the back to pull the bridle joint tight. After smoothing the edges of both armrests, I glue them to the back rail.

Before sawing the side seat rails to shape, the tenons should be cut on the ends. I employ the same tablesaw setup I used for the leg tenons, cutting the rail's tenon shoulders square with the ends of the still-square rail blanks. Although the side seat rails are curved and the tenons join the back legs lower than the front legs, the tenons will still fit squarely into the leg mortises (see figure 1, p. 36). Once all the joints are cut and fitted, you can shape the tenonless front and back seat rails and round their edges. I don't shape the legs yet, because it's easier to hold them in a vise after they've been glued to the side rails.

Assembly—Before gluing up the legs and side seat rails, I cut two wedging slots in each tenon and bandsaw a whole coffee can full of wedges. After gluing and clamping, the wedges are driven in the tenon ends, to tighten the tenon in the mortise. With the leg-and-rail assembly held in my bench vise, I begin shaping the legs using a spokeshave, rasp and cabinet scraper, as shown in the smaller photo above. While shaping, I follow the plans, using both my eye

and touch to bring the shapes to final form. Leave the joint surface area unshaped where the front and back rails will join the legs. This area is shaped later, after assembly is completed.

To drill the 1/2-in. dowel holes in the front and back rails, I dry-clamp the rails in place with the right and left sides of the leg assemblies, taking care not to put clamps where I'll need to drill. To bore the holes, I use a brace fitted with a double-twist auger bit that's marked at a 2 1/2-in. depth by a file groove on the flutes. I eyeball the angle of the holes to approximately 10°, the upper one slanting down and the lower one slanting up into each rail end, as shown in the larger photo above. The dowels are cut about 3 in. long (the excess is trimmed off later), chamfered on one end and kerfed on the other to accept a wedge. If the dowels fit too snugly in their holes, reduce their diameter by driving them through a dowel-sizing plate (available from Woodcraft Supply, 41 Atlantic Ave., Box 4000, Woburn, Mass. 01888).

Because the dowel holes are angled, the chair, less the arms and backrest, must be assembled in one step. I use four small bar clamps for the initial squeeze before wedging the dowels and two heavy bar clamps to snug the joints up tight. Moving quickly before the glue dries, I spread yellow glue on the ends of each rail and into the dowel holes with a stick, then butter each leg at the joint. A single glue-dipped dowel is then driven into each rail end. Holding the rails in a vise while installing these starter dowels with a mallet helps keep everything in order. Then, I push the legs onto the angled dowels in the rails, first one side, then the other. The second dowel for each joint is then driven home. When all the dowels are in place, I clamp the chair with the bar clamps and drive the wedges into the kerfed dowel ends. The excess dowel is cut off flush with the leg's surface with a small handsaw. I then attach the bar clamps directly across the rails, using a softwood pad under each clamp face to distribute the pressure and avoid

iron-staining the wood. I finish by removing the bar clamps and wiping up the glue squeeze-out with a damp sponge.

After the glue dries, I finish shaping the legs around the rail joints with rasps and sandpaper, then glue the armrest/backrest assembly on top of the legs. After this assembly dries, I clean and shape around the armrest joints and finish shaping the armrests. This is easier if the chair is clamped securely by its side rail in a bench vise. Next, the long slots for the seat caning are cut in all four seat rails with a sabersaw. I start by drilling three closely spaced pilot holes at one end of the curved rails with a $\frac{3}{32}$ -in. drill bit, then follow along the holes using a coarsely set blade in the sabersaw

to create the $\frac{3}{32}$ -in.-wide slot. The edges of the slot are rounded, first by roughing out a chamfer in the slot with a countersunk bit in an electric drill, then by running a strap of 80-grit sandpaper reinforced with masking tape back and forth through the slot, like a shoe-shine cloth. I sand the chairs and rub in several saturation coats of Watco Danish oil before caning the seats, so all surfaces can absorb the oil evenly. When the last of the oil fumes has dispersed from the shop, you're ready for the last step—caning the seats. □

Scott Dickerson divides his time between chair design and land-use planning. He lives in Harborside, Maine.

Wrapping a cane seat

by Janet Redfield

The wrapped-cane seat I use to upholster my husband's foursquare chair has a tightly woven center section with a subtle diamond pattern on the top. The underside is a simple over-under pattern, which hides the splices and tied-off cane ends. Wrapping and weaving the seat pattern (see drawings below and at right) seems complicated, but it's far simpler once you have the cane in hand.

To begin, you need a bundle of common-size cane (available from H.H. Perkins Co., 10 S. Bradley Road, Woodbridge, Conn. 06525); a small spool of #34 beading wire (available in craft shops); small, sharp scissors; an 18-in.-long, $\frac{1}{8}$ -in.-dia. dowel or rod with a dull point on one end; and a bucket of water.

It can take from seven hours to seven days to cane a chair, so set the chair on a table at a comfortable work height. Open the bundle of cane and hang it up so you can remove one strand at a time. Pull out five or six of the longest strands, cut out cracks, brittle black spots and other imperfections, and discard

any strands less than 5 ft. long. Soak the strands in a bucket of water for 10 minutes. Meanwhile, cut several $2\frac{1}{4}$ -in.-long pieces of the beading wire to splice the canes later. With the chair facing you, mark the center of the front seat rail with masking tape, to help locate the pattern.

The first step in the actual caning is to wrap and stretch a straight pattern of cane all running side to side. This provides a warp for the pattern to be woven into from front to back later on. Take one cane from the bucket and dry it off. Note the cane has a shiny, rounded top side that must face up on top of the seat. Insert 10 in. of it, flat and dull side up, through the slot on the outside of the left side rail. Wrap the 10-in. end around the left, front chair leg and temporarily tape it down. Remove any twists in the cane, and begin wrapping and stretching the warp through the slots in the right and left rails, following the sequence shown in figure 2 below. Repeat the process, alternating

wrapping the cane around the rail with stretching it between the rails, moving from front to back. As you run out of cane, refill the bucket so all strands soak at least 10 minutes. You'll form two layers of cane, one at the top of the seat and one at the slots. Do not pull the cane tightly, because it will tighten up as it dries; it should flex 1 in. up or down at the center of the seat. Also, slide the wraps so they're tight against each other on the side rails.

Several strands of cane are needed for the warp, so you need to splice pieces together. When you reach the end of one cane, cut the strand closest to the back approximately $4\frac{1}{2}$ in. in from the inside of the left rail on the bottom of the seat, so your splices will be covered when you weave the seat later. Notch the cane and wrap the splice with wire, as shown in figure 2 below, and continue wrapping. When you have wrapped five or six rows, untape the cane from the front leg and tie it off, as shown in figure 3

Fig. 2: Wrapping the warp

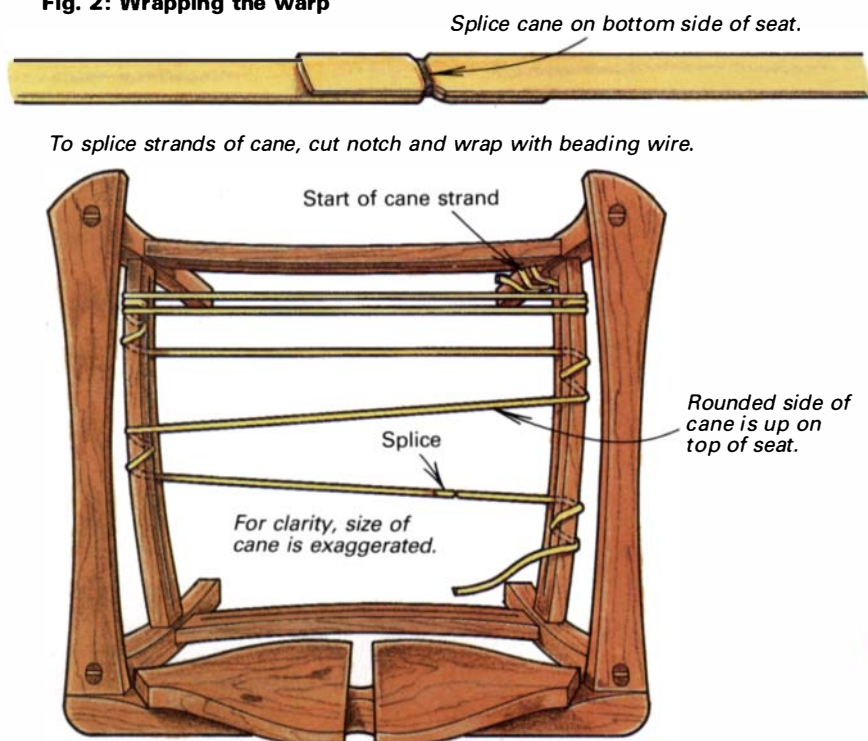


Fig. 3: Tying end of warp

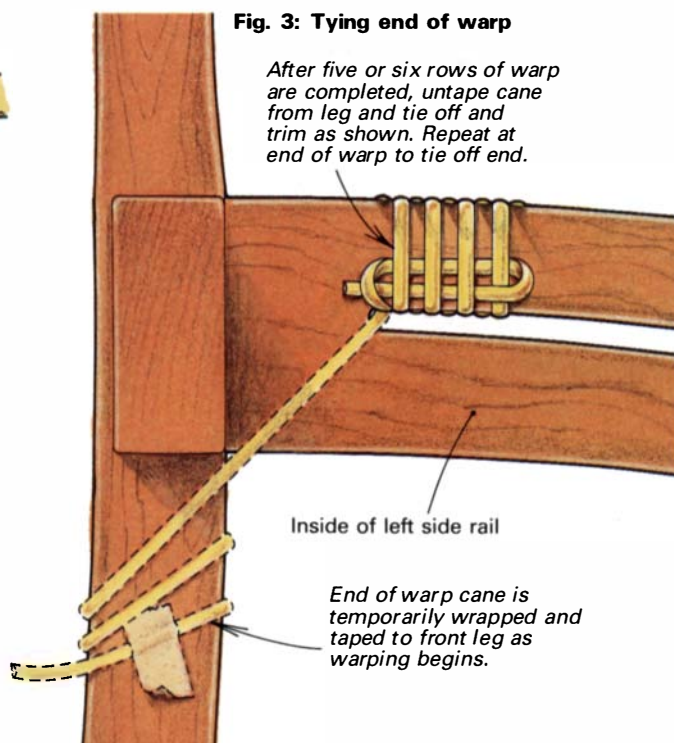
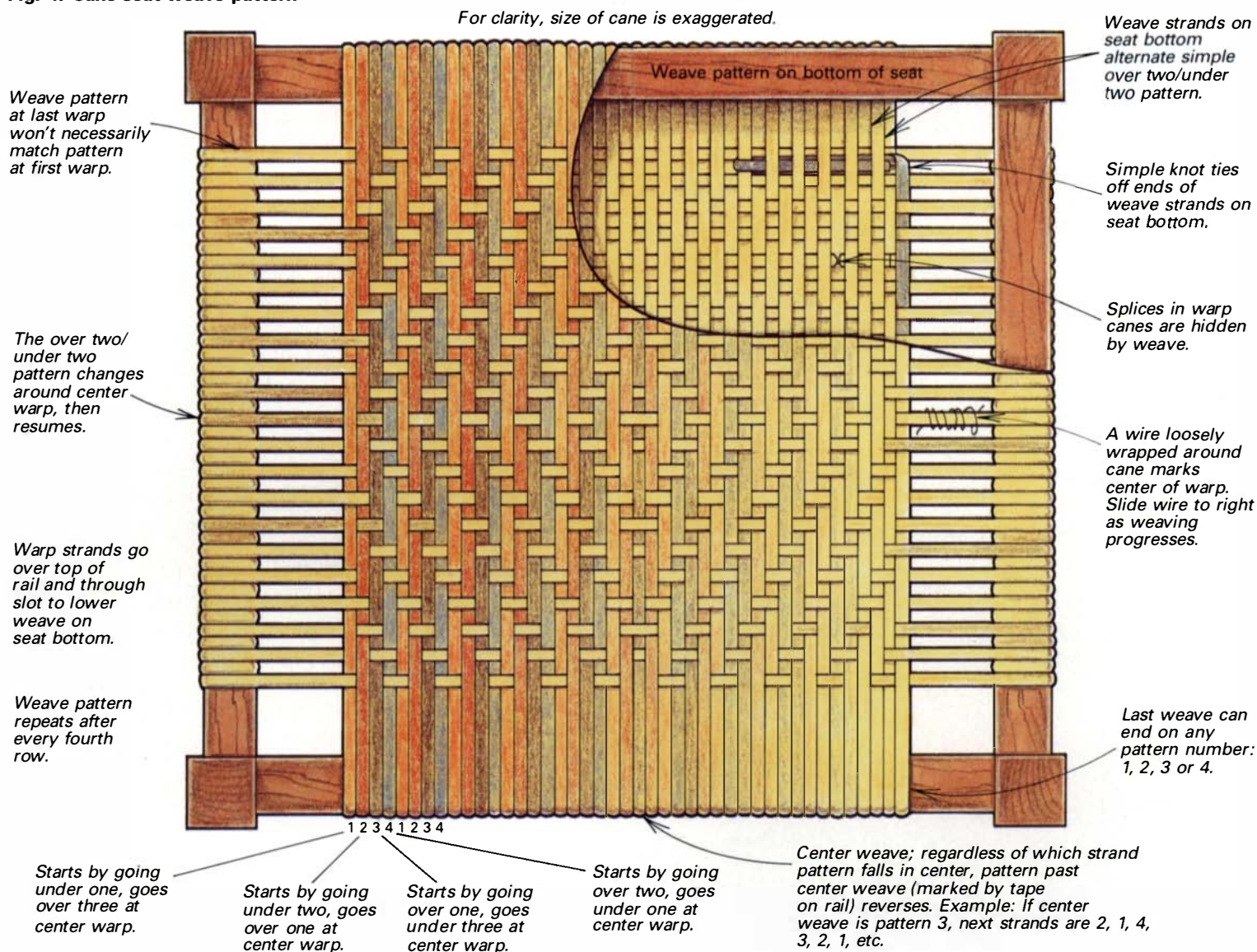


Fig. 4: Cane-seat weave pattern



on the facing page. Continue wrapping and splicing until you have filled the side slots. Check to see that the warp strands are all straight and not too tight. Finally, tie off the end of the last cane as you did the first.

Now rest the chair on a soft surface upside down on its arms, with the back toward you. Due to their growth nodes, you must feel each cane to find the direction it slides easiest in, and weave it in that direction. Insert a cane, rounded side up, through the outside of the slot in the back rail. Weave it through the bottom warp strands, going over two canes, under two, over two, under two, as shown above. Continue weaving toward the front. Pull the cane through the front slot until only 3 in. dangle out at the back rail. Align this first woven cane so it is perfectly straight and in line with the end of the front and back slots on the chair's left side (viewed from the top). Now turn the chair over, with the front facing you. Bring the cane hanging from the front slot over the top of the front rail and begin weaving the top of the seat, following the pattern of row

#1 in figure 4. Depending on the number of warp strands, you may end the weaving going over or under one or two strands at the back of the seat, but that's okay. Wrap the center warp strand loosely with wire, so you can locate it easily and slide it to the right as you work.

Flip the chair over and insert the weaving cane through the outside of the back slot. Now weave the seat's underside in an alternating over-two under-two pattern. Insert the strand through and over the front rail as you did above, pull the woven cane tight and begin weaving row #2. Next, weave the seat bottom, then row #3, seat bottom and row #4. When you reach row #5, repeat pattern #1, and then rows #6, #7 and #8 copy rows #2, #3 and #4 respectively. This pattern continues to the middle of the chair, marked with masking tape. Then you must flip the pattern and reverse the four-row repeat you did on the first half of the seat. Whether the center strand is the same as rows #1, #2, #3 or #4, the strand just right of it follows the weave pat-

tern of the next lower-numbered row.

When a cane runs out, thread a new one in on the seat bottom. Cut off the previous strand two-thirds of the way from the back. Insert a new strand through the front slot, weaving it toward the back so it's woven over and under in the same pattern as the previous strand at least 6 in. past the old strand. Push the new strand up over the old one, overlapping the two. Push the pair tightly together.

As you near the end of the rail slots, the woven canes will be tight and weaving will be difficult. On top of the seat, the 18-in. dowel will ease the weaving process: Slide the tool into the warp, following the correct row pattern, then thread the strand alongside it and pull the tool out. When you're done weaving, tie off the first and last canes under the seat, as shown in figure 4. Remove the center wire and masking tape, and pop the seat with your finger. It should twang—a sign that you can sit down and relax. □

Janet Redfield is a stained-glass artist. She lives in Harborside, Maine.

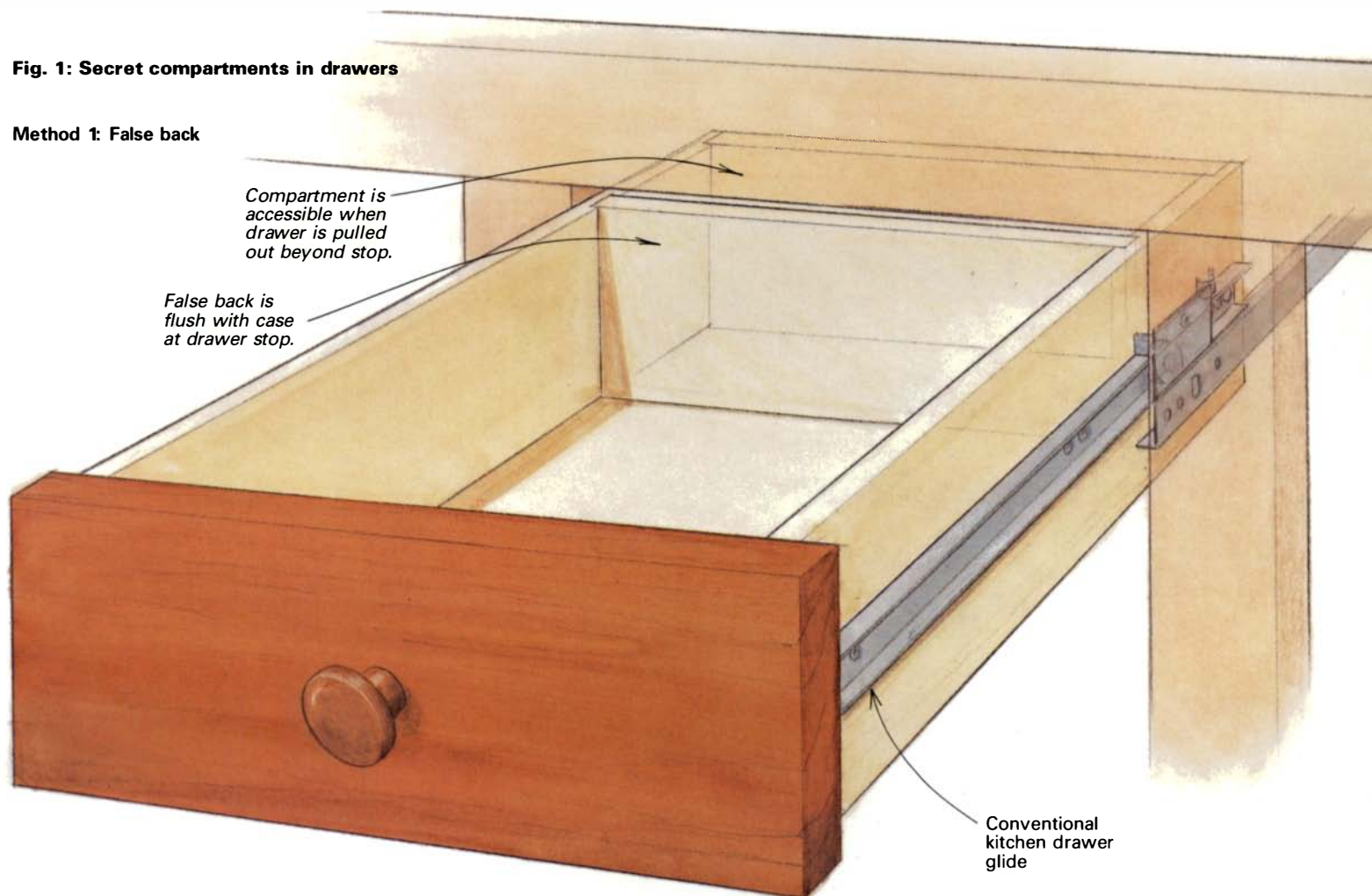
Secret Compartments

A furnituremaker's cache box

by Chris Becksvoort

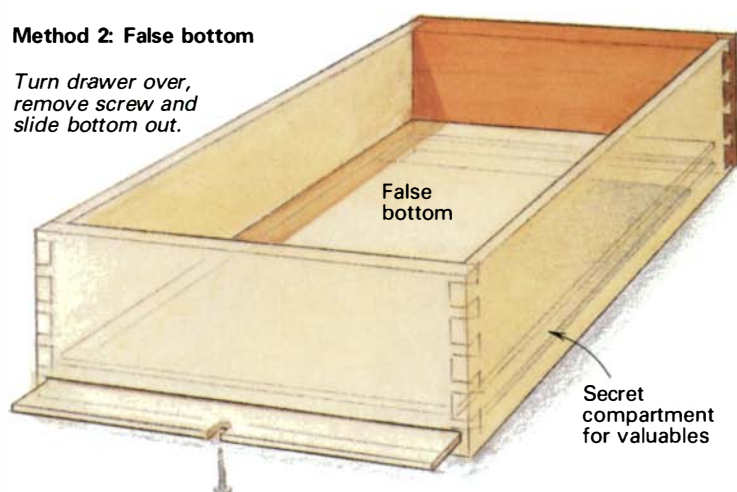
Fig. 1: Secret compartments in drawers

Method 1: False back



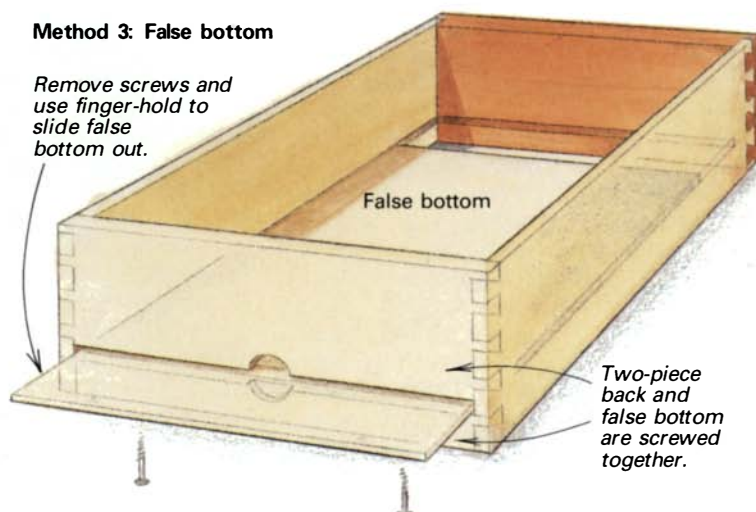
Method 2: False bottom

Turn drawer over, remove screw and slide bottom out.



Method 3: False bottom

Remove screws and use finger-hold to slide false bottom out.



Secret compartments were so common in the days before safety-deposit boxes that they could be considered a hallmark of custom-built furniture. And, because hidden compartments have been popular among the well-to-do since ancient times, craftsmen have had plenty of time to come up with all sorts of hiding places. They can be a simple drawer fit into otherwise wasted space inside a cabinet or complex and imaginative devices based on hollow members, springs, catches and sliding panels—anything to fool the eye. Secret compartments are often commissioned for a specific purpose, such as hiding coins, jewelry, precious documents or pictures; sometimes they are the furnituremaker's whimsical secret, unbeknownst to the customer until the piece is delivered.

These surprise compartments are my favorites. They allow me the most leeway in placement, size and construction; in addition, the customer feels like the recipient of a gift—an unexpected bonus. It also seems only right that a hidden compartment should be a secret shared only by the furnituremaker and the furniture's owner. Let's face it, a hidden compartment advertised in *The New Yorker* is no secret by anyone's standards, but merely a sales gimmick.

Some types of furniture lend themselves better to hidden compartments than others. The best are case pieces with drawers and desks with pigeonholes. But tables, beds, clocks and even lamps can be adapted to contain these intriguing tricks of the trade. I'll describe some of those I've used in my own work or seen in other pieces of furniture. These examples are only a few of the possibilities: There are many others, from the extremely simple to the clever and complicated. The next time you're designing a piece, take a little extra time to examine how you can utilize any wasted space in the furniture. You'll be amazed at how thrilled your customers will be.

Drawers—Years ago while working on a kitchen, it occurred to me that most drawer glides, except the full-extension models, leave the back 4 in. of the drawer essentially inaccessible. So I ran a cross-grain dado 3½ in. from the back end on each drawer side and inserted a side-to-side divider. When the drawer is pulled out to the stop, as shown in method 1 on the facing page, the false back is flush with the case. When the glide stops are released, the drawer can be pulled out to access the long narrow compartment beyond the false back. This area is good for storing seldom-used utensils or those that have always disappeared when you need them most.

One of the best methods for hiding photos, documents or other flat objects is a double-bottom drawer. If the compartment between the bottoms is kept as thin as possible, it is virtually undetectable, but the trick in this, as well as in other methods, is not to get greedy. If you pull out a 6-in. drawer and discover only 3 in. of

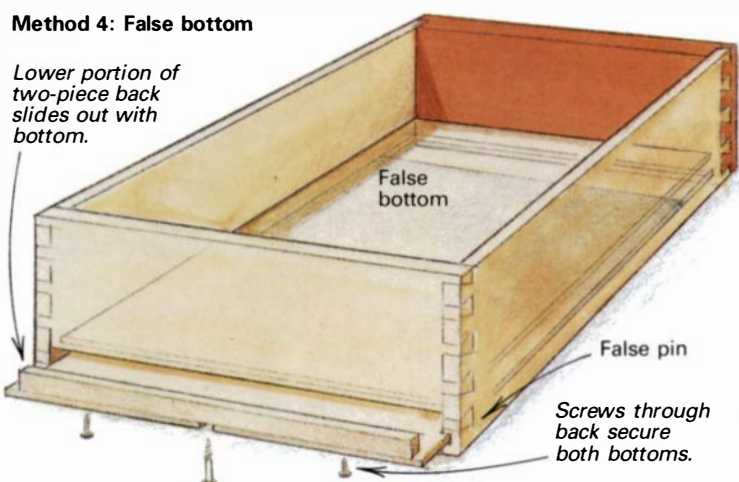
space inside, something appears amiss—you are not fooling anyone. On the other hand, you can probably get away with a 2-in. compartment in a 12-in.- or 14-in.-deep drawer.

The bottoms of my drawers are slid from the back into grooves in the drawer sides. To create a secret compartment, I run parallel grooves on the insides of the drawer sides and front, ½ in. to 1 in. apart. The back only gets the upper groove, because the actual bottom is slid underneath it and held in place with a screw. When the drawer is assembled, the false bottom is captured in the four upper grooves. The real bottom can be slid in and out to get to the hidden compartment (see method 2 on the facing page). An alternative method is shown in method 3. The two-piece back with a recessed finger-hold allows the false bottom to be slid out. Although the spaces created by these double bottoms are not easily detectable, they are bothersome to get to, because the contents of the drawer must be removed. In the first case, the drawer must be turned upside down to place anything into the compartment; in the second case, the false bottom, which is acting as the drawer bottom, must be removed. To avoid having to empty the drawer, you could use the two-piece back method, but attach the lower section of the back to the actual bottom of the drawer so they both slide out together, forming a tray, as shown in method 4 below. Taking this a step further, you could put sides all around this tray and create a minidrawer.

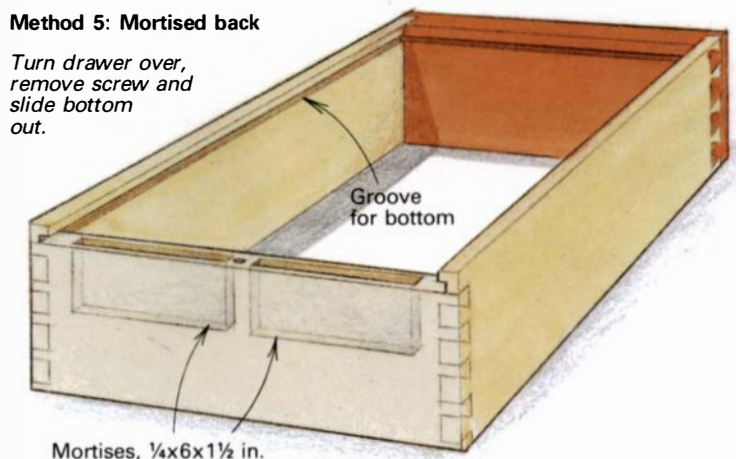
The traditional construction of a chest of drawers presents another opportunity for hidden compartments. Visualize for a moment the interior of an average case piece with drawers and a face frame. On such pieces, there is often unused space behind the face-frame members, both between the case side and the drawers and between the drawers themselves. This space can be utilized by simply building narrow wooden boxes to fit into these locations. These boxes are totally hidden unless someone removes the drawers to look inside the case. Even if the divider strip between the drawers is only 1 in. wide, a flat box with ¼-in.-thick sides still yields about ¾ in. of usable interior space. Any number of methods can be employed to secure the box: magnets, dowels, ledger strips, inset spinners or sliding pins.

Some time ago, I was commissioned to build a chest of drawers that required a very well-hidden compartment for 10 gold coins. The usual false bottoms or boxes hidden in the case itself might be discovered. Security was the primary concern; access was secondary. I finally devised an "invisible" compartment, built the piece and delivered it. I told the owner it was up to him to find the compartment. He paid. I left. A few days later, he called to confess he still had not found the secret compartment. He had removed all the drawers and gone over the entire inside of the case with a mirror, a magnet and a fine-tooth comb to no avail. I told him to

Method 4: False bottom



Method 5: Mortised back



take out the middle drawer, turn it over, remove the screw holding the bottom, slide out the bottom and look. The drawer back was partially hollow. With a horizontal mortiser, I had made two $\frac{1}{4} \times 6 \times 1\frac{1}{2}$ -in. slots in the bottom edge of the drawer back, one on each side of the screw hole. The coins could then be wrapped in felt or tissue to keep them from rattling. With the bottom replaced, there is no reason to suspect the hiding place (see method 5 at the bottom of the previous page).

Desks—In addition to the drawer methods, desks lend themselves to a host of different hidden compartments. I've always suspected that pigeonholes in roll-top and slant-top desks were originally conceived by cabinetmakers to allow themselves room to play with these ideas. Everyone has seen a slant-top desk with two fluted half-columns that pull out and are actually narrow drawers. These are practically institutions, and not secret by any means (at least not now). Another common method often found in the pigeonholes of slant-top desks is a thin drawer behind the molding or scalloped fascia above the pigeonholes. These parts either pull out like drawers or hang on hooks, clips or magnets. Roll-top desks sometimes have small corner brackets in the pigeonholes that pull out to reveal a tray just big enough to hide two, always elusive, pencils.

Pigeonholes, letter slots or compartments with doors are also ideal locations for false backs. A compartment behind a false back is not readily apparent if it is not too deep, especially if the surrounding areas are filled with books or papers. The created space can be reached either from the front, by reaching in and removing a part of the back panel, or through a removable panel near the back of one of the vertical dividers, as shown in figure 2A below. Either way, the access panel should be as unobtrusive as possible. I've used several methods with either hinged doors or loose panels. One of my favorite devices is the magnetic-touch latch, a boon for makers of secret compartments: Just push on the panel, and it pops right out. For a hinged door, one latch will suffice; for a

loose panel, two, with doorstops, should be used. Panels and doors should fit as tightly as possible without binding.

An alternative to the touch latch is illustrated in figure 2B below. In this method, the panel is made as wide as the opening, but $\frac{1}{4}$ in. taller, with a discreet fingernail catch incised with a gouge on the front of the panel. The panel is lifted into the $\frac{5}{16}$ -in.-deep upper groove, pushed into place and dropped into the $\frac{1}{8}$ -in.-deep bottom groove. Because of the shallow bottom groove, the panel is still held in place above.

Whenever possible, access to the hidden area on desks or other large pieces should be from the front, sides or interior of the piece. Only once have I run across a compartment reached through a hinged door in the back. This entails moving the piece away from the wall to gain access, which is not only difficult, but in the case of a full bookcase or large wardrobe, almost impossible.

Hollow posts—Another traditional hiding place, somewhat reminiscent of Bat Masterson's cane, is the hollowed-out post. The hollows usually consist of drilled-out holes, which limit the amount and type of storage space available. On the other hand, you would be surprised at how many \$20 bills can be rolled up and slid into a $1\frac{1}{2}$ -in.-dia. hole. If coins are to be hidden, it's best to tailor the hole to accept a plastic vial, which is easier to remove than loose coins.

Turned posts are generally much easier to work with than square ones, because the cap for the compartment can join the post in an inconspicuous place. The underside of a ball or ring, or a scribe line is perfect for this. The bedpost in figure 3 below shows how convenient a finial is for capping a hollowed-out post. To make this sort of secret compartment, I turn the post as I normally would, but I allow $\frac{1}{2}$ in. to 1 in. of extra length for the tenon, which I turn directly below the portion of the post that will become the removable cap. This tenon's diameter must match one of your drill bits so the cap will fit snugly into the hollowed-out compartment you will drill in the post. When I've turned the tenon

Fig. 2: Removable panels (behind pigeonholes)

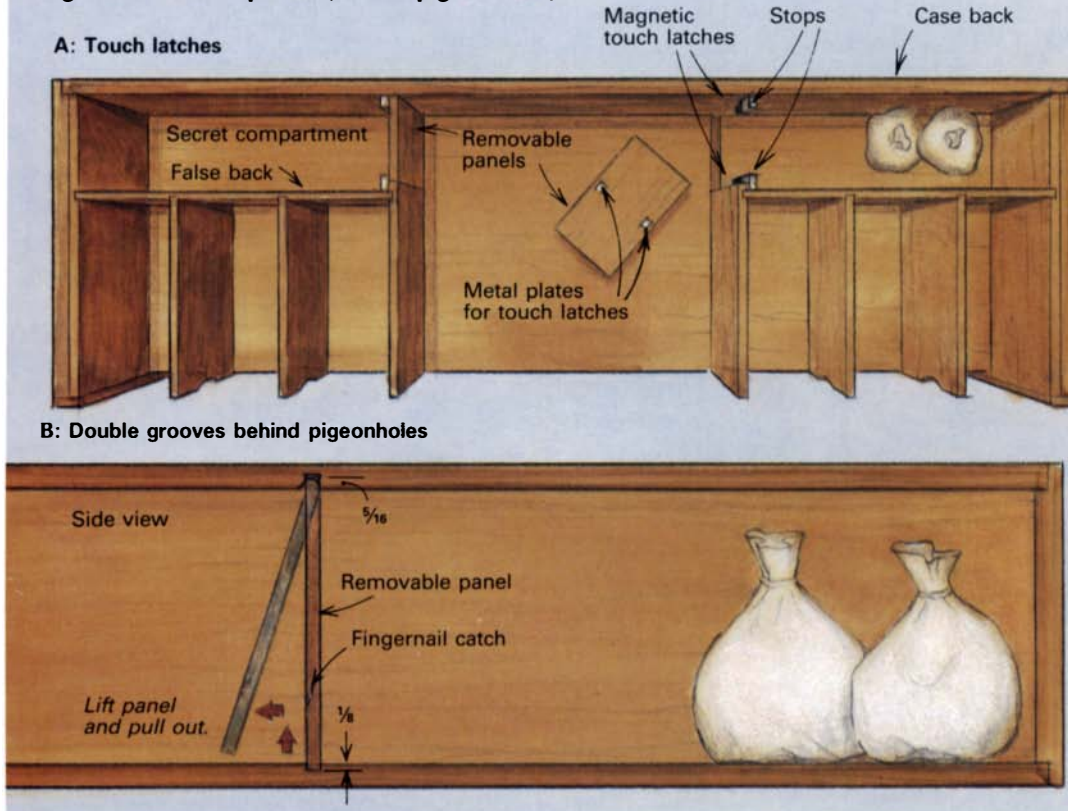


Fig. 3: Hollow post

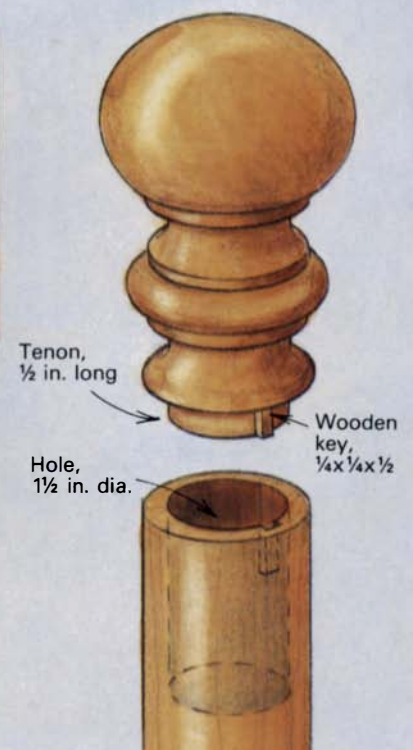
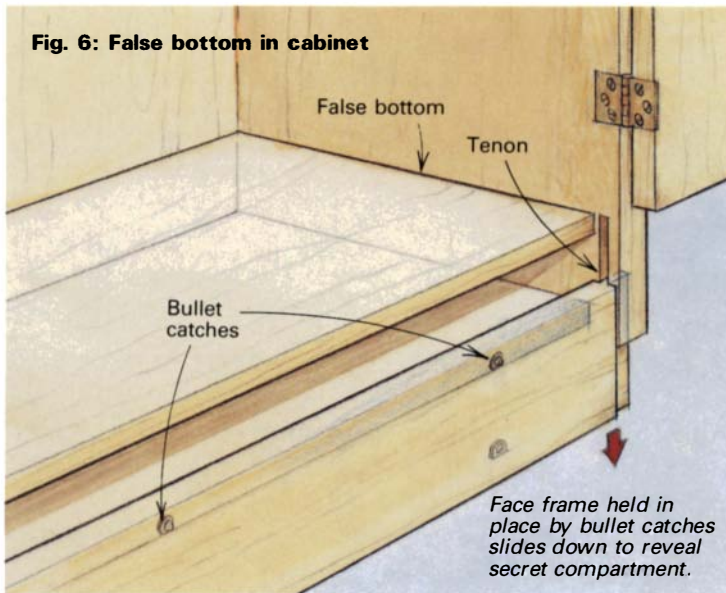


Fig. 6: False bottom in cabinet



slid into place. The loose center section could now be pushed up with the fingertips, yet it could not fall through, because it rested on the dividers and the two ribs (these also kept the trap-door from warping). The panel was virtually invisible, because the end-grain cuts were above the dividers. And, because the panel was only a shaving thickness narrower than the opening, the long-grain gaps were nearly impossible to see. This method could be used in false bottoms if the cross-grain cuts were angled to keep the panel from falling through and if the ribs, screwed to the underside of the loose portion to resist warping, were shorter than the width of the panel.

Figure 6, left, shows an example of a false bottom in a wall-hung cabinet. In this instance, I merely made the bottom portion of the face frame removable. It slides up and down with a tongue-and-groove arrangement at the ends and is held in place by bullet catches in the bottom.

Christian Becksvoort is a contributing editor at Fine Woodworking and a furnituremaker. He lives in New Gloucester, Maine.

Secret compartments in built-ins

Built-in cabinets allow much greater opportunities for hidden compartments than any freestanding piece. Even something as small as a medicine cabinet in a 4-in.-deep partition can give access to as much or more space than the cabinet itself by using the space between the studs, above and below the cabinet. A full-size cabinet in a knee wall can yield a secret compartment large enough for a person to hide in.

Most built-in bookcases, and even kitchen cabinets, have toe spaces that create a large empty space about 4-in.-deep beneath the bottom of the cabinet. Many times, I've put in loose bottoms, either hinged in the back or merely set on ledger strips all the way around. Whether the cabinet sides are plywood or solid, the bottom must be the same material so wood movement between the sides and bottom is identical, or the loose bottom may be pinched, preventing its removal. The bottom must be as tight as possible to avoid suspicious gaps, yet loose enough to lift out. The trick is lifting this loose bottom with no obvious knobs or finger-holds. Several ways come to mind: a small piece of string, a sheet-metal lifter or even a knob that's screwed into place only when needed. I like to use the seesaw lifter illustrated in figure 7 at right. The only visible clue to this lifting device is a $\frac{5}{32}$ -in.-dia. hole near the front of the bottom for inserting a $\frac{1}{8}$ -in.-dia. dowel to depress the lever and lift the bottom.

When remodeling older houses or adding a room in an attic, there are often large wasted spaces alongside closets and fire-

Fig. 7: Lifter for loose bottom

To access secret compartment, insert dowel, $\frac{1}{8}$ in. dia., into hole and push down to lift loose bottom.

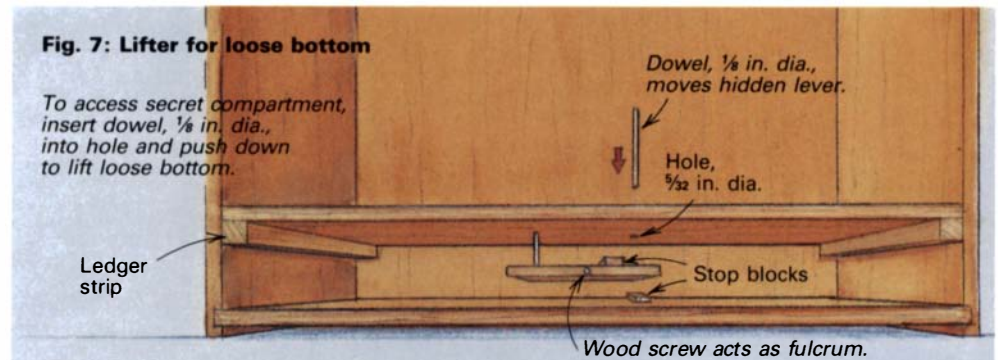
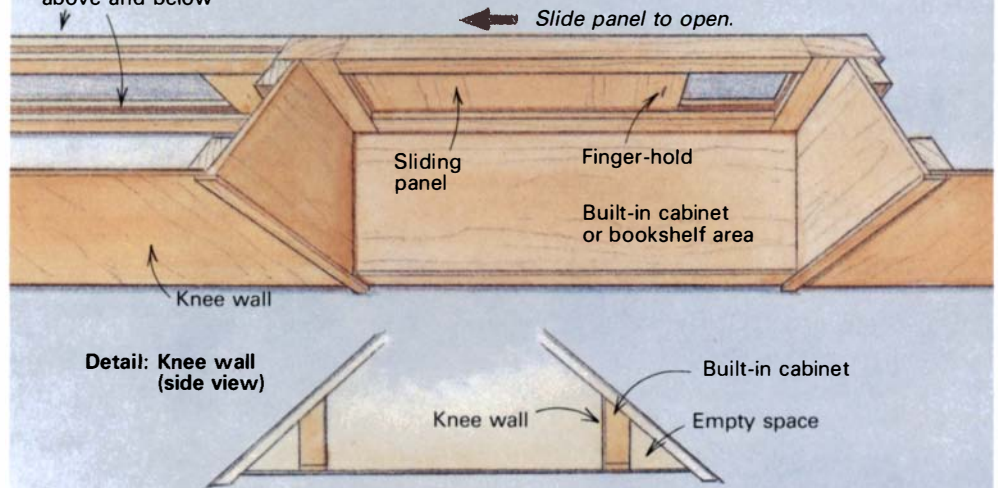


Fig. 8: Sliding panel in knee wall of attic (top view)

Wood track, 1x2x3/4 in., above and below



places or behind attic knee walls where the roof meets the floor. This space can be partially used by installing built-in bookcases or chests of drawers, but these built-ins can also be perfect for concealing access to unused space behind and alongside them. Plywood backs can be hinged and held shut with magnets or with a turn latch attached to a slotted wood screw. I like to use a frame-and-panel back with a flat plywood panel that slides out of the way. The

panel is held in grooves in the frame pieces as usual on three sides, while the fourth side is made so the panel can slide by onto a simple wooden track inside the wall. A simple finger-hold is all that is required to slide the panel, but if you want to really impress, the panel can run on glides and be moved with pulleys and cable.

Be sure to think ahead though, because all this work needs to be done before the unit is ever installed.

—C.B.



Three examples of the author's sliding-lid boxes: The smallest box houses an antique mouth harp. The box is carved and painted—a functional little sculpture. 'The Illustrated Box,' center, has chip carving on its edges and interior. The old man's face creates the illusion of depth. The domino box (7½ x 2¼ x 1¼ in.), right, was the author's first. Its lid is decorated with simple incised carving.

Sliding-Lid Boxes

Hand carved, top to bottom

by John Heatwole

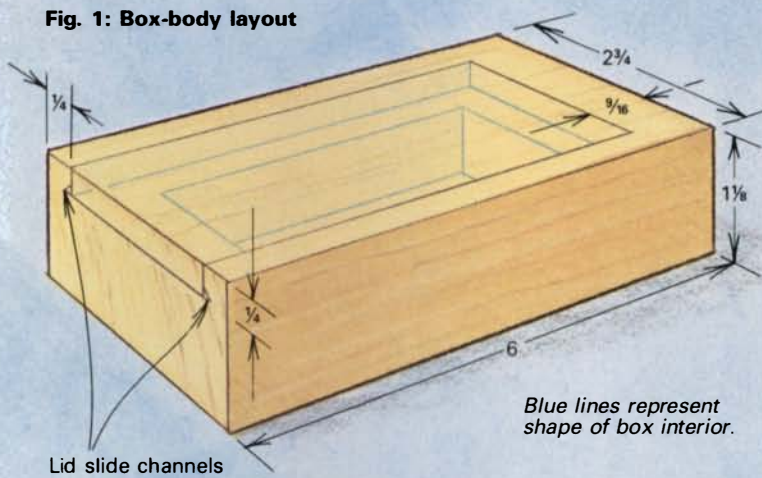
I made my first carved box a number of years ago to house a set of old-bone tavern dominoes. Since that time, I've carved 20 to 30 sliding-lid boxes. I've always worked my boxes out exclusively with hand tools, not because I think this is the only way they should be done, but because handwork has been a tradition in my family for more than 200 years, and I'm very comfortable with it. By roughing out these boxes by hand, I feel I'm in total control, that the tools are an extension of my hands and mind. I love the sound of wood being peeled or carved, and as I work, I can hear the creative wheels turning. Besides, a beginning carver with limited financial means can produce a truly unique item with a very small investment. I've sold many pieces through galleries during my career, and I'm sure the fact that my work is done entirely by hand has not been a disadvantage.

In this article, I will describe how to make a small sliding-lid

box by hand from solid stock. I will show you how to lay out the areas to be carved away, using beveled stop cuts to help preserve crisp edges, and I'll explain how to make the beveled slide channels in the box to receive the lid's runners. If you like, you can add decorative carvings to your boxes, but I'll leave that whole process up to you. I sometimes do figurative carvings in the interiors, as well as on the lids, as you can see from the photos above. Once you've mastered the basics, only your imagination and carving skills will limit what you can do.

Wood selection and tool kit—All the techniques I discuss can be applied to almost any wood. Inexperienced carvers should note that more pressure needs to be applied with harder woods and thus more caution. I recommend basswood, or linden as we call it in my part of the country, for your first few boxes. It is easily

Fig. 1: Box-body layout

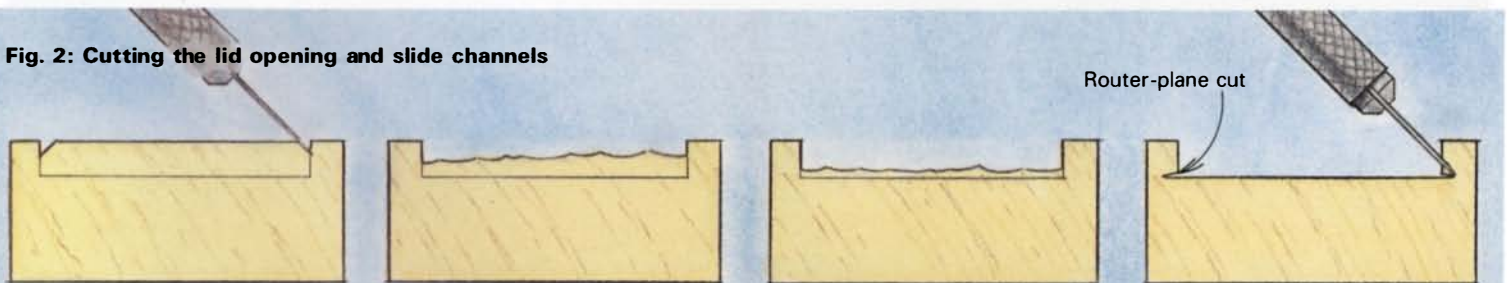


Blue lines represent shape of box interior.



Above left: To make the beveled slide channels, turn the router at an angle and let the point cut into the base of the sidewall about $\frac{1}{8}$ in. Push or pull the router to the front of the box, taking care not to go too deeply and weaken the sidewall. Take the blank out of the vise and draw a line $\frac{3}{32}$ in. up from the lid opening. Above right: With your finger as a guide, cut at a 45° angle along the line to meet the router cut. Repeat this and the router cut until the wedge breaks free. Cut at the rear wall to release the wedge.

Fig. 2: Cutting the lid opening and slide channels



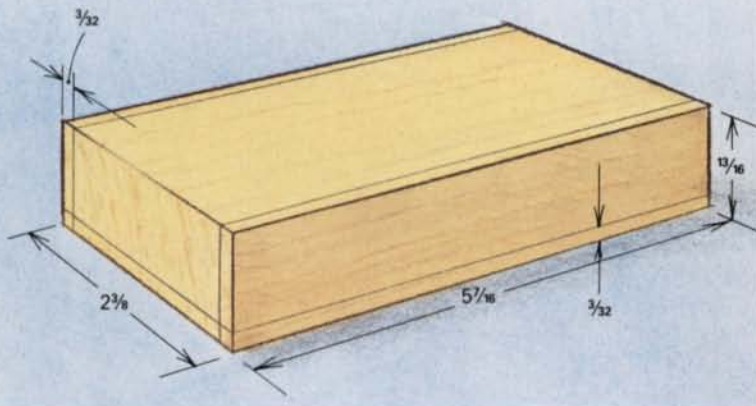
A. To create a stop cut for hollowing out the lid opening, make vertical cuts $\frac{1}{8}$ in. deep on layout lines. Then, make 45° angle cut to meet vertical cuts and remove wedges.

B. Use gouge to remove wood down to stop cuts.

C. Repeat steps A and B to within $\frac{1}{16}$ in. of layout line. Remove waste to line and flatten bottom with triangular blade in router plane.

D. To form the slide channel, make cuts, $\frac{1}{8}$ in. deep, at base of sidewalls with router plane. Holding X-acto knife at a 45° angle, make cuts to meet router cuts, and remove wedge. (See photos above.)

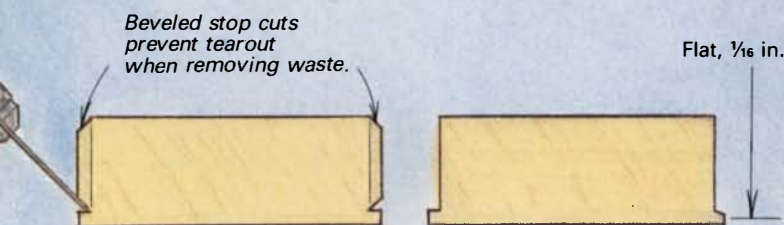
Fig. 3: Lid-blank layout



Pare the wood away from the lid's sides with a 20mm chisel. The beveled stop cuts reduce the chance of tearout beyond the line. When this wood is removed, the runners along the bottom of the lid will remain. Choke up on the chisel, as shown below, so if the chisel slips, your hand will hit the block before the chisel could cause injury.



Fig. 4: Cutting the lid



A. Bevel top edges along layout lines. Cut $\frac{1}{8}$ in. deep along lines on edges, cut down to them at 45° angle and remove wedges.

B. Remove waste with chisel (see photo at right). Pare runners at 45° angle, leaving $\frac{1}{16}$ in. flat at bottom edge.

Flat, $\frac{1}{16}$ in.

worked but will maintain a crisp, strong edge, even in the small dimensions of the lid's runners. Basswood also takes stains and colors well. The following are the only tools you need: miter box, pencil, X-Acto knife with a #24 blade or a 6mm skew chisel (I've come to prefer the X-Acto knife for scoring lines because of its razor-sharp blade), 11mm straight gouge with a medium deep sweep, 20mm straight chisel, 8mm straight chisel, hand router-plane with triangular blade, and 150- and 220-grit sandpaper.

I begin by having a local cabinet shop mill two pieces of basswood, each about 3 ft. long. From these, I can make half a dozen boxes. The piece for the box body is $2\frac{3}{4}$ in. wide and $1\frac{1}{8}$ in. thick. The piece for the lid is $2\frac{3}{8}$ in. wide and $1\frac{1}{16}$ in. thick. The lid stock should be as thick as the depth of the lid opening ($\frac{1}{4}$ in.) for a flush fit, or thicker if you plan to do a high- or low-relief carving. The lid for the box discussed here is $1\frac{1}{16}$ in. thick to allow for a high-relief carving.

Carving out the lid opening—Using the miter box, cut a 6-in. blank for the body from the $1\frac{1}{8}$ -in. stock. Lay out the lid opening by drawing lines on top of the blank (see figure 1 on the facing page). I draw the lines freehand, using my finger as a guide along the edge of the blank. The shoulders should be $\frac{1}{4}$ in. thick and as deep. The rear wall of the box should be $\frac{9}{16}$ in. thick. I sometimes leave the rear wall even thicker, say $\frac{7}{8}$ in., so I can trim the corners and make the box into an oval after I've fitted the lid. If the front of the box is to be rounded, it must be done after the lid is in place, because the lid must also be shaped.

After laying out the opening, remove all the wood to a depth of $\frac{1}{4}$ in. between the shoulders and the rear wall. Clamp the blank in a vise, and with your X-Acto knife and a steady hand, score along the lines to a depth of about $\frac{1}{8}$ in. Holding the knife at a 45° angle, make cuts $\frac{1}{8}$ in. in from these lines and remove a wedge the full length of the cuts (see figure 2A on the facing page). These grooves act as stop cuts when you hollow out the lid opening. Now, take the 11mm gouge and make a series of cuts between the grooves. I usually pare the ridges left by the gouge with a 20mm flat chisel and then repeat the gouging and paring, down to a depth of about $\frac{3}{16}$ in. Take special care not to cut into the shoulders and rear wall; this is why the stop cuts were made. With a triangular blade in the router plane set to a depth of $\frac{1}{4}$ in., clean out any remaining chisel marks and take the lid opening the rest of the way down so you have a flat area $\frac{1}{4}$ in. deep.

Now you're ready to cut out the beveled slide channels. Without changing the blade's depth, turn the router to about a 45° angle with the sidewalls, and gently let the point of the router blade cut into the base of a sidewall at the back corner to a depth of about $\frac{1}{8}$ in., as shown in the top, left photo on the facing page. With a light touch, push or pull the router plane to the front of the box, taking care not to cut too deeply and weaken the sidewall. Do this on both sides. Now take the blank from the vise and draw a line $\frac{3}{32}$ in. up from the bottom of the lid opening along the inside of both sidewalls. With the X-Acto knife at a 45° angle, cut along these lines so the blade meets the router cuts (see figure 2D on the facing page); steady your hand by running your fingers along the box's edges, as shown in the top, right photo on the facing page. You might have to repeat this cut and the router cut a couple times before the strip will break free from the slide channels, as shown in the photo. A cut with the X-Acto knife at the back wall will help to break the strip out. Clean up these channels by folding a square of 150-grit sandpaper once or twice and drawing it back and forth in each channel several times. This should be repeated with the 220-grit sandpaper, to make the channels smoother and thus easier for the lid to slide in.

The sliding lid—The lids in old sliding-lid boxes are often warped, probably because these boxes were used almost exclusively as containers in shops and barns, where they were exposed to extreme temperature and moisture changes. Boxes used as household containers or conversation pieces, however, are not likely to warp, if the wood has been kiln dried or sufficiently air dried.

From the $2\frac{3}{8}$ -in. by $1\frac{1}{16}$ -in. stock, cut a piece $5\frac{7}{16}$ in. long on the miter box. I always leave the lid about $\frac{1}{16}$ in. too long, in case I need to trim a little for a better fit against the rear wall. Figure 3 on the facing page shows the layout lines for the wood to be removed to create the two narrow, beveled runners. The lines on the top are $\frac{3}{32}$ in. in from both long edges and extend down each end. The lines on each edge are $\frac{3}{32}$ in. up from the bottom and extend around the corners to meet the lines on the ends. With the X-Acto knife, make a cut along the bottom line on both edges and a 45° cut to meet these lines. Remove the wedges. Also, bevel the top corners along the layout lines at a 45° angle, as shown in figure 4A. Pare away the waste by eye with the 20mm straight chisel, as shown in photo at the bottom of the facing page. Finally, bevel the runners with the 8mm straight chisel tilted at a 45° angle away from the stock, leaving a scant $\frac{1}{16}$ in. of flat on the long edge (see figure 4B). I choke up on the chisel and hold the lid blank so if the chisel slips, the heel of my hand will bump the end of the blank before I could cut myself.

Now, try the lid to the lid opening on the box blank. If it won't slide in easily, the lid is probably too wide or the runners are too thick. If the lid is too wide, sand both runners back and forth on a piece of 150-grit sandpaper flat on the workbench until it fits. If the lid fits, but is tight, fold a piece of 150-grit sandpaper and sand the bevels of the runners a few times, trying the lid until the runners slide in the channels easily. The lid should not fall out by itself, but it should move without requiring much pressure. Keep in mind that a wax finish on the boxes will make the fit a little more snug.

Hollowing out the box cavity—Once you have a box blank with a nicely fitting lid, you can hollow out the box interior. For a standard, straight-wall box, I proceed as I did with the lid opening. I mark out the area to be removed, score the lines and make stop cuts. Then I use a gouge to take away most of the waste wood and flatten the bottom with the router, leaving the bottom about $\frac{3}{16}$ in. thick. Be careful not to round over the top edge of the box cavity or the lid opening by levering the back of the gouge on them as you work. To keep the walls straight and vertical, it helps to repeat the scoring, gouging and routing process several times as you go deeper.

As an alternative to hollowing the whole box, you can also lay out an oval, two circles or a combination of shapes, gouge them out to a depth of $\frac{1}{2}$ in. or $\frac{3}{8}$ in. and smooth them with sandpaper. It may look like you don't have enough room for your jewelry, special stones or whatever with this type of depression, but try your object first to see if it fits before you gouge too deeply.

The photos of the finished boxes on p. 47 reflect several variations: straight walls utilizing the whole area below the lid opening, as in the domino box; a carved recess, custom fitted for a mouth harp; and an egg-shape recess smoothed and painted in the interior of "The Illustrated Box."

Any hand-rubbed oil finish, such as Watco or Tung oil, will work fine on these boxes. I sometimes add a final coat of hard paste wax. If you want to add color to your box, refer to my article in *FWW* #63 for staining and painting methods. □

John Heatwole is a professional sculptor living in Bridgewater, Va. The Delaware Art Museum selected his wood sculpture "Crawdadd" as the first piece for its new American Fantasy Art collection.



Modern scroll saws are more than just hobby machines. They can do a wide variety of sawing jobs, from cutting delicate marquetry patterns in thin veneers to sawing fretwork in thick hardwood.

The saws, from left to right, are the Hegner Multimax 2, Lancaster Machine Co.'s Pro-Cut 20 in., RBI's Hawk 220 and Delta's 18-in. Electronic. The stand is optional with the Pro-Cut.



The scroll saws from left to right include Excalibur's Excalibur II, Strong Tool's 2015, American Machinery Sales' Superscroll 18 and

Penn State Industries' Super 15. The Strong 2015 is shown without its bolt-together stand, which does come with the saw.

Testing Scroll Saws

Smooth and precise cuts, even in thick stock

by Greg Bover

I had always been a little skeptical of scroll saws. They seemed to be designed more for hobbyists cutting out whirlygigs and knickknacks rather than for the needs of a professional shop. Although our pipe-organ building company, C.B. Fisk Inc., had used a 1940's Boice Crane scroll saw to cut curves smaller than our bandsaws could handle, the saw never cut thick hardwood well. Consequently, it mostly sat and gathered dust.

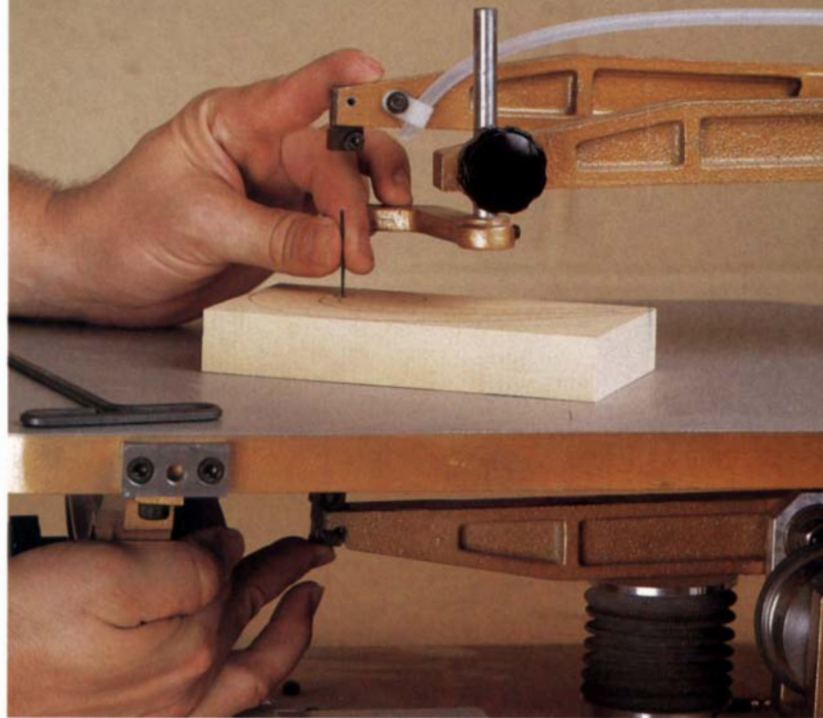
But when I saw a guy at a woodworking trade show last year cut names out of 8/4 oak, I began to think that modern scroll saws were more than just toys. They seemed capable of doing difficult, precise work, cutting tight-radius scroll work in thick hardwoods smoothly enough that the sawn surfaces were ready to finish with only light sanding. While pricing a few scroll saws, I discovered that there are vastly differing prices between various makes and models with seemingly similar capacities and features. To determine how the scroll saws differ and how a modern scroll saw would work in our shop, we picked eight scroll saws, ranging in price from \$129 to slightly more than \$1,000, and tested them over a period of several months. Our observations and opinions are stated below, and a chart of specifications for the eight models is located on p. 53. But first, let's look at how modern scroll saws work.

Saw anatomy—The tool itself is pretty simple. Basically, it's nothing more than a stationary table with a thin blade coming up through the center, secured by arms at top and bottom. To make the blade cut, the arms move up and down in a reciprocating motion, or stroke. The arms are driven by an eccentric shaft (or gear drive on some saws) powered by an electric motor. On all modern scroll saws, the blade is attached to both arms and kept in constant tension. On older, rigid arm designs, like our Boice Crane, the top of the blade is attached to a spring, which doesn't provide the same constant blade tension throughout the stroke. The constant-tension design allows the perpetually taut blade to cut tight-radius curves in thick wood without excessive flexing, which would cause a low-tension blade to break or bow in the cut.

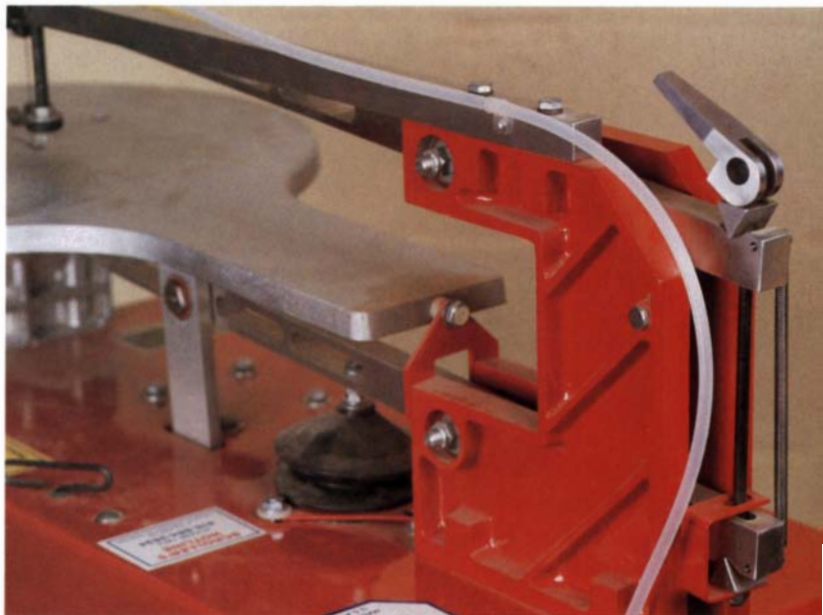
Because the blades are under constant tension and don't flex very much, scroll saws can use very thin blades, like jewelry-saw blades, as small as .010 in. thick and .022 in. wide. These small blades allow delicate cuts for fretwork patterns; the thin-blade kerf makes the scroll saw perfect for cutting marquetry patterns in veneer or for sawing out jigsaw puzzle pieces that fit tightly together. Because the blades can be quickly removed from the clamps on the ends of the arms, it's easy to replace a blade or insert it through a small hole drilled in the middle of a piece, for doing fretwork or cutting out a marquetry background (see top photo this page). Compared to most other woodworking machinery, the scroll saw is quite safe to use: The teeth on the blade are fine and don't cut very aggressively.

Although the saws look similar, the eight models we tested can be divided into two basic types based on the design of their arms. Most saws employ the parallel-arm design: The two arms pivot independently, and only the lower one is powered. The blade is secured to both top and bottom arms via blade clamps, and a knob on a threaded rod connecting the back ends of the arms is tightened to tension the blade (see bottom photo this page). The main advantage with the parallel-arm design is that by pivoting both arms, the blade stays almost perpendicular to the saw table throughout its stroke, for a square cut in tight curves with little blade flexing. If the blade breaks, the upper, nonpowered arm stops running (the exception is the Excalibur, see below), and the broken end of the blade won't stab the top of the workpiece, or your finger—another advantage.

On the other hand, C-frame saws, like the Delta and Superscroll 18, hold the blade between the points of a deep, C-shape casting



By drilling a hole in the workpiece and threading the blade through before tightening the blade clamps, the scroll saw can cut out patterns in the middle of a panel, handy for fretwork or marquetry. As shown above, the removable bottom blade clamp on the Strong 2015 is held with a finger while the upper arm is brought into position; the blade is then aligned in the clamp and tightened.



The rear casting on a parallel-arm scroll saw, like the RBI Hawk 220 shown here, houses the pivot bearings for the two arms and supports the saw's hold-down arm. The threaded rod and hand knob at the back of the arms tensions the blade during the cut and must be released before blades are changed.

that rotates up and down in a short arc. Because both arms are part of the same casting and are not independently pivoting, as on the parallel-arm scroll saws, the blade is tensioned with an eccentric cam or hand screw that pulls up on the upper blade holder. The disadvantage of this design is that the blade moves through an arc rather than straight up and down, which can strain the blade when cutting tight corners in thick stock. Also, because both arms are driven during the stroke, a broken blade will continue to stab the workpiece until the saw is turned off.

Testing eight models—Most of the saws arrived at our shop in time to help us rough out a lot of Gothic tracery for our Opus 92—



The tables on most scroll saws tilt, allowing beveled cuts to be made. Here, the table on the Delta is tilted to 45°, revealing the two trunnions that support the table, as well as the stop bolt that accurately references the table when it's returned to square.

a large pipe organ we built for The Church of the Transfiguration in Manhattan, N.Y. The tracery, which provides the grillwork around the tops of the organ's facade, had to be cut out of 4/4 and 6/4 white oak. We broke blades left and right until we got used to the machines. Of course, we learned a lot about changing blades, and as we got the hang of running the saws, we began to understand their individual merits and shortcomings. Before getting into specifics, here are some general observations from our work with the saws:

All eight saws worked reasonably well, cutting tracery in thick oak or fretwork in thin stock, regardless of whether the saws were of aluminum or cast-iron construction. However, we found that the heavier machines with cast-iron frames and tables, like the Delta and Superscroll 18, vibrated less and thus felt more solid and were more pleasant to use. This is important, because the vibration caused by the saw's reciprocating action can be distracting, especially when turning a thin piece constantly to cut a delicate pattern. Heavy, well-braced stands increase a saw's stability, and three-legged stands, like the Delta's and Hegner's, don't rock even on an uneven floor. For lighter machines or ones without stands, good performance can be had by bolting the saw to a heavy workbench. Although most scroll-saw tables are flat, they tend to be fairly rough; therefore, they must be smoothed with a block and 320-grit or 400-grit silicone carbide paper, then waxed before workpieces can be turned freely. The tables also tilt for beveled cuts, as shown in the photo above, but few of the saws tilt 45° to both the left and the right, which is necessary for cutting dovetail pins.

Despite the the manufacturers' advertisements, power isn't much of an issue with a scroll saw, because the blade always breaks before the motor strains. Because of this, saws with even the smallest motors aren't underpowered. Further, we found speed-change pulleys and control devices unnecessary for most woodworking: It's best to run the machines at full speed, except when cutting thin veneers or metal. High speeds generally produce smoother cuts, except when cutting tight curves, which may cause the blade to burn. All the saws feature built-in blower systems designed to clear sawdust from the workpiece, and most of them blew away enough dust to let us see where we were cutting.

Although we assumed the blade on a parallel-arm saw is supposed to move straight up and down during cutting, we found that the blades on most of these saws move slightly forward and backward, as well as up and down. Saws with blades that move forward on the downstroke, like the Hegner and the Hawk, proved best,

because they cut more aggressively and saved the blade from wear by moving slightly backward and clearing the cut on the upstroke. The blades on the Excalibur and Strong 2015 scroll saws actually move slightly backward on the downstroke and forward on the upstroke—the opposite of the optimum blade movement.

Most saws have blade clamps that will accept any 5-in.-long blade, from #2/0 to #12, and some can even clamp a cardboard emery board for sanding. The blades that came with the saws all performed about the same, but we found that #9 12-t.p.i. blades are best for all-around woodcutting. Any blade is subject to deflection from the pressure of cutting, especially in thick hardwoods. Therefore, a blade clamp that allows the blade to flex freely over its entire length rather than at just the clamp points is better for smooth cuts and longer blade life. The machines with pivoting clamps, like the Hegner, Delta and Superscroll 18, had the least blade breakage.

Generally, we felt all the machines were safe to operate. The hold-down arms featured on all the saws tested offer some protection from the blade and are useful for keeping tiny workpieces from jumping around during a cut. For most cuts, the work can be controlled by pushing down and in at about 45°. It's also worth noting that the thickness-cutting capacity of most saws with their hold-downs in place is less than what manufacturers state in their literature.

Delta Electronic—The Delta saw, manufactured by Delta International Machinery Corp. (call 800-438-2486, or 2487 in Pennsylvania, for a local distributor), is built like a battleship, with its heavy cast-iron frame. We set the saw up in about 45 minutes, and once assembled, the Delta was clearly the most ruggedly built saw in our review. Its round cast-iron table is supported by two trunnions, and a built-in 90° stop makes squaring the table to the blade quick and positive. The saw vibrated very little, even when we cut 8/4 material.

The blade tension lock/release and adjustment knob are on top of the upper arm instead of at the back of the arm, as on the parallel-arm saws, so it's very convenient to reach. Blade change on the Delta is a bit slow, because a pin must be inserted to lock the pivoting blade clamps before their Allen screws can be loosened or tightened. An optional hand screw replaces the Allen screw, making blade changes quicker, but the hand screw gets in the way when the hold-down is raised for deep cuts. The hold-down on the Delta, as well as on the Excalibur and Superscroll 18, is adjustable for bevel cutting. On most other saws, the hold-down must be removed for tilt table work.

The Delta features an electronic speed-control knob and a digital readout, which shows the number of blade strokes per minute (SPM). The knob allows instant speed changes, but the tool's range of 40 SPM to 2,000 SPM was excessive for any work we tried. Because fancy electronic devices are often prone to breakdown, we feel the device is more a gimmick than a bonus for an otherwise fine machine.

Excalibur II—The Excalibur, manufactured by Excalibur Machine & Tool Co. (210 8th St. S., Lewiston, N.Y. 10492), features alloy castings, extruded steel arms and a smoothly surfaced aluminum table. The saw comes without a stand, so it must be bolted to a table or bench. This saw was the hardest to set up: Instructions were sketchy, some hardware was missing and the process took more than three hours. The saw comes motorless, which can save money if there's an old 1,725-RPM motor around with a 5/8-in. shaft to fit the supplied three-step pulley. The motor mount is designed to hang the motor off the back of the saw, and a nice lever arm releases belt tension for speed changes. The cord and switch are supplied, but the switch is on the cord rather than up front on the machine, which can be a problem if the saw needs to be turned off in a hurry.

The Excalibur drives the blade with a "double parallel-link" sys-

SCROLL-SAW TEST

Company and model	List price	Throat depth	Cut † thickness	Motor speed SPM	Stroke length	Arm design	Drive method	Table size	Table tilt left/right	Stand
American Machinery Sales Inc. Superscroll 18	\$387	18 in.	1¾ in.	1,650	¾ in.	C	Direct	8¾ x 17½	45°/0°	No
Delta International Delta Electronic	\$699 \$1,014**	18 in.	1¾ in.	Variable 40 to 2,000	⅞ in.	C	Gear	16 in. dia.	30°/45°	3 leg, bolted
Excalibur Machine & Tool Co. Excalibur II	\$579*	19 in.	1¾ in.	400/800/1,400	¾ in.	P ††	Belt	12 x 17	45°/45°	No
AMI Ltd./Hegner Hegner Multimax 2	\$995**	14½ in.	1¾ in.	1,660	1⅜ in.	P	Direct	9 x 17	45°/0°	3 leg, welded
Lancaster Machinery Co. Pro-Cut 20 in.	\$799	20 in.	2½ in.	800/925/ 1,000/1,160	1 in.	P	Belt & gear	16 in. dia.	45°/45°	Opt. 4 leg, bolted
Penn State Industries Super 15 in.	\$129	15 in.	1¾ in.	1,650	¾ in.	P	Direct	7¾ x 17	45°/0°	No
RBI Industries Hawk 220	\$799**	20 in.	1¾ in.	695/1,110	1⅞ in.	P	Belt & gear	13¾ x 22½	30°/45°	4 leg, bolted
Strong Tool Design Strong 2015 Two Speed	\$999**	20 in.	2 in.	728/1,028	1 in.	P	Belt	13¾ x 22	45°/12°	4 leg, bolted

*, without motor **, stand included †, with hold-down in place ††, both arms powered
SPM = strokes per minute C = C-frame P = parallel arms

tem, powering both the upper and lower arms. Unfortunately, this design makes the Excalibur subject to blade stabbing. Despite this shortcoming, the Excalibur performed well and consistently gave us clean cuts, though its short ¾-in. blade stroke didn't cut fast in thick stock. With the saw mounted to a bench, it was the quietest of all the machines tested. Although the blade clamps don't pivot, the saw wasn't particularly prone to breaking blades, and we judged it the easiest saw to change blades on.

Hegner Multimax 2—The Hegner, imported by AMI Ltd. (2 McCullough Drive, Southgate Industrial Park, Box 312, New Castle, Del. 19720), has a cast-alloy frame and arms, and it was a breeze to put together—a set-up time of only 15 minutes. The saw has an extremely smooth finished alloy table, which we judged the best in the test. Although the table only tilts one way, the trunnions were well machined, and the table locked where it was put without excessive finger pressure on the lock knob. The Hegner runs at 1,660 SPM, the highest speed next to the Delta in the test, and is powered by a direct-drive 1.9-amp AEG motor, with no speed controls. (Hegner has a new line of variable-speed saws that should be on the market by the time this article is in print.) With a #9 blade, the Hegner cut 1½-in.-thick maple well. Its welded tubular-steel stand is heavily braced and stable.

Besides being an all-around well-built saw, the blade clamps on the Hegner had the best design and construction: They allow the blade to pivot freely and make blade changes easy. The Hegner's blade clamps have ⅜-in.-sq. head machine screws that tighten with a large clock-winding type key, an improvement over the small easy-to-strip Allen screws used on the other saws. To make the blade changes even easier, the Hegner has a blade-clamp holder on its table edge that holds and aligns the blade and clamp while they're tightened (see the photo on the next page). An accessory called the "Pierce Pal" allows the blade to be aligned and clamped in the blade holder after it has passed through a hole in the workpiece, for cutting out a pattern in the middle of a panel. Also, because the blade clamps aren't fixed on the arms, one can

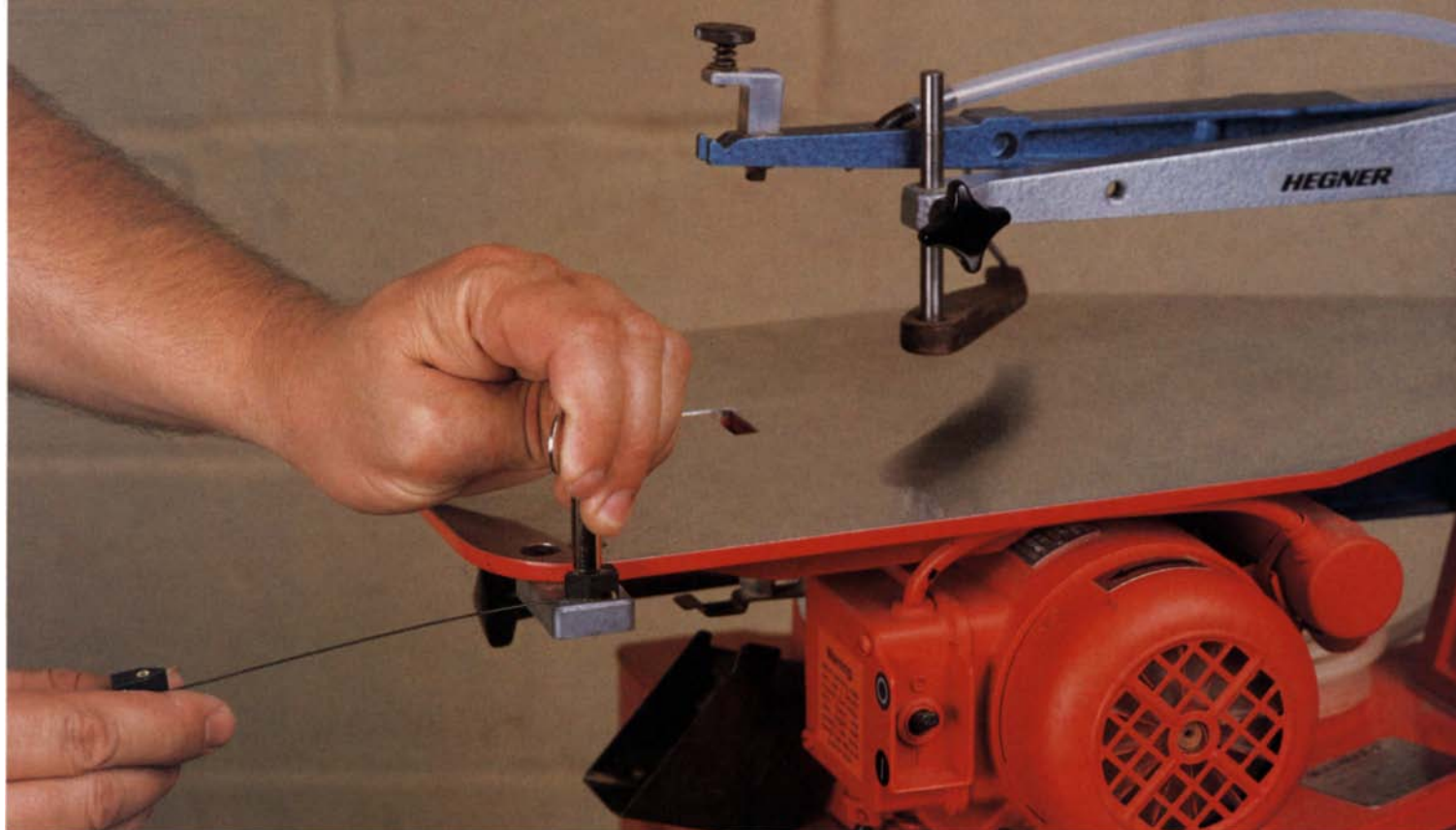
buy several extra pairs. If a blade breaks, just install a new blade already fixed in its clamps. Overall, the Hegner machines (including the larger Polymax 3, which we also tried) are beautifully built and highly favored by our woodworkers.

Pro-Cut 20 in.—This machine, sold by Lancaster Machinery Co. (715 Fountain Ave., Lancaster, Penn. 17601), has cast-alloy arms, frame and table and an optional four-leg stand with braced legs. The saw has a nicely surfaced table that's stabilized by dual trunnions—a sturdy arrangement. The belt-driven machine has a two-step pulley, and changing speeds was very easy, despite the tiny, hard-to-grip thumbscrew on the belt guard. Even with four speeds though, the Pro-Cut's maximum speed of 1,160 SPM seemed slow; we felt the saw would have cut better at a higher speed. The Pro-Cut, as well as the Hawk and the Strong 2015, has a large 20-in. throat capacity, which is useful for cutting out fretwork patterns in large panels.

Blade change is a real ordeal on the Pro-Cut, because the top blade clamp is hidden under a shroud on the upper arm, and a special tool and Allen wrench are needed to set the lower blade clamp. The Pro-Cut comes with a foot pedal on/off switch that plugs into the cord. This feature came in handy a couple of times, but we didn't need to start and stop the saw too often.

Hawk 220—The Hawk, made by RB Industries Inc. (1801 Vine St., Box 369, Harrisonville, Mo. 64701), has a cast-alloy frame and table supported by a sheet-metal stand with four unbraced legs. Although the saw arms are sturdy and appear to be milled from solid bar stock, the saw is light and wobbly, and it vibrated badly. The table tilts 45° both ways, but the trunnions are sloppy, and the table was difficult to lock in place. Despite its pivoting blade clamps, the saw broke more than its share of blades and was prone to burning in the kerf when we cut 1¼-in.-thick oak.

The Hawk has two speeds and a motor that's mounted under the saw, out of the way. Unfortunately, making speed changes becomes difficult, because the motor pulleys are located under the



Besides providing a pivoting blade clamp that prevents blade breakage by allowing a blade to flex during cutting, the Hegner has a built-in holder that supports and aligns a blade in the clamp while it's tightened in place.

saw. Two different length V-belts are required, one for each saw speed pulley. Blade change requires a special rod and an Allen wrench to secure the pivoting top blade clamp. The blade tensioning/release adjustment features a convenient cam lock that takes only a flick to engage or loosen for blade changes.

Strong 2015 Two Speed—This saw, made by Strong Tool Design (20425 Beatrice, Livonia, Mich. 48152), has a cast-alloy frame, arms and large 13¾-in. by 22-in. table. The stand has four legs that are splayed in lieu of bracing to give the saw stability, but we found the legs to be always in the way. The table surface was adequately smooth, but the single trunnion didn't lock well enough to keep the table steady when cutting heavy work. The hold-down can be bolted on either side of the frame, making it easier for left-handers.

Cuts with the 2015 were generally smooth, but the light saw vibrated considerably. A few times after tightening the blade-tensioning adjustment, the pivot on the end of the bolt didn't engage correctly and tension would suddenly release in the middle of the cut. The blade clamps are designed to pivot with the blade, but unfortunately, arm design makes the blade move back on the downstroke. Blade changes were relatively easy with the provided Allen wrench. One problem, however, is that the lower blade clamp barely fits through the table, so the blade needs to be bent and worked through the opening. Since our test, the 2015 has been superseded by a new model, the Strong Prospector, also with a 20-in. throat.

Super 15 in.—This saw is the least-expensive saw in the sample: a fraction of the price of the \$1,014 Delta, the most expensive saw we tested. Manufactured in Taiwan and imported by Penn State Industries (2850 Comly Road, Philadelphia, Penn. 19154), the Super 15 looks like the Hegner and is remarkably similar to Taiwanese saws sold by Grizzly and Delta. Although Penn State's ads claim the saw has professional quality and precision, it simply doesn't. The overall quality of the castings and the saw's fit and finish is poor. For instance, the Super 15 has a cheap plastic hold-down and miniscule pump bellows that are absolutely useless. Also, the blade clamps

are badly machined and don't grip the blade well.

Like the Pro-Cut 20 in., the Super 15 features a covered top arm for safety. But on the unit we received for testing, the cover had been bent, and the arm hit it on every stroke, making a terrible sound until we bent it back to shape. On the positive side, the saw can cut cleanly enough (albeit with a lot of vibration), no doubt thanks to its high 1,650 SPM. Also, the Super 15, like the Superscroll 18, has a power-switch lock so it can be child-proofed.

Superscroll 18—Imported by American Machinery Sales Inc. (Box 5285, Marshallton, Del. 19809), this Taiwan-made saw is hefty built and doesn't offer many frills. Although the table surfacing and machining are still pretty rough, this saw is a step up from the Super 15, both in capacity and performance. The Superscroll's 18-in.-deep throat is enough for fairly large work, and with its hold-down in place, the saw has the same depth-cutting capacity of most other, more expensive scroll saws. The saw is a hybrid design: It features direct drive, like many parallel-arm saws, but is a C-frame saw, like the Delta.

The Superscroll 18 has pivoting blade clamps that allow for a fair amount of blade flex. Plastic hinged covers flip over the blade clamps (I can't see why), and a removable table insert makes accessing the lower arm for blade changes easier. The Superscroll 18 produced a moderate amount of vibration during cutting, which decreased when we bolted the saw to a heavy workbench. Cutting action was solid and yielded smooth cuts in all but thick hardwoods. Overall, the Superscroll 18 is a lot of saw for the money.

Other models—As interest in scroll saws grows, manufacturers continue to offer additional models, which we were unable to include in this test. Companies offering other scroll saws include AMT, Grizzly, Sunhill, Sakura U.S.A. and Transpower. □

Greg Bover is the woodshop foreman of C.B. Fisk Inc., pipe-organ makers in Gloucester, Mass. Shop members Rob Hazard and John Schreiner helped with the testing for this article.

Alabaster on the Lathe

Turning stones into translucent vessels

by Max Krimmel



An ordinary woodturning lathe can be used to cut and polish alabaster until it glows with translucent colors. The author's red and pink platter in the back is 15 in. in diameter, the largest vase in the center is 10 in. tall and the small pink vase is 2 in. in diameter.

Turning rocks is tricky, but that just adds to the fun. And delicately colored stones like alabaster, when turned, develop a pleasant translucent glow. I conduct turning workshops across the country and have been impressed at the popularity of alabaster work. I suppose that's not too surprising considering turners are such an adventurous lot, eager to chuck on anything from a worm-eaten tree trunk to a variety of fruits and vegetables. In addition, you don't need any special equipment for alabaster, nor any special techniques. The process is just like scraping out a wood bowl, only slower, although alabaster does have a couple of personality quirks. It's not so much that the material is contrary as that it is different and takes a little getting used to.

Alabaster is a crystalline form of gypsum (calcium sulfate), which is the main ingredient in Sheetrock. Gypsum rates a #2 on one commonly used hardness scale (talc being #1 and diamond #10). You might notice some variation in hardness from piece to piece, but even though it's rock, all alabaster is soft. Impurities are responsible for its subtle colors, which can range from translucent whites through pinks, to browns, grays and greens. The turned pieces are a bit like crystal wine glasses—lovely, but if you drop one, that's that.

You can rough out the alabaster blanks with any variable-speed reciprocating saw and a large-tooth or bimetal blade. A bandsaw running bimetal skip-tooth blades at slow speeds will cut alabaster. The low-tech chisel-and-mallet approach also works fine. Currently, I'm mounting the rock on the lathe and using an air chisel to knock off enough material to balance the piece, then using a narrow scraper known as a Stewart Slicer (available from Dennis Stewart, 2502 N.W. 4th Ave., Hillsboro, Oreg. 97124; 503-640-3089).

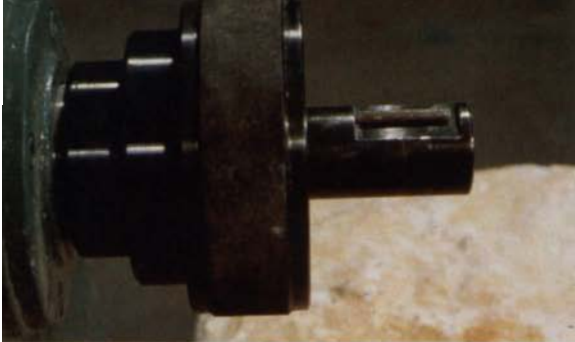
For the actual turning, I use carbide-tipped scrapers. Commercially available woodturning tools are fine, but I made my scrapers by unbrazing carbide tips from old router bits, then rebrazing them onto square-stock steel (available from KBC Tools, 6300 18-Mile Road,

Sterling Heights, Mich. 48078; 800-521-1740, or 800-482-1047 in Michigan). You can also order tools specially made for alabaster from Jerry Glaser, 8341 Delgamy Ave., Playa del Rey, Calif. 90293. I sharpen my carbide tips with a 120-grit silicon carbide (greenstone) wheel.

High-speed steel scrapers are best for the finishing cuts (see top, right photo on the next page). The steel edges aren't as durable as carbide, but they produce a cleaner cut, probably because they can be sharpened to a finer edge. I grind the ends square with no bevel. This way I can use one side until it is dull, then flip it over and use the other side. These high-speed steel scrapers are available from Craft Supplies USA, 1287 E. 1120 S., Provo, Utah 84601; (801) 373-0917. Craft Supplies also sells double-faced tape, the type of pin chuck I use (the version included with combination or six-in-one chucks) and Hot Stuff cyanoacrylate glue, which is invaluable for holding the work together.

Alabaster can be crumbly because of fractures and stresses within the stone, so it can break easily on the lathe. I turn each bowl as thin as I dare, usually about $\frac{1}{8}$ in. to $\frac{3}{16}$ in. My current success rate is about 80% and would be even lower if it were not for the cyanoacrylate glue. Once the outside is roughed to shape, use thin "original" Hot Stuff on anything that even looks like a fracture in the stone. If the glue soaks into the crack, I go over it with the thicker "Super T" Hot Stuff and then spray on the Hot Stuff accelerator, which speeds glue hardening. If the glue doesn't seem to flow into the crack at all, I assume the crack just looks like a fracture. I repeat this procedure whenever I get nervous about things breaking, usually on the inside when the piece is about $\frac{1}{4}$ in. thick and always just before the final thickness.

Safety hazards—Be aware: There is *always* a chance the block will shatter. Even if everything is going well, dust is a problem. Alabaster dust is similar to Sheetrock dust, so wear a dust mask or a respirator,



A pin chuck, fit into a center hole drilled in the rim side, holds the blank.



The blank can be rough-cut round with a reciprocating saw.



Initial scraping with carbide-tipped tools brings the stone to rough shape. Here, the bottom of the bowl is being trimmed flat with a high-speed steel scraper.



Above: To center and clamp the preturned wood base to the piece, the author uses a stub with the proper Morse taper for the tailstock on one end and threads for a faceplate on the other. The base is then



glued to the stone using the tailstock as a centering clamp. Wooden rim segments are applied with cyanoacrylate glue. Below: Turning procedures are much the same as for scraping cuts in wood.



use a dust collector, and if possible, work outside. I use a Makita 410 dust collector, with its intake nozzle mounted near the tool rest. This clears the air and helps keep the dust out of the headstock bearings. In addition to breathing problems, the dust can dry out your skin severely, so I wear latex gloves. Of course, wear a face shield: These are rocks, not wood chips, that will be flying off the lathe. I recommend steel-toe shoes, because the rocks are quite a bit heavier than wood, and if you turn enough of them, you will inevitably drop one off the lathe. The last time this happened to me, the 105-lb. piece hit the floor and rolled off through the wall.

Attaching alabaster to the lathe—I usually start with a pin chuck from the rim side, then proceed as shown in the photos on the facing page. The only unusual gadget I use is a device to center and clamp the pretuned wood base to the piece. It is simply a stub with the proper Morse taper for the tailstock on one end and threads for a faceplate on the other end. With the bowl on the headstock and the base on the faceplate, I screw the base/faceplate assembly onto the stub, insert the stub into the tailstock, then wind the tailstock out until the base and bowl connect. This avoids turning a mortise and tenon to center the bowl on the base.

You can also adapt other chucking systems to alabaster. You can grind a flat on what will be the base of the piece with a belt sander, glue on a pretuned wood base, glue or, for small pieces, double-tape a waste block to this base and screw a faceplate to the waste block. Or, you can grind a flat on the rim side, tape it to a faceplate, turn the outside, then glue on a base and waste block as before. Use whichever method seems most comfortable to you.

Turning techniques—You must rely on a fairly gentle touch as you turn, because alabaster isn't flexible. The rotational energy of the lathe must be absorbed by the tool, the tool rest and your hands, or by the scraping away of the stone's surface. Too much pressure or a slip with the scraper either stops the lathe, knocks the piece off the faceplate or breaks the stone.

You will likely find two additional crystals in alabaster: quartz and selenite. Quartz crystals are very hard and may be as large as a pencil eraser or as small as a grain of sand. You will feel them and hear them; they will take the edge right off your tool, sometimes making sparks as they do so. If you run into quartz, stop and dig it out. My "quartz digger" is simply a concrete nail with a piece of wood for a handle. Selenite is another crystalline form of gypsum. It usually is found on the outside of the rocks and looks similar to mica. You can cut selenite, and if it runs deep into the rock, it can yield spectacular results. But, selenite crystals usually separate from the rest of the piece, so keep filling with Hot Stuff as you turn, as this will sometimes keep the crystals in place.

If you decide to permanently attach a wood base or rim to the alabaster, the Hot Stuff glue makes a good permanent bond. Whenever one of my joints has failed, there has always been a layer of alabaster left attached to the wood, indicating the stone, not the glue, as the weak link. Just remember: The wood will move as its moisture content changes; the stone will not. With wood pieces as small as the rims on these bowls, wood movement doesn't seem a problem; with the larger bases, it can be. After the piece is turned, finish all surfaces of the base with a moisture-sealing finish.

Finishing alabaster—I first sand the surface with 36 grit for rougher shaping, working up through 15-micron sandpaper (available from The Luthier's Mercantile, Box 774, 412 Moore Lane, Healdsburg, Calif. 95448; 707-433-1823) for that final glow. I use all the sandpaper dry. My favorite finish is paste wax, but you might prefer lacquer or the traditional oil finishes commonly applied to wood turnings.

Finding alabaster

I get most of my stone from Colorado Alabaster Supply, 1507 N. College, Fort Collins, Colo. 80524; (303) 221-0723. Stan Jones, the owner, says that the company deals mostly by the ton, and small pieces suitable for turning are, in effect, waste that may or may not be available at any given time. You may have to wait six weeks to two months for delivery of a small order. Typical cost is as low as 30¢ to 35¢ per pound, with a nominal handling charge.

I suggest you start with a 20-lb. to 30-lb. block, which in my experience, would be large enough for a 6-in. by 2-in. bowl. Drill cores of 2 in. to 3½ in. in diameter are sometimes available, too. Here again, if you want 500 lbs. of cores, Jones will be happy to core out as many rocks as necessary; if you want 10 lbs. and he is out, the order might take a while.

A speedier yet more expensive route is to order from a specialty supplier. Sculpture House (30 E. 30th St., New York, N.Y. 10016; 212-679-7474) has alabaster (mostly imported Italian) for immediate shipment and will help you figure out what to order over the phone. Cost is \$1.50 per pound, and the minimum order is \$50.

You might be able to obtain the rock from local sculptors or sculpture-supply houses as well: Alabaster is a very popular carving stone. Here in the West, you can often find alabaster at rock shops along the highway. If they don't have it, they probably know who does.

Another approach is to become a prospector, which gets you the best prices of all, usually free. Look for places on the map with names like Alabaster, Gypsum or Plasterville. Gypsum, the main component of Sheetrock, is fairly common, and where there is gypsum, there will be alabaster. By asking around, you can usually get permission to dig it. The question is whether or not it will be solid enough and large enough to be useful. Here's how to test: You want a piece that gives off a good ring when struck. Pick the piece up and give it a sharp tap. (My favorite tapper is a wooden-handle rigging axe, which is a framing hammer that combines a typical hammerhead with a hatchet face instead of a claw.) A solid piece will have a clear clink or a ring. If you get the sound of an indistinct "thud," look for fractures and break off anything that looks loose, or try holding the piece differently, then tap again. This is pretty easy for a 20-lb. rock. With a 150-lb. rock, however, it is more of a problem; still, you can usually balance it on a corner and get a ring. With a 500-lb. rock, good luck! —M.K.

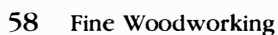
One final caution about finishes: Your bowls must be purely decorative or at least reserved for the storage of dry goods, because alabaster dissolves in water. How quickly? Well, a few drops of water on a waxed alabaster surface probably won't make marks, but I once filled a bowl with water, and the liquid noticeably etched the surface in half an hour. Obviously, if there is a fracture in the piece where water can seep through, things will only get worse. To avoid this kind of damage, I sometimes lacquer the inside surface, especially on enclosed shapes. I don't especially like the look or feel of the lacquer, but it is hard to see inside these enclosed vessels anyway. I also think that with enclosed shapes it is more likely that someone down the line will put water in them. In those cases, lacquering should work fine, unless a possible natural fracture in the stone eventually causes the lacquer to check.

One of the best rules when beginning to work with alabaster is that if at first you don't succeed, keep trying. As I mentioned earlier, about 20% of my starts are failures, but in the beginning, they were more like 40%. Half of these are due to excessive concentrations of quartz or structural problems with the stone, and half are just my mistakes. Have fun: After all, that's the ultimate point of it all. □

Max Krimmel is a guitarmaker, illustrator and turner. He lives in Boulder, Colo. All photos are by the author.

Beads and crown dress up a basic cabinet

Fig. 1: Shaker-style wardrobe



I've never been especially fond of period furniture; therefore, the commission I received to build a traditionally styled wardrobe cabinet was quite a challenge. The client did not specify the style, but the piece had to fit into an Early American bedroom dominated by a huge antique mahogany bed—a family heirloom. Because all my previous work had been with contemporary designs, I had some reservations about accepting the commission; a contemporary wardrobe would clearly be out of place in this bedroom. Thus, I set out to find a period style that would be traditional yet allow for some creative interpretation so I could incorporate my own design details. In this article, I'll tell you how I developed my design, worked out the details and built the cherry wardrobe cabinet pictured at right.

Before I began designing the wardrobe, I searched through furniture reference books for a period piece to serve as a point of departure. In my search, I discovered a reference book called *Chests, Cupboards, Desks and Other Pieces* by William C. Ketchum, Jr. (published by Random House, Westminster, Md. 21157). Although primarily a book for furniture collectors, I find it a valuable resource for furniture designers: The book includes photographs and drawings of a dizzying number of styles, from English and French period pieces to Shaker designs to Wendell Castle stack-laminated work. The book even includes joinery details and dimensions for many of the pieces.

Ketchum's book contains a photo of a simple Shaker wardrobe that seemed to fit my needs. The piece is traditional looking yet plain enough to benefit from the addition of some of my decorative details. I was already somewhat familiar with Shaker furniture and crafts, having at one time manufactured Shaker-style steam-bent oval boxes, and I like the Shakers' straightforward, functional approach to furnituremaking. There are also modern interpretations of the style that I like, such as the work of furnituremaker Thomas Moser of Maine.

It was necessary to adapt the dimensions of the wardrobe to fit the client's room and accommodate the amount of clothing the cabinet would have to hold. To help visualize how the cabinet would relate to its surroundings, I made a perspective sketch of the room, including a view of the ceiling and other bedroom furnishings. I chose to make the wardrobe 78 in. tall and 42 in. wide to fit harmoniously with the client's large bed, and I made the wardrobe 22 in. deep to easily handle bulky winter clothes hung on a clothing pole inside.

Pleased with the proportions of the cabinet, I went back to the drafting table to work out the small details, such as the cutout base beading around the door frames, the profile of the crown molding and the joinery to hold the cabinet together. Because solid wood would be used throughout, I had to design the cabinet to allow for expansion and contraction. In addition to frame-and-panel doors, this meant making a frame-and-panel back and a sliding joint for attaching the crown molding to the top of the carcass. The top, bottom and sides of the carcass would consist of edge-glued boards joined with dovetails at the top and pin tenons at the bottom. A face frame would be glued to the front of the carcass, and the back frame would be fitted into a rabbet in the carcass sides. I also shaped door, base and crown molding details to give the cabinet individuality.

Carcass construction—I began by building the basic carcass. After edge-gluing several narrow 4/4 boards to make the sides, top and bottom, I cut the dovetails at the top of the case by hand, using a chisel, mallet and dovetail saw. You could also use a router and dovetail template. Next, I laid out and chopped the mortises at the bottom of the sides to accept the multiple tenons on the carcass bottom. These mortises were cut with a straight bit in a router



The design of the author's cherry wardrobe cabinet, above, is based on a traditional Shaker piece that he modified, adding his own details to the doors, base and crown molding.



By changing the position of the two movable rails that guide the router, the author works his way across the bottom of the carcass side, chopping mortises for pin tenons that will join the sides to the bottom of his wardrobe cabinet.

guided by a homemade jig, as shown in the smaller photo above. The jig is a square template made up of two rails and two adjustable fences. A plunge router is set into the square, the bit is plunged and the router is then moved around inside the fenced area (router base bearing against the fences and rails) until the mortise is completed. The two adjustable fences, pinned into place with removable dowels, are repositioned for each of the seven mortises across the width of the two carcass sides. The routed mortises have rounded corners that must be squared up with a chisel.

Next, I cut the multiple tenons on the ends of the carcass bottom. After marking these tenons by transferring lines from the mortises, I bandsawed away most of the waste, then pared the tenons for a tight fit into their mortises. As an alternative, you can use a router to rough-cut the shoulders, then pare them with a chisel. Either of these



The author makes raised panels for the wardrobe doors on the router table. In the first step, shown above, he reduces the thickness of each panel's edge by running the panel vertically by a straight bit. A fingerboard clamped to a spacer provides the pressure needed to stabilize the panel as it's fed. This fingerboard also prevents the climb-cutting bit from self-feeding the panel.



Hagood uses a homemade beading plane to detail the inner edges of the door frame. The mahogany plane has two nonsymmetrical bead-profile blades, one for cutting in each direction. A piece of quarter-round molding on the underside of the plane guides it along the frame's inner edge for a straight cut.

operations can be time-consuming, but I don't know a faster way to make pin tenons or an alternative joint that has the same integrity.

As with most wardrobes, mine has a high shelf for storing clothing above the hanging garments. The $\frac{3}{4}$ -in.-thick shelf joins the inside of the carcass by sliding into a simple $\frac{3}{8}$ -in. by $\frac{3}{4}$ -in. dado plowed into the cabinet sides. The dado is the same depth as the rabbet cut along the back edges to accept the frame-and-panel back. I cut the dado with a $\frac{3}{8}$ -in. straight bit in a router, using a straight board clamped across the cabinet side as a fence. Because the $\frac{4}{4}$ shelf must span the width of the 42-in. cabinet, I supported the middle of the shelf with a lap joint on the $1\frac{1}{2}$ -in.-wide center stile. Dovetails at the top and bottom of the stile connect to the front edges of the carcass top and bottom, as shown in the draw-

ing on p. 58. The shelf is notched so the edge of the shelf is flush with the front of the stile.

Originally, I'd planned to let the base of my wardrobe rest on the floor, with a decorative molding at the bottom edge. However, I saw another base treatment I liked in the Ketchum book and adapted this base to fit my wardrobe. With this new base, the carcass is cut out to make four feet, with gentle convex curves coming up from the floor along the insides of the feet—a pleasant visual effect. Drawing in scale, I experimented with various curves until I came up with one I liked. I scaled up this curve on graph paper to make a full-size plywood template, which I used to mark out the cabinet sides. After roughing out the curve with a sabersaw, I clamped the same template to the cabinet side and routed the final shapes with a piloted straight bit bearing against the template.

Creating the same curved feet on the front of the wardrobe involved modifying the cabinet's otherwise straightforward face frame. I used a typical face frame, assembled with mortise-and-tenon joints, on the front of the cabinet and a frame-and-panel back. But the stiles weren't wide enough for the same curve I had cut on the cabinet sides, so I glued $1\frac{1}{2}$ -in.-wide ears to the inside edges of the stiles, providing stock for the curved feet. I cut the bottom rail shorter than the top rail and tenoned it to the ear pieces instead of the stiles. If I'd made the bottom rail extra wide to accommodate the cutout, I would have created a wood-movement problem by joining a 6-in.-wide rail cross-grain to the face frame's stiles.

Gluing up a cabinet of this size was quite a task in my small shop. The cabinet's size stretched every clamp in the shop to its capacity. The carcass dovetails were tight enough that they didn't need clamping, but the pin tenons needed to be pulled into their mortises with pipe clamps. A 2x4 I had carefully bandsawn into a bow shape (convex surface toward the cabinet) was used as a caul to distribute clamping pressure across the sides. After the carcass was dry, I glued on the already assembled face frame.

Though plywood is a suitable and more-often-selected choice for the back of a large cabinet, I decided to stick to the more traditional solid-wood frame-and-panel back. This frame consists of three stiles and four rails mortised and tenoned together, dividing the back into four panels. The panels themselves are flat and only $\frac{3}{8}$ in. thick, the same thickness as the grooves in the frame. The entire glued-up back recesses into the rabbet cut in the back of the carcass earlier.

Building frame-and-panel doors—After measuring the face-frame opening, I made a pair of door frames that fit snugly into the opening. The frames are joined with haunched mortise-and-tenon joints, and each member has a $\frac{5}{16}$ -in.-wide groove, cut with a dado blade on the tablesaw, to hold the panel. The bottom door rails are wider than the top rails, to overcome visual foreshortening, which makes bottom rails look narrower than they are. I let the stiles run long to prevent splitting during mortising, then trimmed them to length after the doors were assembled.

I raised my panels with a router, homemade router table and two different bits. The first operation was to reduce the thickness at the panel's edge with a $\frac{1}{2}$ -in. straight bit. The panel's edges were routed with the panel on edge and held tight against the fence by a fingerboard clamped directly above the bit, as shown in the top photo on this page. To produce the cleanest cut possible, especially while shaping the panel's endgrain, I climb-cut the panels, feeding them into the bit counter in the same direction it was spinning. If you try this, make sure to take several shallow passes on each edge, to prevent dangerous self-feeding, which can occur when climb-cutting. The pressure of the fingerboard also prevents self-feeding,

and it shields your fingers from exposure to the whirling bit.

After the panel edges were thickened, I cut a cove to finish the panel raising. I used a ½-in. core-box bit in the router, shaping the panels on the router table. I laid the stock flat on the table and shaped the cove in a few passes, raising the bit each time until its tip just contacted the flat in the panel edge cut from the previous operation. I then sanded the panels and glued up the door frames with the panels in place.

The next step is to detail each door with a cock bead around the inner edge of the frame. I originally scratched the bead with an old scraper blade filed to the correct profile, but I was unhappy with the fuzzing and tearout. I chose instead to make my own beading plane, shown in the bottom photo on the facing page. The plane is designed to cut into the corners from two directions for work on an already assembled frame. (You can plane the bead in the frame edges prior to assembly, but you need to stop the beads on the stiles where they meet the rails.) One of the plane's blades is a standard cutter from a Stanley #55 Multiplane set. The other cutter, a mirror image of the first, is made by modifying a straight plane blade. Both blades are held in place with removable wedges, making it easy to lower one cutter and retract the other, depending on the direction of the cut. A strip of molding on the underside of the plane body acts as a fence to keep the cutter parallel to the frame's edge as it cuts the bead.

Traditionally, the corners of a beaded frame were carved so the beads look mitered into one another. This is because the beading plane or scratch stock can't shape the bead all the way into a corner. Instead, I glued an end-grain dowel precisely into each corner, to serve as a return for the bead detail and to give the cabinet an original touch, as shown in the photo above, right. I made a drilling guide by boring a hole through a scrap and gluing a tiny triangle to the bottom to reference against the frame's inside corner. Clamped in place, the guide established the precise location of the hole and kept the bit straight as I bored each ¼-in. corner hole with a hand drill. A tape flap stuck to the bit told me when the hole was deep enough. The dowels for the corners were made from cherry scraps, using a plug cutter in the drill press. Each dowel was glued in with epoxy, then trimmed and sanded flush with the surface of the door frame.

Crown molding—For this highly visible detail, I chose the fanciest piece of cherry I had. To shape the crown's cove profile on the tablesaw, an improvised fence was diagonally clamped across the saw table and a length of stock long enough for the entire crown was passed over the blade, which is raised a little at a time. By varying the angle of the fence and depth of cut, you can produce many different cove shapes. I experimented until I had a profile that mimicked the curve of the feet. After coving, I angled the molding's edges as detailed in the drawing on p. 58.

The bead detail where the crown molding meets the cabinet is the same as the bead on the doors, adding visual detail and making any irregularity in the seam between the cabinet and molding less obvious. To hold the molding at the correct angle for beading, I first cut some small plywood triangles and hot-glued them to the bench in a straight line. I then hot-glued the noncoved side of the crown molding to the triangles so the molding's bottom edge was facing up and level. The narrow edge gives the beading plane little support, so it is a bit tricky to get a straight bead. To stabilize the plane, try laying one hand on the molding alongside the plane as you walk down the length of the molding taking the cut. It'll take several passes to get the full bead profile, but in the end, this great-looking detail makes it all worthwhile. After scraping the cove smooth with a curved scraper blade and sanding its show



Photo: Tom Hagood

The beaded inner edges of the door frame and inlaid corners, as well as the cove-and-bead crown molding, provide the author's wardrobe with a distinguished degree of visual interest.

surfaces smooth, I cut the length of crown molding into three pieces and joined the mitered corners with splines and epoxy glue.

Crown molding has been traditionally nailed or glued on old cabinets, but this can create problems. The molding, attached cross-grain on the cabinet sides, loosens over time because of expansion and contraction of the cabinet's sides. To compensate, I attached the assembled crown to the cabinet's side with a sliding dovetail joint, as described in "Cross-Grain Constructions," *FWW* #72, p. 80. This allows the cabinet sides to move while holding the molding securely to the cabinet.

The crown is fastened to the cabinet sides with two 3-in.-long male dovetail strips—one screwed to each cabinet side. These strips slide in female dovetails cut into angled blocks glued to the back of the molding. After the male strips were in place, an assistant held the molding while I screwed the front molding on from the inside of the cabinet. Then, I applied hide glue to the female dovetail blocks and slid them onto the dovetail strips from the back. I held the components in alignment until the glue set. This procedure is not as difficult as it sounds, especially if you're good at cutting sliding dovetails. In addition to alleviating wood-movement problems, this method avoids difficult clamping procedures and ensures that the molding is perfectly aligned. The whole crown is removable: This makes finishing the cabinet sides easier and lightens the heavy wardrobe, in case it needs to be moved.

After final sanding and finishing (I used Watco oil to bring out the cherry's color, but you can use any finish you like), I attached the knobs, mortised in the locks on the doors and hung the doors on the cabinet. Keeping with the Shaker style, I turned two small, plain cherry knobs. Each has a dowel turned on its back that is glued and wedged into a hole drilled through the door stile. I used standard 2½-in.-long butt hinges to hang the doors, three per door, and mortised them into the door frame and face frame for a clean fit with very little gap around the doors. Finally, I mounted a removable clothes pole inside the cabinet just below the shelf.

My client is pleased with the wardrobe, and so am I. The adaptations I made to the design seem to mediate well between the room's ornate furnishings and the cabinet's simple Shaker origins. While the extreme austerity of original Shaker designs is not always completely satisfying to me, I enjoyed reinterpreting the Shaker wardrobe design. But, I'll always acknowledge the Shakers' basic premise: "Keep it simple." □

Tom Hagood is a woodworker in Birmingham, Ala.



The results obtained from a well-tuned scraper are evident here. The wide, fine shavings are indicative of the blade's sharpness. When the blade no longer produces these fine shavings, it's time to rebone its edge and form a new cutting hook.

Souped-Up Scraper

Old-time hand tool challenges belt sander

by Kelly Mehler

Whenever I run into my former apprentices, I'm always curious about whether any of the things I taught them have turned out to be valuable tools for making a living. Invariably, I'm told that one of the best tricks is how to tune-up a cabinet scraper—not the steel hand scrapers most woodworkers are familiar with, but the old metal-body ones with spokeshave-like handles and a reputation for not working. But I've found that once you learn how to handle this scraper, you can take wide, fine shavings off any hardwood with ease; it's especially effective on highly figured woods where you have cross-grain. With a well-tuned blade, you can smooth a tabletop faster than you can with a belt sander.

My scraper is a Stanley No. 80, pictured at the top of the facing page. You can order it or a similar version from most woodworking-supply houses. As with a plane though, you want to make sure your tool has a flat, smooth bottom. The scraper, as it comes from the manufacturer, is usually not flat or smooth enough to do a good job. My scraper has a sole that's 3¼ in. by 2⅞ in., so it's not much of a job to flatten and polish the sole with a piece of fine

silicone carbide paper supported by a glass plate or other flat surface. The scraper blade itself is 2¼ in. wide and 2⅞ in. long. It's held in position by a flat metal clamp and two screws. The only other part is a thumbscrew that bears against the blade to keep it from chattering and to flex it. The more the screw flexes the blade, the heavier the cut.

I started using this scraper years ago when it seemed I was sanding all the time and getting sick of the dust and noise. I also don't think a sanded surface finishes as well as a scraped one. I did a lot of reading to see how other craftsmen handle the problem and decided these old cabinet scrapers, which traditionally were used for smoothing after planing, offered a lot of possibilities. Many craftsmen are reluctant to use them, perhaps because of the perceived difficulty in tuning the tool: It's more complex than sharpening a plane blade or chisel, because it requires forming a hook, which does the scraping, on the blade edge after the blade has been sharpened. At first, I couldn't get the tool to work well. It took awhile to master the technique of getting the correct combination of bevel angle, straight edge and hook angle.



The cabinet scraper used by the author is a Stanley No. 80. For a newly purchased tool, it's necessary to flatten and polish the sole and modify the scraping blade to produce the best smoothing results. A carefully tuned tool will produce a surface ready for finish-sanding.

My procedure for preparing the blade is much like the one used with the more familiar hand scraper, except the blade for the Stanley No. 80 requires a beveled edge. The blade is square when it arrives from the factory, so I shape a 45° bevel using a bastard mill file. This angle permits a fine cut with hardwoods and is critical, because unlike a hand scraper, the angle formed by the clamped blade and the work surface is not adjustable. I've never used the scraper on soft woods, but I suspect that a lower angle and a blunter bevel might work best.

My vise is located near a wall. To gauge the bevel, I've penciled in a 45° line on the wall at a height where I can sight along the blade's edge as I file. The system is surprisingly accurate. You can also double-check your work with a combination square. The important thing when filing the bevel is to keep the bevel flat and straight. Always check for flatness with a straightedge, or put the edge on a flat surface, such as a bandsaw table, and check where light comes through between the blade and table. This flattening operation should create just a slight burr, barely large enough to feel with your finger.

I remove the burr by polishing the back side of the blade on a 1,000-grit waterstone, but a medium or fine Carborundum stone will work as well. It will probably take eight or nine strokes to remove the burr. I also polish the bevel itself on the stone using the angle on my combination square to check my progress. A really smooth edge is necessary to make the finest cuts. Polishing the bevel again raises a small wire burr, so I finish up with a few strokes on the back side to remove it.

The next step is to turn over a hook on the cutting edge; the hook does the actual cutting. As with a conventional scraper, I form the hook with an oval steel burnisher. With the blade lying on a flat surface, bevel side down, I first burnish the back side of the blade, keeping the burnisher flat but with a little additional pressure on the edge to "draw" the metal toward the edge. Next, I clamp the blade vertically in my vise. I start burnishing at a 45° angle, pulling the burnisher toward me using light pressure while keeping it in contact with the full surface of the bevel. I continue to burnish while gradually decreasing the angle and increasing the pressure. I stop when I reach a 15° angle, which I again gauge by referring to a line marked on the wall, as shown in the photo at right. By this point, I have shaped a sharp hook evenly along the length of the blade's edge.

I always put the blade into the scraper from the bottom, with the bevel side facing toward the thumbscrew. I set the body on a flat surface, such as a workbench, and push the blade down so it is even with the bottom of the scraper body. Then, I tighten the screws (but not the thumbscrew) to secure the blade. I hold the blade down as I tighten the screws, offsetting the blade's tendency to be forced up.

The thumbscrew is turned so it just touches the blade, exerting



The final step in tuning the scraper is to form the cutting hook on the edge of the blade. The author is shown here burnishing the scraper's edge using a 15° line marked on the wall as a guide. Earlier, in preparation for forming the hook, the blade is flattened and its edge is made straight and filed to form a 45° bevel.

almost no pressure. I take a few practice strokes to be sure the blade is scraping evenly across its entire width and make any necessary adjustments by tapping the blade's top edge. As scraping proceeds, the hook gets worn. You can compensate for this by tightening the thumbscrew, which causes the blade to flex and increases the hook's "bite."

Using the scraper is much like using a plane. Grab the scraper handles firmly, keep the sole flat on the surface and push. Take long strokes with even pressure. Lift the scraper on the return stroke to prevent dragging the blade and consequently dulling it. It's also a good idea to take skewed cuts with the scraper held at a slight angle to the cutting direction, as shown in the photo on the facing page, because this produces a smoother cut and prolongs the life of the hook. From then on, it just takes practice until you can produce a shaving as wide as the scraper body. When the shavings become crumbly, producing more dust than shavings, it's time to go back to the stone, rehone the blade's edge and burnish a new hook. □

Kelly Mebler builds custom furniture and operates the TreeFinery Gallery in Berea, Ky.

Pedestal Tables

Sculptural bases and veneered tops

by Jim Wallace

When I design a table, I consider the pedestal as important as the top. Modern manufacturers often relegate the table base to the role of unobtrusive support, as if to say: "Paint it black and perhaps it will disappear." However, my tables are meant to be sculptural as well as functional, so the pedestal is an integral part of the design, not merely a support for the top, no matter how spectacular it may be.

My table designs are inspired by many sources: nature, art, architecture, fashion and graphics. The pedestal or "Post" in the bottom photo on the facing page was influenced by the decorative elements of Post-Modern architecture, hence the name "Post:Modern Table." My designs often are influenced by more practical considerations. For example, the top of the Post:Modern Table is veneered with 24 wedge-shape segments, partly because the satinwood veneer was available only in 5-in. widths and partly because I didn't have a press large enough to veneer the top as one piece.

Constructing these pedestal tables, with their sculptural bases and unique veneering problems, is a challenge in any shop, but especially so in my 300-sq.-ft. one-man shop. This small space also has forced me to limit my tool collecting. I have a 10-in. tablesaw, hand circular saw, 12-in. disc sander, belt sander, orbital sander, drill press, $\frac{3}{8}$ -in. drill, router, clamps and a compressor for spraying lacquer. In this article, I'll concentrate on describing some of my techniques rather than giving you plans for duplicating one of my tables. I want to show that even though you may not have a shop stocked with expensive tools, you needn't limit the creativity of your designs. Being from the school of "whatever works," I

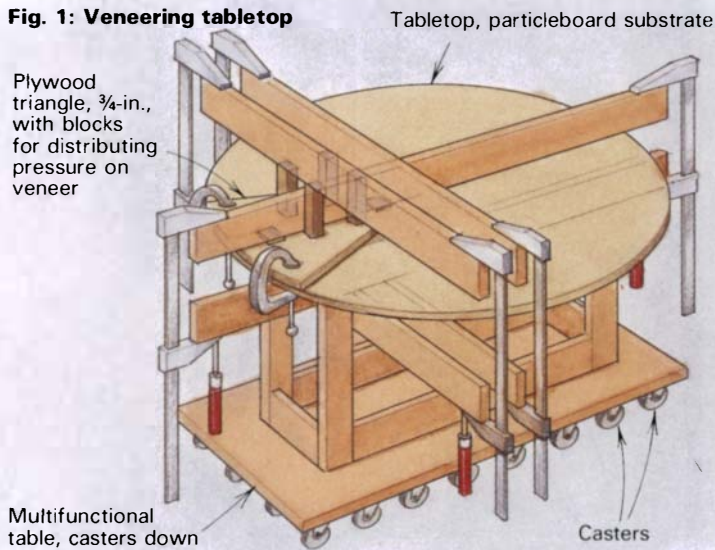
have evolved some unorthodox methods for building tables and have come up with devices to compensate for many of my shop's shortcomings.

Whatever works—The multipurpose table shown in figure 1, below, simplifies many operations. It is constructed from 2x4s and plywood, with 32 casters mounted on 6-in. centers on the top. My mother says it looks like a geriatric skateboard, but she'll have to wait, because I'm still finding new uses for it around the shop. In figure 1, the table's being used casters-down, as a stand to hold the tops while the veneer is clamped. Turned this way, I also use it as a mobile workbench for moving large in-progress pieces from my small garage shop to my driveway, where I work whenever possible. Cutting up the large 4-ft. by 8-ft. sheets of birch plywood and particleboard needed to construct all my tables is a real chore for one person. Turned casters-up, the multipurpose table becomes an out-feed table the same height as my 10-in. Craftsman tablesaw, which is also on wheels for moving outside. The sheets slide neatly off the saw and over the casters, making the process an easy one-man job.

Because my pedestals are built with various sizes of polygons, I devised the adjustable jig shown in the photo below. It's basically a board with a pivot pin and a wide slot for an adjustable miter gauge. The piece to be cut is drilled in the center so it fits snugly on the pivot pin. The miter gauge, fitted with the appropriately angled fence (for example, 45° for an octagon, 30° for a hexagon), is set in conjunction with the saw's rip fence to cut the desired-size piece.

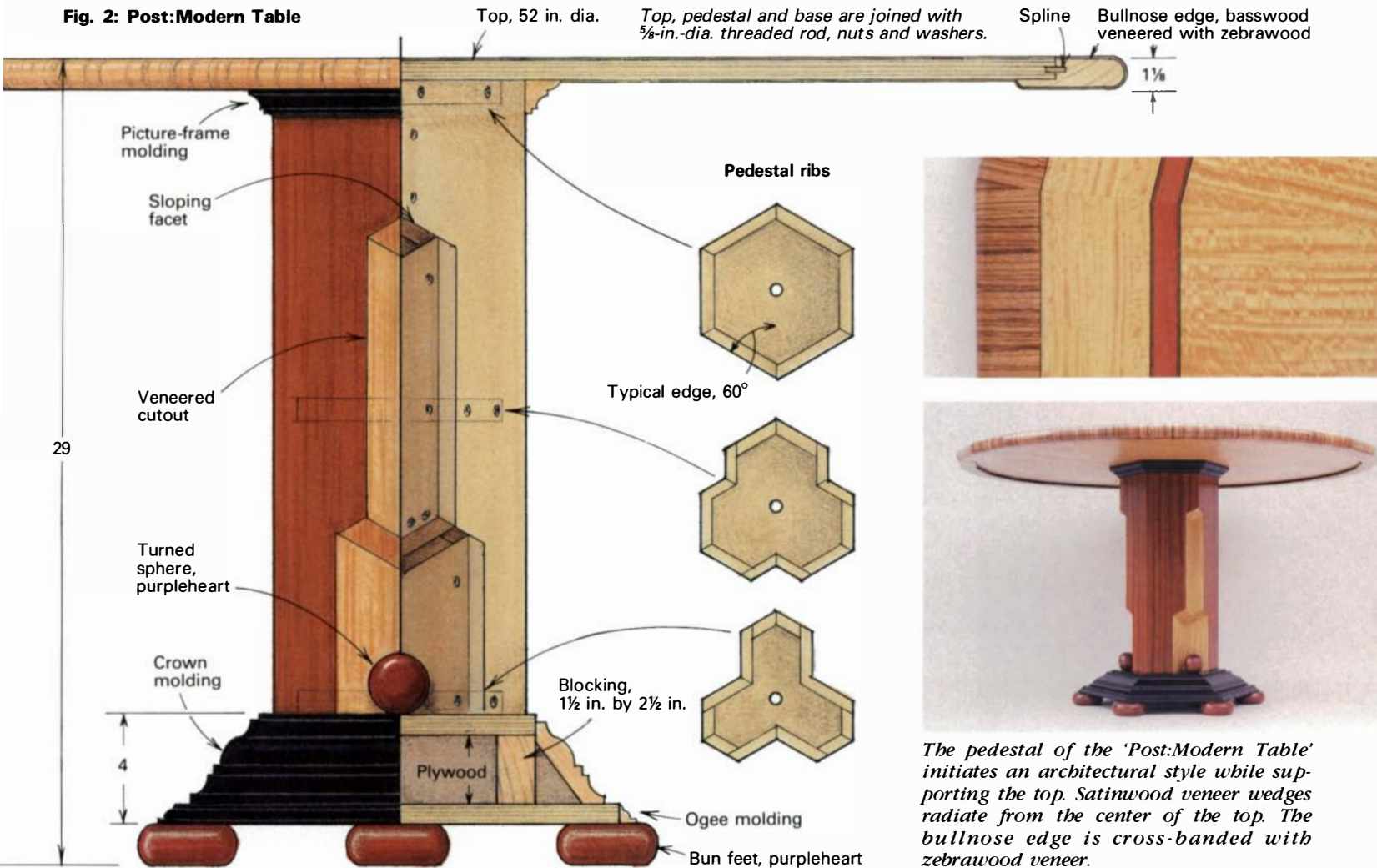
The circumference of each tabletop is embellished with a series

Fig. 1: Veneering tabletop



This jig for cutting polygons has the versatility to cut various shapes in a large range of sizes. Set up here to cut octagons, the jig can be adapted to cut hexagons by replacing the 45° miter gauge with one that has a 30° fence.

Fig. 2: Post:Modern Table



The pedestal of the 'Post:Modern Table' initiates an architectural style while supporting the top. Satinwood veneer wedges radiate from the center of the top. The bullnose edge is cross-banded with zebrawood veneer.

of facets. Each top begins as a 4-ft. square of $\frac{3}{4}$ -in. particleboard, on which I locate the center with diagonal lines and draw a 4-ft.-dia. circle. To cut the facets, I use a Masonite template guide based on the number of facets desired. As an example, I'll describe how to cut the 24 facets on the Post:Modern Table. I lay out three radii at 15° intervals and draw the chords between them at the edge of the circle. From this layout, I make a wedge of $\frac{1}{4}$ -in. Masonite that covers the three radial segments. Then, I glue and nail three small strips to the wedge to serve as guides for the circular saw when cutting the facets. I lay one edge of the template on one of the radii, locate the point of the wedge at the center of the circle and screw the wedge to the top. I saw each facet with the circular saw base running against one of the little guide strips. Then, I unscrew the wedge and rotate it around the circle, overlapping one sawed facet and sawing two new ones each time I move it. Overlapping the cuts in this way will produce uniform facets. Any slight discrepancy can be eliminated when fitting the veneer and edging for the last facet.

Figure 1 on the facing page illustrates how I overcome the problem of veneering a 4-ft.-dia. tabletop without a veneer press. I divide the top veneer into wedge-shape sections and glue down two or three sections at a time, clamping them under a jig that covers $\frac{1}{8}$ th of the top. I span the triangular jig with 2x4s and clamp their ends to evenly distribute the pressure. Corresponding 2x4s running beneath the tabletop keep the substrate flat. Great pressure is not required, as long as the veneer is pressed flat while the aliphatic resin glue cures. I hold the veneer in place on the substrate with masking tape and put waxed paper between the veneer and the jig to keep the parts from sticking. I minimize glue squeeze-out by spreading a thin coat only on the substrate. Minor squeeze-out can

be trimmed with a utility knife or carefully popped off with a chisel. When I've glued down enough sections to cover 90° of the circle, I use a square and straightedge to trim the last wedge square. I repeat this at each 90° interval to eliminate any accumulated error as I go around the circle. I always veneer the underside of the table right after the top and apply finish to both sides to prevent warping.

Building the Post:Modern Table—The pedestal of the Post:Modern Table is a hollow, hexagonal column of particleboard, reinforced with three internal plywood ribs (see figure 2 above). The veneered cutouts in this pedestal are an example of the unique construction problems some of my designs present. I notched for the cutouts in the ribs and the sides before assembly and made the final cut at the top of each cutout with a hand circular saw after the hexagon was glued up. However, this required careful planning. In addition, there were some dangerous stop cuts on the tablesaw where I had to hold the side piece tightly on the saw table as I raised the angled blade up through the piece. In hindsight, it occurred to me that I could have assembled the pedestal as a complete hexagon and then made the cutouts with the circular saw. This is a more direct method, akin to carving, and eliminates a potentially dangerous tablesaw operation.

Figure 2 shows the finished pedestal and its parts. I cut out three identical ribs, using the adjustable polygon jig, and drill a 1-in.-dia. hole in the center of each rib for the all-thread rod that joins the top, pedestal and base. The pedestal's six sides are ripped to final width with the tablesaw blade tilted to leave a 60° bevel on the edges (so they'll form a hexagon when assembled). If I were to build this pedestal again, instead of prenotching the ribs and sides,

I would assemble the hexagon at this time, gluing and screwing the ribs in place inside the post and taking care not to put screws where the cutouts will be.

Mark the outline of the cutouts with a pencil and straightedge. Use a circular saw running against a guide board screwed to the side of the pedestal to make the 60° cuts along the long vertical lines. Relocate the guide as you work your way around the pedestal. The angled facets at the top of each cutout are cut with the circular saw riding on a jig that straddles the corner of the post and is screwed securely to the pedestal's sides. If your circular saw doesn't have the depth of cut for the top cutouts or where the cuts intersect the ribs, you can finish up with a handsaw. Sawkerfs that extend too far will be filled and veneered over. Particleboard pieces are custom-fit and glued and screwed into the cutouts and any remaining gaps. After filling all screw holes, sawkerfs and rough spots with auto-body filler, I sand all the surfaces smooth. Auto-body filler is perfect here because it cures quickly to a hard sandable surface, even when it's used to fill large areas. And, it's relatively inexpensive when purchased by the gallon. I *always* wear a dust mask when sanding it though, because the dust is an irritant.

Next, I make a paper pattern for the six facets of each cutout, cut the satinwood veneer close to the pattern's size and trim the veneer to fit into the inside corners. The veneer is glued down using cauls cut to fit over each piece and clamped across to the other side of the pedestal. After trimming the outside corners with a utility knife, I sand the veneer flush. The pedestal's main sides are veneered with padauk, two opposite sides at a time, using plywood

and 2x4s as cauls to distribute the pressure.

I borrowed a neighbor's lathe to turn the purpleheart bun feet and the spheres at the base of this pedestal. The lacquered bases for my tables are off-the-shelf white-pine architectural moldings, mitered and glued to a box made from two pieces of plywood with blocking in between (see figure 2 on the previous page).

The tabletop is veneered with satinwood wedges radiating from the center to a purpleheart border. The purpleheart is sandwiched between thin strips of satinwood and black imbuya, a Brazilian hardwood. The grain of the satinwood outer rim runs parallel with the table's edge, as shown in the top photo on the previous page. To cut the components for these veneer wedges, I clamp pieces of veneer between a pair of ¼-in. Masonite router templates, one pair for each of the shapes, and trim the veneer pieces to size with a flush-trim bit. Then the components of each wedge are assembled with veneer tape. Three of the wedges are then taped together and glued down using the triangular jig described earlier. The tabletop's underside is also veneered with satinwood, but with the grain running in one direction.

The bullnose edge is basswood wrapped with a cross-band veneer of zebrawood. I shaped four 4-ft.-long bullnose sections with a ¾-in.-dia. roundover router bit. To make the mold for veneering the bullnose, I resawn a 4x4 in half. I partially hollowed out the mating sides, cutting out most of the waste on the tablesaw and rounding the inside corners with a ¾-in.-dia. cove bit in the router. To test the fit, dry-clamp the halves of the mold together and try a veneer-wrapped section of bullnose. Continue making adjustments

Photo: Michele Russell Slavinsky



These are a few examples of the veneers available from Alpi of Modigliana, Italy. The fabric-like patterns, known as AlpiN-iN veneers, come in a wide color range and can even be made to order. The

bird's-eye sample is made from veneers that are reconstructed into logs in such a way that when they are resawn into veneers, they mimic nature's grain patterns.

Italian veneers lend an exotic touch

Veneers give me a greater variety in grain patterns, colors and construction techniques than I can get with solid wood. In addition, veneers allow more extensive use of rare and costly woods, helping to extend and preserve a dwindling resource. So it was with great excitement that I discovered Alpilignum veneers made by Alpi, a manufacturer in Modigliana, Italy.

These veneers are available in a wide range of patterns that simulate traditional wood grains, such as quartersawn oak, flat-sawn rosewood, bird's-eye maple and several varieties of burl. Alpi also offers a line of designer veneers, known as AlpiN-iN veneers,

in various colors and complex patterns that suggest woven textile designs. These veneers can even be custom ordered to your own designs.

To construct these patterns, sheets of veneer, sometimes precolored, are arranged into the desired patterns with the aid of computers and glued into a new "log." This log is then sliced into ⅜-in.-thick patterned veneers. Standard dimensions are 24½ in. by 133 in. and 24½ in. by 98 in. Because of strict quality control, the patterns and colors are true throughout an entire flitch; there is almost no noticeable variation from one sheet to the next. Be-

cause these veneers are made entirely of wood, they cut, lay up, glue, sand and finish exactly as standard woods and veneers.

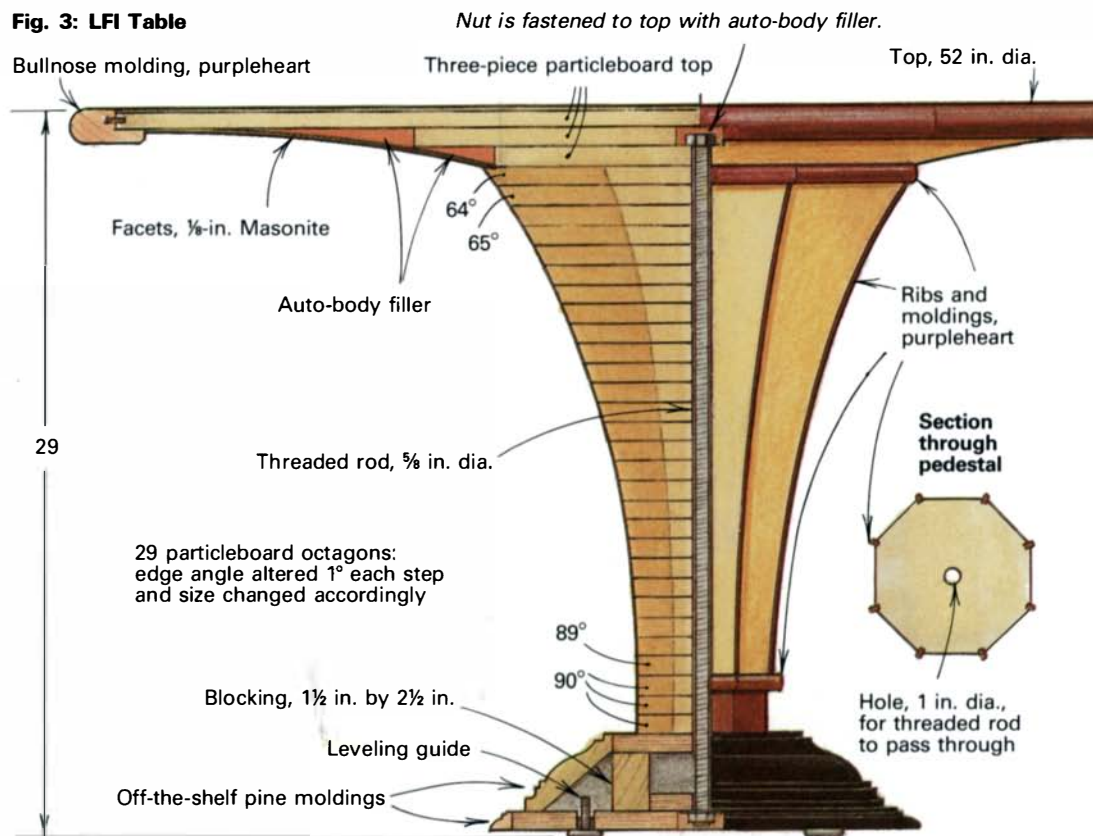
Alpi also manufactures dimensioned lumber with inlaid vertical lines or geometric patterns.

Alpilignum veneers and other Alpi products are marketed in Canada and the United States by The Dean Co. Their main office, showroom and factory are located at Bee Street and Stafford Drive, Box 1239, Princeton, W.Va. 24740. They also have offices at Box 426, Gresham, Ore. 97030, and at Box 1818, 2006 English Road, High Point, N.C. 27261. —J.W.



The gradually flaring pedestal of the 'LFI Table' (named with the customer's initials) blends into the subtly shaped underside of the top. The top's pattern is created in part by the herringbone design of the AlpiN-iN veneer (see sidebar, p. 66).

Fig. 3: LFI Table



on the mold with router and tablesaw until a tight fit is obtained. Then the mold's two halves are glued together and lined with aluminum foil to prevent the veneer from sticking to the mold. To apply the cross-banding, center the veneer over the mold's opening. Wet the veneer's surface with Titebond, and apply several clamps to press the veneer into the mold with the bullnose stock. After the glue cures 24 hours, the form can be tapped loose with a hammer. Excess veneer is trimmed with a block plane, and the 4-ft. lengths of bullnose are rabbeted to lap under the tabletop. I then miter each segment on the tablesaw and glue them to the edge of the top.

Before assembling the table, I finish its parts with several coats of lacquer. The underside of the top gets the same number of coats as the top. Then the top, pedestal and base are assembled, with $\frac{5}{8}$ -in.-dia. threaded rod running through the pedestal and the base. I inset a nut with auto-body filler in the underside of the top and recess a nut and washer in the underside of the base.

Building the LFI Table—The pedestal of the "LFI Table" (LFI are the customer's initials) is constructed by stack-laminating 29 $\frac{3}{4}$ -in.-thick particleboard octagons (see the lower photo above). This is where the adjustable polygon jig really comes in handy. To form the flare in the pedestal, I decrease the edge angle of each octagon by 1° from the one before it and increase the width to compensate for the 1° flare (see figure 3 above). The octagons are tacked with small finish nails, to hold them in alignment during the glue-up. When all the octagons are assembled, I clamp the stack by tightening nuts on the ends of a $\frac{5}{8}$ -in.-dia. threaded rod passing through the 1-in. hole previously drilled in the center of each octagon. Then, I sand each curved side smooth. Cardboard templates are used as patterns for cutting the veneer for each side.

Veneering these curved sides presents a novel problem, requiring a novel solution. I cut an auto-tire inner tube into two C-shape pieces, filled them each with sand and closed the ends with bailing wire. I sandwiched the pedestal between layers of veneer, waxed

paper, $\frac{1}{8}$ -in. Masonite and rubber sandbags, then clamped them all together with bar clamps, using 2x4s laid across the sandbags as cauls. I was able to veneer all eight sides quite easily in four clamping operations. The veneer on the edges of each side was trimmed and then gently sanded before veneering the next two faces. A $\frac{1}{4}$ -in. by $\frac{1}{4}$ -in. groove was routed the length of each corner to receive the bandsawn purpleheart ribs. A purpleheart bullnose molding trims the transition from the flaring pedestal to the underside of the top, as shown in figure 3 above.

Using the same techniques described for the Post:Modern Table, I cut 16 facets on the edge of the top and veneer it with wedges of herringbone AlpiN-iN veneer (see the top photo above and the sidebar on the facing page). Next, I rout $\frac{1}{4}$ -in. by $\frac{1}{4}$ -in. grooves between each wedge section and around the faceted edge of the top and glue in a thin border of satinwood sandwiched between strips of black imbaya, which I had previously laminated and sawed into $\frac{1}{4}$ -in. by $\frac{1}{16}$ -in. strips. I leave these inlaid borders slightly proud of the surface to protect the top veneer while I work on the table's underside.

With the top upside down, I glue and screw two different size particleboard octagons to the underside to continue the flare from the pedestal (see figure 3 above). The steps between these two octagons are filled and evened out with auto-body filler, and as it is curing, I tack $\frac{1}{8}$ -in. Masonite wedges over each section to form the gentle flare. Any gaps between the Masonite wedges are filled with auto-body filler and sanded smooth. The facets created this way are then veneered one at a time, with the AlpiN-iN wedges weighed down with the rubber sandbags. The bags are heavy enough so clamping isn't necessary, but a layer of waxed paper is needed to protect the veneer from the black of the inner tube. When the veneering is complete, I glue the solid purpleheart bullnose to the table's edge and sand the inlaid borders flush on the top. □

Jim Wallace, Institute of Business Designers, is project designer with The Bommarito Group, a commercial interior-design firm in Austin, Tex.

Fig. 1: Joining molding

1A: Coping

Wood movement will not cause joint to open, forming a crack.

Internal joints may be coped.

External joints must be mitered.

1B: Straight miter

Butt joint cut at 45° angle

Wood movement causes pieces to slide past each other, not separate.

Quarter-round molding

Fig. 2: Bisecting angles

1. Draw an arc with the compass point at the corner.

2. Using the side points as centers, draw two intersecting arcs.

3. Line from the intersection of the arcs to the corner indicates miter angle.

Joining Molding

Coping with corners and complex miters

by Graham Blackburn

Making molding isn't as hard as it looks, but installing it in a room or on a piece of furniture can quickly turn into a nightmare of angled cuts, opened joints and mismatched profiles. And, if matching up all the coves, beads and rabbets as they run around and into corners isn't enough of a challenge, you have to deal with several wood-movement problems. Fortunately, with a little practice and foresight, you can handle the job with just a saw, compass, handplane and a variety of butt joints, miters and curved cove cuts.

As always in dealing with seasonal wood movement, you must bear in mind that all wood moves and that cross-grain fixed to long-grain invites trouble. Panel-holding molding is usually glued and nailed to the surrounding frame, and there is rarely any conflict with the frame's grain direction. In corners, the molding is usually mitered; you can keep this miter tight by cutting the pieces slightly long and springing them into place. Molding used as edging—around tabletops or at the junction of tops and skirts, for example—also is usually attached long-grain to long-grain. But

where you *must* fix a piece of long-grain molding across the grain of another piece, always allow for the inevitable movement differential between the two pieces. If it is of small dimension, nail and glue the molding at the ends and use only small nails at the center of its length. These nails must be pliable enough to give a little. For stouter pieces of molding, slot-screwing from the back side of the base into the molding might be better. Elongate the hole in the base and place a washer under the screw head so it can move as the base expands or contracts. Very large molding that must be affixed across the grain is sometimes made from cross-grain segments glued end to end. For more about cross-grain constructions, see *FWW* #72, pp. 80-81.

Wherever possible, it's best to use continuous, unbroken lengths for long spans and locate any joints at corners and other places where the molding changes direction. If you can't avoid joining pieces, take advantage of any architectural feature that might visually distract from the joint. In any case, avoid joining the pieces near a corner, where any short piece will always look like a mistake.

Fig. 3: Curved miter

Pattern doesn't line up if miter is a straight cut.

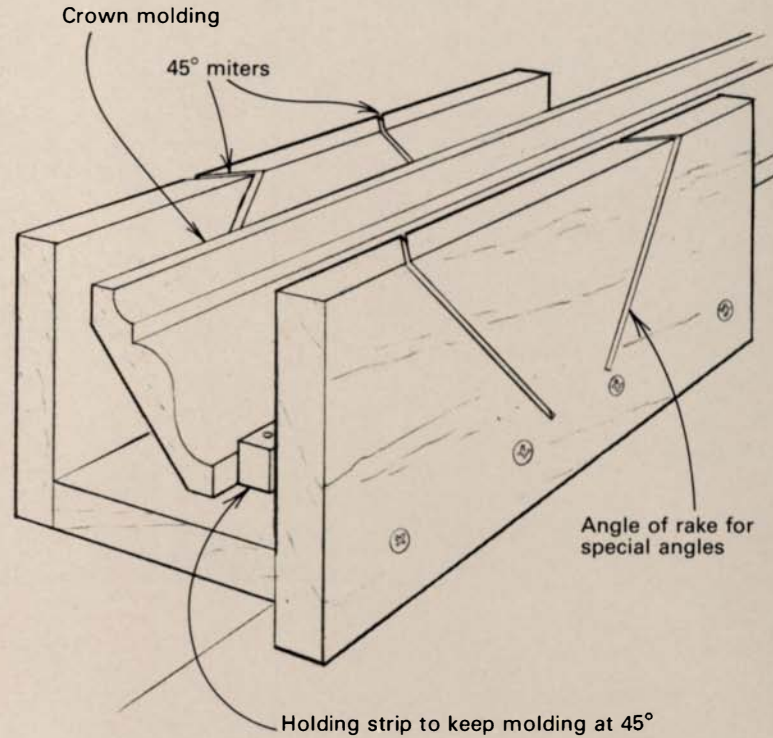
1. Plot miter by extending lines from pattern elements onto sheet of paper.

2. Connect intersections of pattern lines with straight segments.

3. Average lines to sketch smooth curve.

4. Scribe curve on molding; cut and pare to line.

Fig. 4: Mitering crown molding



If you can cut both pieces slightly long, make a simple butt joint by springing the two pieces together. While this will keep the joint closed, it can put a great deal of pressure on the ends of the molding, causing the joints there to fit poorly. Thus, it is better to cut the butt joint at an angle to create a straight miter, as shown in figure 1 on the facing page. If the pieces shrink, the mitered ends will slide over one another, rather than pull directly apart, exposing a gap.

Joining molding at inside corners requires either mitering or coping. Coping involves cutting one piece so it butts into the corner, then scribing the molding's profile onto the mating piece and sawing or paring the end to the exact reverse section of the piece, so it will butt into the profile. This allows the wood to move without breaking the joint and means you'll only need to make one special cut. If it's difficult to scribe the pattern directly from the intersecting piece, you can cut a 45° inside miter on the end of one piece and use a coping saw to cut along the curved pattern between the bevel and the face of the molding. Moldings with many tiny pattern elements are often very difficult to scribe and cope. Coping also cannot be used for external corners.

Mitering molding—On flat surfaces, mitering of simple profiles is a fairly straightforward matter of cutting 45° bevels. But, it can be difficult with complicated shapes, especially when the moldings intersect at angles other than 90°. The basic rule is that the angle of the miter must perfectly bisect the overall angle of the corner. With a 90° corner, this results in a 45° miter; if the corner of the panel isn't 90°, you can bisect the angle with a compass, as shown in figure 2 on the facing page, either working directly on the panel or on a sheet of paper. Using the corner as a center point, draw an arc that will intersect with both sides of the corner. Now, using these side points as centers, draw two intersecting arcs. A line between the intersection of the two circles and the corner will perfectly bisect the corner and indicate the miter angle. Use a bevel

gauge to transfer the angle to the molding, saw proud of the line and trim for a perfect fit.

You have a slightly different problem when a curved section meets a straight section of an identical pattern. Here the miter *must* be curved. To plot the line, put a piece of paper under the moldings, as shown in figure 3 above, and extend the pattern lines as shown. Connect the intersections with straight lines, then sketch in a smooth curve, which can be scribed on the molding. Curved miters are best cut oversize, then trimmed to the line with a knife or chisel.

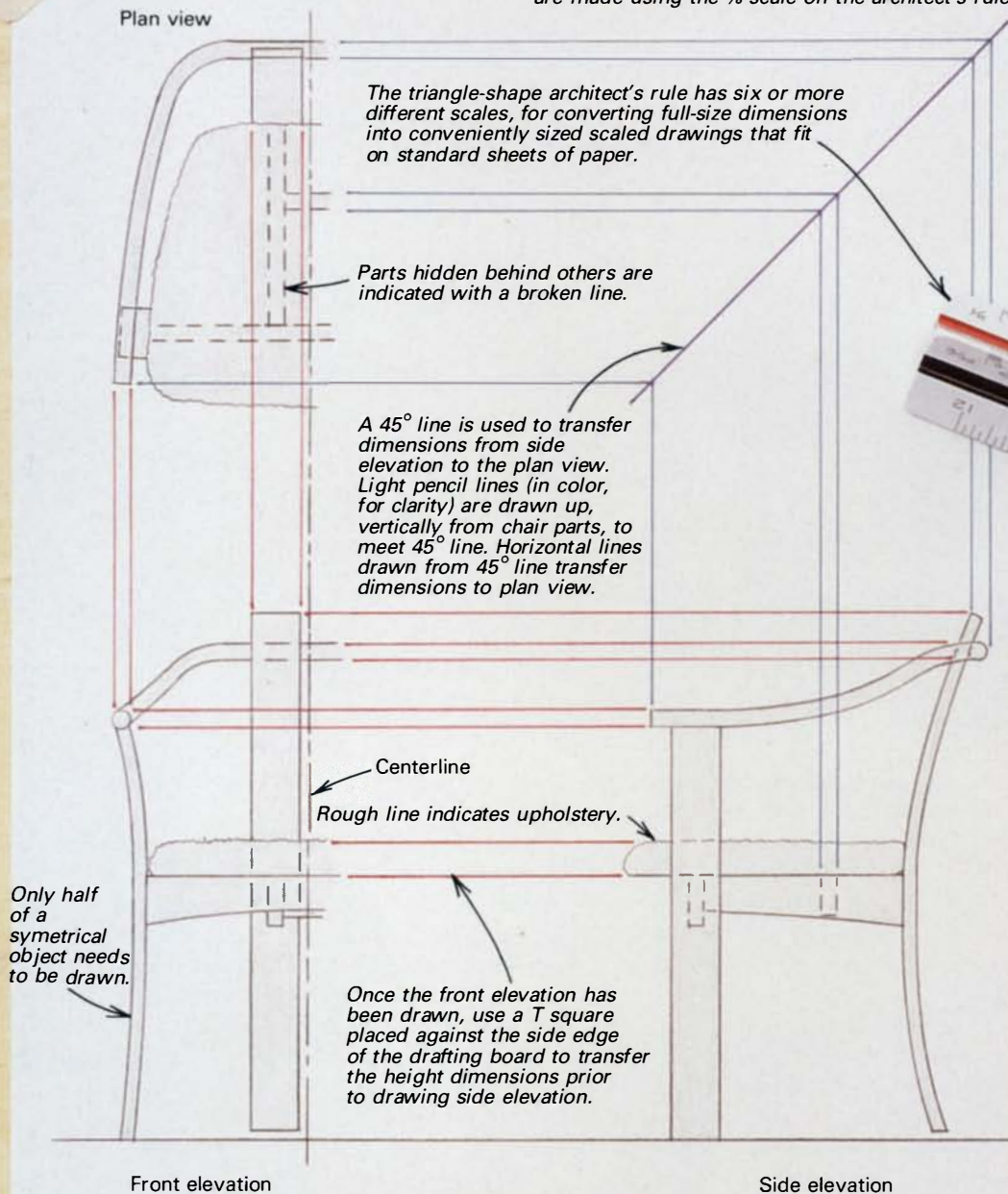
Straight miters may be sawn using a tablesaw or a miter box. Unless the molding will be painted, it is usually best to saw slightly oversize and then trim to produce a perfect joint. The best way to trim the joints is with a handplane and a miter shooting board, which is just a baseboard with a step at its edge and an angled fence to support the molding. Extend the mitered end over the step and trim it by "shooting" along the step with the plane running on its side on the baseboard.

Everything I've said about mitering so far refers to joining molding that fits flat against an interior surface. Crown molding, however, is often beveled on the back so the angled molding will butt between a wall and the ceiling or between other similar surfaces. If you want to miter crown molding, you must allow for the installation angle, which is usually 45°. You can produce the needed 45° compound miter by fixing holding strips in the miter box to hold the molding at the proper installation angle and by using regular 45° slots to guide your saw. If the miter is at an odd angle, as at the end of a raking gable or an arched pediment, knock up a special miter box or modify your regular box by adding a guide slot angled to produce the needed compound miter angle (see figure 4 above). Again, set holding strips to support the molding at the proper installation angle. □

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Fig. 1: Scale drawing

This drawing is 1/8-in. to 1-in. scale. Measurements are made using the 1/8 scale on the architect's rule.



French curve is useful for drawing irregular curves not possible with a compass.

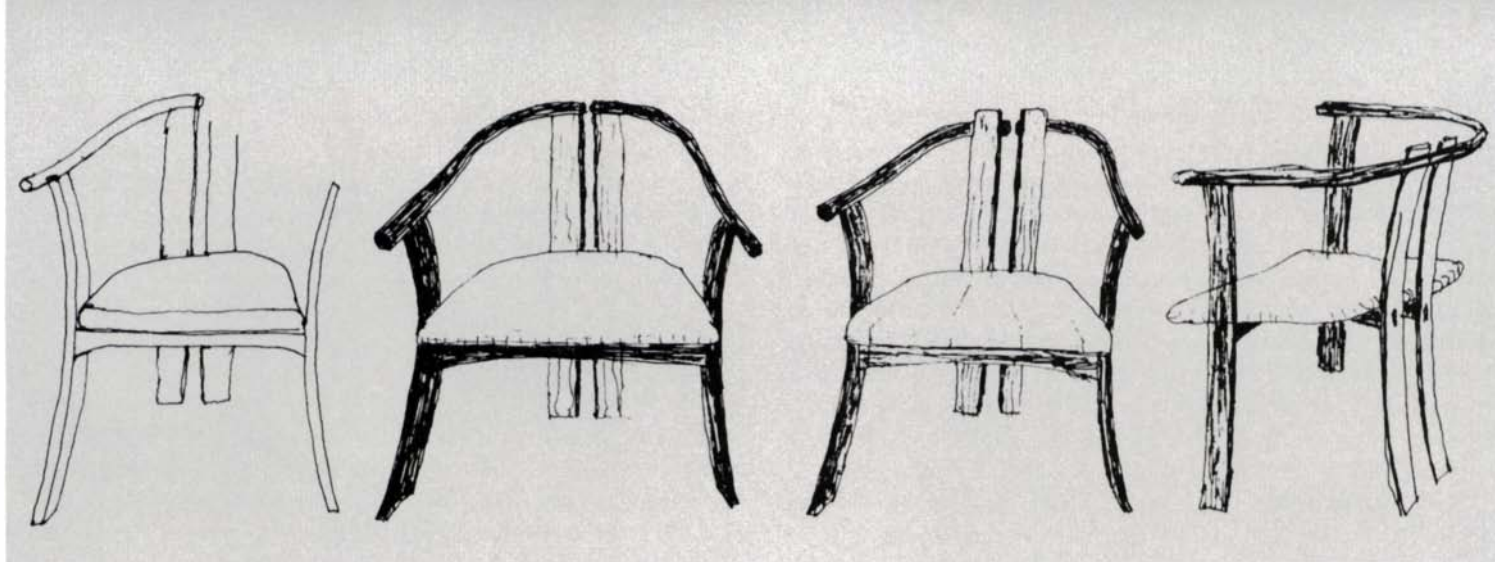
T square, placed against edge of drawing board or table, is used to keep all horizontal lines parallel.

Drafting triangle is used with T square to draw perpendicular lines or 45° angles.

Drawing and the Design Process

Translating ideas into furniture

by Peter Korn



Selections from the author's sketchbook illustrate how his chair ideas begin as crude sketches that are refined through drawings and models.

At the start of my career as a self-taught furnituremaker, I focused on learning craftsmanship. I'd usually jot down some rough pictures and general measurements and go straight to the lumber pile; design was something to put up with in order to learn technique. The pieces I built incorporated the construction techniques I wanted to learn, and I worked out details as I encountered them. After a few years though, I began to take craftsmanship more for granted and found myself increasingly absorbed in the process of imagining something and then working out a successful design.

Drawing is one of the most useful tools in the design process: It helps the designer/craftsman capture that first flickering idea, then through a series of refinements, translate it into a buildable piece. Drawing doesn't create the inspiration for design, but it is a shop tool that can make the design process more fluid and efficient. There are lots of different drawing methods available for craftsmen to choose from, ranging from freehand doodling to meticulous drafting. Choosing the right kind of drawing to develop or communicate your furniture idea can be just as important as selecting the right hand or power tools to build it. In this article, I will explain how I use drawing in my design process, and I'll take you through all the stages, from rough sketches to full-scale drawings, and even throw in a few tips on making mock-ups or models and prototypes. I'll use a chair I recently designed for the contract furniture industry, pictured on p. 73, to illustrate my drawing methods and design process.

Sketching—When looking for a new chair design, the first thing I do is sit down and start doodling. I'll sketch chairs, one after the other, and let my ideas flow out onto the paper. The ideas can come from anywhere: Furniture designers can be inspired by anything from Post-Modern architecture, Mayan civilization or the work of a craftsman they admire. With maturity, the individual styles of designers/craftsmen emerge in their own design work, submerging the evidence of outside influences.

You don't have to be a formally trained artist or even know how to draw to make useful sketches. Rough sketching is for you alone, and as long as you know what your sketches mean, they serve their purpose. The first sketches I made of my contract chair, shown above, may look childishly drawn, but they were clear enough to help me conceive and nurture my ideas. I try not to be too judgmental at this stage and let the pencil do the thinking. As you sketch, remember that you're just trying out different ideas—not trying to create a visual masterpiece. If you need help improving your freehand drawing skills, I suggest reading *Drawing on the Right Side of the Brain* (see further reading on p. 73).

A bound spiral sketchbook and pen or pencil are the best imple-

ments for encouraging creativity in design. Further, because their pages don't get lost, bound sketchbooks add up to a useful record of your development as a designer. Sketches are worth saving, because even if you don't know the relevance of a particular idea now, you may come across some need for it in the future. Occasionally, perhaps once a year, I'll thumb through my old sketchbooks and rediscover some little drawing that surprises me with a useful idea.

Sketching techniques develop with practice. The basic trick to good sketching is to draw each line cleanly and continuously rather than make tentative scratches. This is often difficult at first, but it's worth the effort, because I believe we perceive through the physical motion of making the line, not just through looking at it once it is drawn. Drawing with a pen rather than a pencil encourages boldness of line, because you can't erase. I may use cross-hatching to give a form dimension or darken in parts of the sketch to get a better sense of the piece's overall form and to distinguish different materials.

I often sketch for short periods of time, leaving the sketches for an hour or a day so I can come back and view them with a fresh eye. Eventually one of my chair drawings will sing to me, and I enter a new phase of the design process—trying to capture the melody. To find out just what it is about the sketch that resonates involves more sketching: playing with proportion, fiddling with details, perhaps having the arm of a chair meet the legs in a different way.

Scale drawings—Once I've come up with a promising set of sketches, it's time to make scale drawings to turn the melody into a song. Measured scale drawings translate rough sketches into proportionally accurate views of the chair that are smaller than life-size. The trick is to keep the interesting aspects of your original idea alive while adapting it to functional proportions. Crucial considerations for my contract chair included arms low enough to slide under the apron of a table, legs with a large enough "footprint" to stabilize the chair and a curve for the continuous arm that would enclose the sitter's back comfortably. You can research chair dimensions by measuring the furniture you live with to see what's comfortable and what isn't, and you can refer to one of the design standards books listed at the end of this article.

There are three views needed in a scale drawing to fully describe a three-dimensional piece of furniture: the front elevation, side elevation and plan view, as shown in the drawings on the facing page. Front and side elevations show the piece in flat, straight-on views, without any sense of perspective. The plan view shows the furniture seen from directly above, again with no perspective. A practiced eye can look at these scale-drawing views and fairly clearly extrapolate the three-dimensional object.

Before beginning a scale drawing, you must choose an appropriate

scale of conversion, where one unit of measure will represent another. For most scale drawings of furniture, I use a scale of either $\frac{1}{8}$ in. = 1 in. or $\frac{1}{4}$ in. = 1 in. These scales allow the three views of a furniture piece to fit on a single sheet of 11-in. by 14-in. paper.

To save the trouble of mathematically converting all the dimensions of the furniture piece into scale sizes, I use an architect's rule, which has 12 different scales printed on it, including the scales I use most often. An architect designing a building employs the $\frac{1}{4}$ -in. scale to mean $\frac{1}{4}$ in. = 1 ft., but it's more convenient for a furniture designer to use the same scale to mean $\frac{1}{4}$ in. = 1 in. For example, using the $\frac{1}{4}$ -in. scale, a line that's 1 in. long on paper represents a true distance of 4 in.

Besides an architect's rule, there are other drafting supplies you will need to make good scale drawings. Special paper isn't required (you can use brown-paper bags if that's all you have), but it does help. Although it's more expensive than plain paper, translucent vellum paper is great for scale drawings for several reasons: It takes lead and erases well, you can trace through it and you can run it through a blueprint machine for copies. I prefer Admaster 406R, which is available at drafting supply stores. I use unlined paper, but some people prefer graph paper with a grid size that matches the scale of the drawing. Without a ruler, you can quickly count the squares to check a measurement, and the grid also helps you lay out square and parallel lines; if you use unlined paper, you'll need a T square.

Instead of using a regular wooden pencil, I find it convenient to use a lead holder with removable lead. A little hand-held sharpener keeps the lead point sharp so it will draw a line of consistent thickness. Drafting leads and pencils come in different hardnesses, with B pencils being softer and H pencils being harder. I prefer leads in the range of H to 3H, but there is no one correct hardness to use for all scale drawings. The softer the lead, the darker the line, but the lead will need sharpening more often and the drawing will smudge more easily. Besides an eraser (I like the Pink-Pearl brand), you'll want an eraser shield, a thin piece of sheet metal with various shape holes punched in it. A hole in the shield is layed over a small section of the drawing you wish to erase, protecting adjacent areas from being erased. You'll also need a drafting triangle, and depending on how curvacious your design is, a circle template, a compass and a variety of french curves will come in handy.

Although they look more technical, scale drawings, like sketches, don't take any particular training to do. Some prefer to do the front elevation first, but I like to work out all three views simultaneously in reference to each other. If the piece is symmetrical, as in the case of my chair, you can save time and room on the paper by drawing only half of the piece and indicating the axis of symmetry with a dotted line labeled "CL" for centerline. Lay out the dimensions of the piece accurately, starting with the overall forms, then filling in the details later. At this stage of the design process, your scale drawings don't have to include every detail of joinery and construction, only the information needed to continue refining your visualization of the piece. In order to draw the irregular curves for the arm of my chair, I lightly sketched the curves freehand until they looked right, then firmed up the lines with corresponding sections of a french curve. When parts are hidden behind others, such as the seat rails in the plan view, they are indicated with a dotted line.

Measurements can be copied from one view to another by using the graph paper's grid or a T square to transfer the dimensions. Height dimensions are transferable between front and side elevations, while widths are copied from the front elevation to the plan view. You can also use the 45° method, shown in the drawing on

p. 70, to transfer depth dimensions from the side elevation to the plan view.

Occasionally it's necessary to draw a rear view or a side elevation from the opposite direction for a complex piece with details not seen in the usual three views. Cutaway views, called sections, are used when there are parts of the piece that don't show up in elevation or plan views. Sections are more likely to be useful when doing the comprehensive full-scale drawings used for construction of the furniture piece.

Full-scale drawing—If sketching encourages your creativity and scale drawings capture it, full-scale drawing is the stage where your idea becomes buildable. This form of drawing is impractical for large cabinets and unnecessary for straight-line furniture pieces that can be easily constructed using information from scale drawings. For a complex piece like a chair though, full-scale drawings are invaluable in several ways. Measurements and joinery details for a piece can be checked in actual size, minimizing the possibility of mathematical errors creating misfitting or wrong-size parts. Full-scale drawings also provide a ready source of tracing templates for curved or irregular parts, and they provide a complete record of your piece and all its details. If a full-scale blueprint drawn in America were mailed to a craftsman in Taiwan, for example, he would have all the information needed to build the piece.

Full-scale drawings are prepared in the same manner as scale drawings, only they are drawn to show more detail, including the joints, the profiles of edges and corners and the orientation of wood grain. I make the same three views as in the scale drawings described above, only I use a normal (not scale) ruler to lay out the dimensions. I like to work on Clearprint 1000H paper, which is available from drafting-supply stores. I buy the paper in 42-in.-wide rolls, more than wide enough for most chairs. I cut off a length and tape or pin it to the sheet of plywood I use for a drawing table. The drafting tools I use are the same as for scale, but a larger, 42-in. T square is helpful. After completing the three usual views, I draw separate detail drawings and cross sections where necessary to illustrate hidden parts or complex joints.

Rendered perspectives—Scale and full-size drawings that clarify proportions and construction details usually provide enough information for me to build the piece I've designed. But these mechanical drawings are often difficult for a layperson to understand. A rendered perspective is like a photograph of the piece, as it would look were it built, and is great for communicating with a prospective client or manufacturer. Though renderings can be time-consuming, they're a good sales tool and prevent misunderstandings caused by differences between what the client expects and what the craftsman builds.

There are lots of books that explain rendering and perspective drawing in detail (see further reading on the facing page), but here are the basics: In perspective drawing, the dimensions are taken directly from the scale drawings. Before you begin drawing the object, you must choose the angle and distance from which it will be seen by an imaginary viewer. The viewer's eye level becomes the horizon line on which one or two vanishing points define where horizontal lines (which would be parallel in an elevation drawing) converge. It's this convergence of parallel lines on the horizon that gives a drawing a realistic appearance, because edges of actual objects appear to come together (converge) as they recede from the viewer. Rendering is the process of shading the drawing to give it a feeling of volume and texture. You can get an idea from looking at my chair rendering (see the top, left



Photo: Robert Millmar

The author used shading and perspective to make the rendered drawing of his chair, above left, look like the finished chair. Also, a rendered perspective is an excellent sales tool for selling a design to a prospective client, who may not know how to 'read' a scale drawing. The full-size model, above center, helped the au-

thor anticipate problems and make final changes before investing the time and materials to build the final piece. The first finished version of the author's dining chair, above right, is the culmination of an idea that started as just doodles and was refined through drawings and mock-ups.

drawing above) of how the shaded cushion and sketched-in wood grain give the drawing a realistic appearance.

Mock-ups and prototypes—Once the full-scale drawing is done, I have a choice to make between building the piece or making a full-size model or mock-up first. While the drawing stages I've described are crucial to the design process, drawings of a complex piece are often insufficient for getting a clear image of how the lines will interact when the actual piece is viewed from different angles. A mock-up or model is invaluable here. Building a mock-up is much like building an actual piece of furniture, and you can measure directly from your full-scale drawings to size the parts. If the piece is symmetrical, you may build only a half model, as of my chair shown above (center). Early mock-ups can be made from cardboard and scraps that are just hot-glued or nailed together. The trick is to keep things flexible so you can experiment with changing the shape of parts or changing the way they connect to each other. Eventually, I get to a stage where I'm ready to make a better quality model—my prototype for the chair. The prototype may only be screwed-together plywood, but it's built well enough so I can sit in it to test its comfort and stability. My prototype convinced me to change the design of my chair, because the meeting of the back splat with the arm didn't look as good in life as in my drawings.

For tables and other simple forms, there's no need for mock-ups, because the process can be time-consuming. But when it comes to a spatially complex piece, the work put into development of a model can help you steer clear of functional or visual problems, as the following story illustrates. A few years ago, I began showing rendered perspectives of a chair collection (not including the chair shown in this article) to manufacturers of contract furniture. After speaking to several companies, I refined my drawings according to their feedback. In drawing each perspective of the chairs, I carefully chose the angle of view that would show off my chair in the most flattering way. One manufacturer finally signed a contract for my chair collection and made three prototypes from my full-scale drawings. Viewed from the correct angle, each chair looked as

good as the original perspective drawings. But when we walked around the chair, the design lost its coherency and proportional attractiveness. I discovered that through the drawing process I had perfected one view of the chair and ignored the others. Eventually, the manufacturer decided not to produce the collection, and I am left wondering if it would have succeeded had I worked out the designs with mock-ups before submitting them. Having spent the time to extensively prototype the design of the chair in this article, I am confident it works, visually and in terms of comfort. □

Peter Korn is director of the woodworking/furniture design program at the Anderson Ranch Arts Center in Snowmass, Colo., where he teaches a workshop on basic drawing for designers. For more information, write to Anderson Ranch, Box 6194, Snowmass Village, Colo. 81615.

Further reading

Books on drawing basics:

Drawing on the Right Side of the Brain by Betty Edwards. J.P. Tarcher, 9110 Sunset Blvd., Suite 250, Los Angeles, CA 90069; 1979.

Thinking with a Pencil by Henning Nelms. Ten Speed Press, Box 7123, Berkeley, CA 94707; 1981.

Books on perspective drawing and rendering:

Color Drawing by Michael Doyle. Van Nostrand Reinhold Co., 135 W. 50th St., New York, NY 10020; 1983.

Design Graphics, 2nd edition by C. Leslie Martin. MacMillan Publishing Co., Inc., 866-T 3rd Ave., New York, NY 10022; 1968.

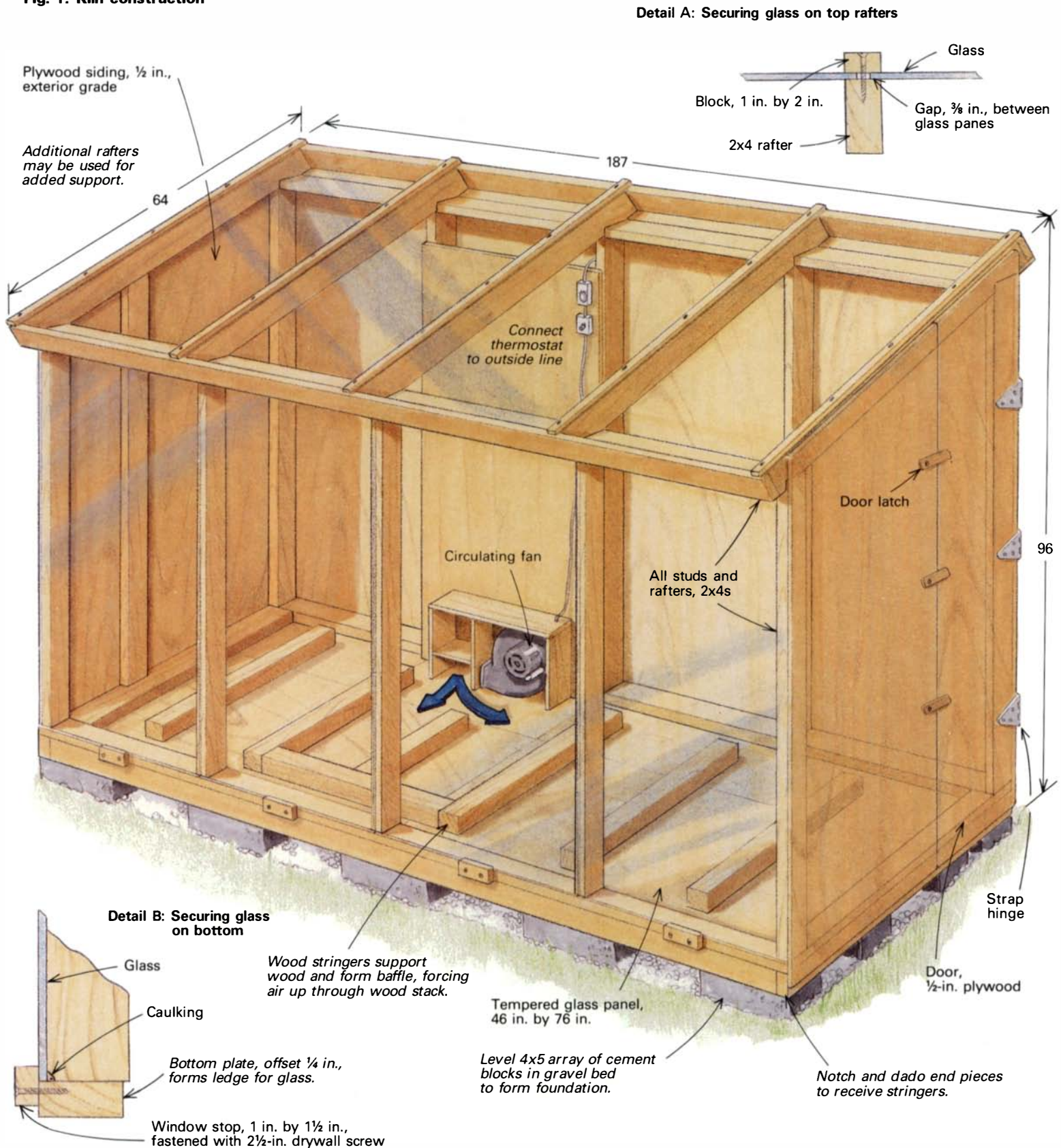
Perspective Drawing Handbook by Joseph D'Amelio. Leon Amiel, Publisher, 31 W. 46th St., New York, NY 10036; 1964.

Books on standard measurements for design:

Humanscale 1/2/3 by Niels Diffrient, Alvin Tilley and Joan Bardagjy. The MIT Press, Massachusetts Institute of Technology, Cambridge, MA 02142; 1974.

The Measure of Man: Human Factors in Design by Henry Dreyfuss. Whitney Library of Design, 18 E. 50th St., New York, NY 10022; 1967.

Fig. 1: Kiln construction

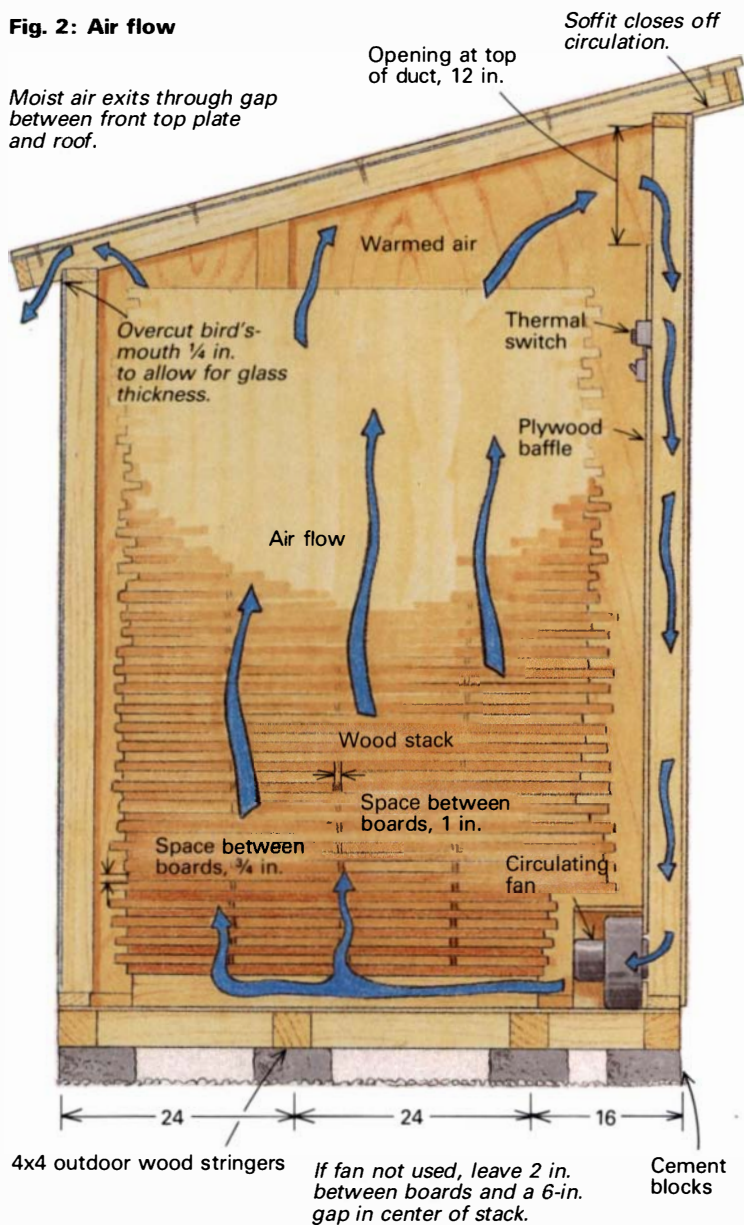


A Solar Kiln for Drying Wood

Dry, defect-free wood and a place to store it, too

by John Wilson

Fig. 2: Air flow



My solar kiln holds about 1,500 bd. ft. of lumber and can produce two batches of uniformly dry, check-free wood each year. The kiln can be built as a temporary or permanent structure by two men in a single day for about \$375. My only operating cost is for running a small fan to circulate air and to exhaust moisture. The kiln also doesn't require extensive monitoring or sophisticated moisture meters. Another real plus for a small shop like mine is that the kiln can be used to store the wood indefinitely; the natural day/night drying-and-relaxation cycle prevents stress damage even after the wood is dry.

The kiln will work effectively in any area of the country. I've even had good success near my home in south central Michigan, an area that holds the distinction of having the worst solar energy use-potential in the country because of its combination of cold temperatures and overcast skies.

In addition to letting me control both the supply and quality of my wood, the kiln lets me work with treasured oddities of burl, crotch and spalted wood, which commercial mills consider as defects to be graded out, left to rot or used in someone's fireplace. Also, several wood species that do not grow in sufficient amounts for commercial operations are available from time to time in my locality. Finally, there is an abundance of green lumber available at attractive prices to the person with the capacity to dry it.

Solar-kiln anatomy—My solar kiln is 16 ft. long by 5½ ft. deep and 8 ft. high. The photo on p. 76 shows the completed structure. Its foundation is concrete blocks laid on a level bed of gravel. These blocks support 4x4 pressure-treated stringers under a plywood floor. Exterior-grade plywood and standard framing lumber are used to form the back and sides. Tempered glass panels salvaged from scrapped sliding patio doors make up the roof and front. Because the tempered glass can't be cut, you may have to change the dimensions of the kiln shown here to accept your glass panels. Therefore, you should get the glass before you start construction. The roof slopes down from the back toward the south-facing front. You could experiment with various slope angles in your area of the country to maximize the solar-collection efficiency, but it isn't critical for drying wood. I've used 3½:12 pitch here, which works well and arises conveniently as a result of using standard-size glass panels for the front wall and 4x8 plywood sheets for the back wall. The slope is also adequate for keeping the glass clear of snow during the winter.

Simplicity of solar wood drying—I've long enjoyed the advantage of direct-gain (passive) solar design in my home and shop. Direct entry of sunlight through windows provides warmth and gives needed light on the darkest of overcast days. A complex, intermediary heat-transfer system is not required as in the more elaborate (active) solar systems. On the debit side, a passive system requires balancing day and night levels of energy and avoiding summer overheating through the architectural coordination of blinds, ventilation and thermal mass.

Passive solar heating adapted for drying wood is equally effective, but simpler than for a home or shop application, because there is no need to be concerned about the extreme high summer and low winter temperatures. It is a system best suited for drying small batches of wood, but it can be scaled to handle larger quantities.

The solar kiln's limitation is that it takes three or four months to dry a batch of wood; a commercial kiln can do the job in a month. But, I consider the kiln's long drying time a small inconvenience for the individual woodworker or the small woodshop in light of the solar kiln's low capital investment, minimal operating cost and self-regulating operation. To the individual woodworker or small woodshop, these advantages, plus the defect-free lumber the solar kiln produces, are much more important considerations.

The kiln's size is limited only by the amount of space available and the quantities of wood you want to dry; it can range from a small coop to a large garage. It must, however, be located and constructed to maximize sun entry to heat the air inside. A kiln facing between southeast and southwest, unobstructed by trees or buildings, works best. A modest fan system working in conjunction with a baffle helps circulate and funnel the warm air effectively throughout the stickered pile of boards. Vents to release warm, moist air and provisions for loading and unloading the wood are also necessary.

Little else is required. This may be surprising if you've heard stories about wood ruined by poor drying practices. Many woodworkers recall the experience of cutting into honeycombed or case-hardened boards from commercial kilns. What protects solar-dried wood from a similar fate is nature's daily cycle: The sun provides the drying warmth during the daylight hours, and the dark night hours provide a "rest" period—every 24 hours. This rest period allows the wood to normalize, permitting higher moisture levels at the core of the wood to migrate to the surface before the next drying period begins. Because the sun dries in short, daily bursts, the drying time is extended from four weeks to four months, but there is



The simplicity of the solar-kiln construction is evident in the above photo. The plywood panel from one end is removed to allow access for unloading a dry batch of lumber.

Recycling glass for kilns

I use tempered glass for my solar kiln. Ordinary plate glass will work, but it's not strong enough to withstand snow loads in the northern part of the United States. Plastic also lacks strength and will rapidly succumb to strong winds and deterioration from ultraviolet radiation. Fortunately, the wide use of tempered glass panels in sliding patio doors makes them readily available at a reasonable cost. New ones cost about \$80; used ones are a real steal (about \$10) if purchased as scrap.

Finding old patio doors may require a little effort, because most glass companies usually dump the old ones. Try talking to these companies about saving the next ones they replace. Glass thermo panes are frequently replaced because of failed (or damaged) seals, which allow moisture to enter the airspace between the two panels. The resulting condensation etches the glass, forming a milky, translucent precipitate that fogs the panel. Usually only the outside glass pane, the one on which condensation occurs, will be affected; the other pane remains clear. I haven't discovered a way to completely remove the surface coloration, but it's not a problem for solar-kiln application. Energy transmission through the glass is virtually unaffected.

When you get the salvaged patio doors home, remove the panels from the frame. A thin strip of aluminum between the glass panels forms an airspace. This in turn is sealed by a rubber gasket between the aluminum strip and each glass panel. A sharp utility knife works well to slice through the rubber seal. Cut around both sides of the aluminum strip to fully separate the panels. You don't have to clean off the seal material that remains stuck to the glass, because it will be helpful in holding the glass in place when you install the panels in your kiln.

My kiln has single-thickness tempered panels that are 46 in. by 76 in. These panels are from the standard 4-ft.-wide patio sliding doors, but you might also find 3-ft.-wide doors with 34-in. by 76-in. glass. The law now requires that glass be tempered for strength and safety reasons, so check to make sure older panels are tempered as well. If they are tempered, the words "safety glass" will be etched in one of the corners.

Two further words of caution: The process of tempering creates large internal stress within the glass. As a result, the glass is very sensitive to pressure or shock, which causes it to shatter, just like an automobile windshield. This also is why the glass cannot be cut. So, it's important to base your detailed layout on the actual glass panel size. Also, when handling the panels, be especially careful to avoid knocking the edges.

—J. W.

great assurance that the end product will be free of drying defects. Because a natural balance is established between the drying wood and its environment within the kiln, "overdrying" isn't a problem.

Kiln design—My experience with solar kilns includes the construction and operation of five units in as many years. I also learned from previous experimenters. The Forest Products Laboratory has published a report on a small solar-heated dryer (Report FPU-7, available from Information Services, U.S. Forest Laboratory, 1 Gifford Pinchot Drive, Madison, Wis. 53705-2389). That kiln, like mine, has a simple design and is easily built using readily available construction materials. With a south-facing flat plate attached, it uses an overhead fan to drive the heated air down through the stack of lumber.

I also read about other designs using condenser curtains to remove moisture, but I've concentrated on simplifying kiln design. My structure costs about one-tenth that of a similar-size commercial unit, is built from readily available materials and works as effectively as the more complex Forest Products Laboratory model. In addition, my design is virtually maintenance free.

Construction—Building the kiln is straightforward, and you'll find the necessary dimensions and details in the drawings on p. 74 and p. 75. Here I'll tell you the procedure I used to build my kiln, as well as offer some hints to make the job easier for you. Begin construction by selecting a location that affords a good southern exposure, unshaded by trees or buildings. Cover the area with gravel and level a 6-ft. by 16-ft. section for the concrete block foundation. Now, cut and assemble the floor frame using the 4x4 stringers. Cut dadoes in the end pieces to terminate the stringers. Next, nail the plywood floor in place.

When building a kiln in a temporary location, I sometimes replace the concrete blocks with sturdy hardwood pallets and fasten the floor directly (no stringers) to them using drywall screws. In fact, I use these screws, up to 3 in. in length, to put together the entire kiln. They install easily, hold well and enable me to quickly and conveniently disassemble the structure to relocate it later on.

The kiln is framed with standard 2x4 studs covered with plywood. The south wall and roof support the recycled patio glass panels you've scrounged up (see the sidebar at left). The kiln shown here uses the most commonly available 46-in. by 76-in. glass panels. Four panels are used for the south wall and another four make up the roof. Allow for a 3/8-in. gap between panels. You'll need the spaces later for installing the window stops.

Fabricate the back, side and front walls separately, then attach the plywood siding. Incidentally, don't worry too much about getting the joints and seams tight. Air will infiltrate into the kiln through cracks in the same way air in your home is replaced periodically. A "leaky" kiln is desirable, because it improves the air circulation through the wood stack and results in more efficient moisture removal.

Access to the kiln for loading and unloading wood is accomplished by simply removing one of the end walls, so for convenience, use a minimum number of screws to secure this wall in place. For the infrequent visits to the kiln to monitor drying progress, I've installed a simple, strap-hinged door in one of the end walls. Lastly, note the plate detail at the bottom of the front-wall frame (see figure 1, detail B on p. 74). The plate extends out 1/4 in. to serve as a sill for the glass panels to rest on. Because the plate is exposed, it's a good idea to make it out of pressure-treated wood.

Next, you'll need to create a baffle by nailing a partial sheet of plywood to two of the back-wall studs. The bottom opening of the baffle will have to be custom-fit to work effectively with your circu-

lating fan. The idea here is to install the fan so it can draw warmed air from the top of the kiln down through the baffle and then direct it up through the bottom of the stacked lumber. I used a 150cfm squirrel-cage fan with an integral 1/10-HP motor, which costs about \$50. It's similar to the exhaust fans commonly used in bathrooms or kitchens, and it is sold by building-supply stores. Install a line-voltage thermostat that's adjustable in the range of 35°F to 90°F. I used a Dayton #2E158A, which can be purchased from heating-and-cooling-equipment suppliers for about \$24. The thermostat is wired in the same way as a commonly used single-pole switch. You'll need to adjust the switch seasonally so the blower turns off when temperatures drop below 55°F in the winter and 80°F in the summer. You may also want to install a power on/off switch so you can control the system manually. If your site is remote and electrical power is unavailable, you can do without the fan and baffle, but you'll need to provide more space between pieces of lumber in the stack to improve the air circulation. Leaving a 6-in.-wide chase-way up through the center of the stack will help considerably. The kiln will work this way; drying just takes longer and takes place less uniformly within the stack. Lumber located in the "dead" areas, away from the freely circulating air, will dry more slowly. For example, I've found that after four months of drying, the top one-third of the stack has reached 6%MC to 8%MC, but the remainder of the stack is still a "wet" 10%MC to 12%MC.

If you already have your wood, load it into the kiln now; you can use the stack as a platform while building the roof. Notch the rafters as shown in figure 2, p. 75. The notch, or bird's-mouth, which joins the top plate of the front wall, holds the front glass panels in place. So, it needs to be cut large enough to accommodate the thickness of the glass. Take care to maintain this space for the glass when you install the rafters. The rafters support the glass roof panels along the edges and centerline of each panel. If you have smaller panels than those used here, the center rafter can be eliminated. Tempered glass is strong—it's used for skylights—and the rafter layout used here provides ample support.

When you install the glass panels, be especially careful to avoid knocking the edges: They shatter easily. It's a good idea to use stop blocks or a toeplate at the lower end of the rafters to hold the roof panels in position. Cover the edges of the glass panels with 1-in. by 1½-in. wood strips, which can be screwed to the rafters or studs through the ¾-in. space between adjacent panels. For a more permanent setup, apply a silicone caulk bedding for the strips and cover them with an aluminum cap. One final comment: A 2-in. gap is intentionally left under the roof panels at the top of the front wall so moist air can escape from the kiln.

Using the kiln—My experience with this kiln isn't much different than the results reported for the more complex Forest Products Laboratory design. The time required for drying depends on your particular location, the time of year and amount of available sunshine. The species of wood also affects the drying time: High-density woods like oak dry slowly; low-density woods like pine dry more rapidly. In southern Michigan, a batch of 1-in.-thick hardwoods can be dried to about 8%MC in four to five months if started in March; a second batch can be dried by November. The winter months are marginal because there are too few sunny days.

I'm continuing to experiment with the kiln to reduce the drying time. I've found that the air circulation can be improved by positioning the 4-in. stringers (which support the wood stack), as shown in figure 1, to form a baffle, which helps force the air through the stack. I've also tried reducing the air gap at the top of the front wall during the final stage of drying to reduce air flow and increase temperature. The effectiveness of this fine-

tuning remains an open question.

If you decide to experiment with your kiln, you'll find a moisture meter to be a good investment. Moisture meters are available from woodworker supply houses for about \$100. *FWW on Wood and How to Dry It* describes a shop-built model. Moisture content can also be determined using a simple weight-loss method described in *FWW* #73, p. 20. □

John Wilson teaches woodworking part-time at Lansing Community College in Lansing, Mich. He specializes in making and selling Shaker oval boxes, and he depends on his solar kiln for his wood supply.

Wood-drying basics

You can dry wood simply by passing air over its surface. Left outdoors and protected from the elements, a stack of 4/4 hardwood with freely circulating air will dry to about 15%MC in about a year in the northeast United States. Further reduction isn't possible, because the moisture in the air, normally about 75% to 80% relative humidity (RH), is in equilibrium with that of the wood. (Relative humidity is a measure of the air's capacity to hold moisture and is defined as the ratio of the amount of moisture contained in the air at a given temperature to the maximum amount of moisture the air can hold at that same temperature.) Our home environments are much drier, however, typically about 40%RH to 50%RH and often as low as 20%RH in the winter. This difference causes problems for woodworkers. Furniture, to remain stable, must be constructed from woods with a moisture content no greater than 6% to 8% to be in equilibrium with the drier indoor air. In the very dry Southwest, the moisture content will be lower; in the more humid South, it will be higher. So the problem of drying wood comes down to circulating dry-enough air to produce these lower moisture levels within a reasonable amount of time.

One way to dry the air is to dehumidify it using a compressor. This is exactly what many of us do to prevent our basements from becoming too damp. Some wood kilns operate on the same principal, but of course on a larger scale: They use large compressors to remove moisture from the air inside the kiln; heat produced as a byproduct of the compressor operation keeps the temperature in the 120° range. This option is usually too expensive for the home woodworker.

Most often, dry air is obtained by heating it. More precisely, moisture is not removed from the air but rather the air's capacity to absorb and retain water is increased as a result of increasing its temperature. Saturated air (100%RH) at one temperature is something less than 100%RH at a higher temperature. This difference, by the way, accounts for our homes feeling drier in the winter: The cold infiltrating air is heated, making it relatively dry.

When air is heated, its ability to absorb moisture is increased dramatically. For example, air saturated at 30°F can hold three times as much moisture when heated to 70°F. Heating the air an additional 40°, to 120°F, increases its capacity to hold moisture by tenfold. This is the practical working range for solar kilns. A kiln can start the day with the ambient air at 70°F and 100%RH, but after being warmed by the sun for an hour or so, the temperature will be close to 120°F. The air will be very dry at this temperature—about 10%RH—and able to absorb a large amount of moisture from the wood.

For more information on the relationship between wood and air-moisture levels, see *FWW on Wood and How to Dry It* or Bruce Hoadley's book *Understanding Wood*, The Taunton Press, Box 355, Newtown, Conn. 06470.

—J.W.

Bird's-Eye Maple

Nature flaunts her 'Midas touch'

by Bill Keenan

Collecting and stockpiling interesting woods for pet projects is characteristic of woodworkers, and I'm no exception. I have a particular soft spot for bird's-eye maple. Once a lumber dealer steers me to the yard's maple stash, I quickly find myself out of control and reaching for my checkbook. But what is the mystique about bird's-eye maple that turns woodworkers into wood worshippers? It may be its golden-grain beauty and rarity, or it may be that nobody can explain how the eyes form. Like a jewel scattering light, this unique wood provides few clues to the mysterious process that forged it.

The distinctive figure, named for the way each tiny swirl resembles the eye of a bird, is usually found in the sugar or hard maple (*Acer saccharum*), one of North America's most distinctive trees, known for its shade, cream-color lumber and sticky harvest of sap. The bird's-eye figure can be found wherever maples grow, but it's most common in the harsh growing conditions of the north country. Occasionally it's found in other wood species, including soft maple, yellow birch, ash and ponderosa pine. Whatever the cause of the figure, it's a result that woodworkers prize. When a bird's-eye log is split along a plane tangent to the growth rings, the wood separates, exposing a bulging cone that extends inward on the bark-facing side of the wood and a matching pit on the log's other side. When a log is sliced lengthwise or rotary-cut for veneer, the result is the familiar bird's-eye pattern.

Individual eyes can be as tiny as pinpricks or the size of a quarter. Once bird's-eyes begin to appear, they propagate, becoming larger through succeeding outer layers of growth. Often the bird's-eyes continue to form throughout the life of the tree. Or, they may end abruptly several inches beneath the surface of the log—happy surprises that lie in wait for woodworkers.

Bird's-eye and other maples have figured prominently in American woodworking and furniture history. I'll tell you a little about it before discussing what we know about bird's-eye formation and the practical aspects of how to work with it.

Bird's-eye history—American furnituremakers have used bird's-eye veneer for more than two centuries. Although little has been recorded about its use, early furnituremakers often used maple in

intricate inlays. In the late 1700s, for example, bird's-eye flourishes were common on furniture of the Federal period.

By the late 19th century, detailed handwork combined with lavish bird's-eye touches had found its way into art-nouveau furniture and the resurgent Louis XV movement. In the late 1920s, a time of transition marked by the merging of a new linear functionalism with ornate traditionalism, the bird's-eye pattern found its niche as a stylistic ornamentation playing counterpoint to the crisp geometry associated with design trends such as Art Deco.

Virginia Boyd, a University of Wisconsin-Madison historian who specializes in American interiors, says bird's-eye maple was also used at this time for reproduction work—Chippendale and other colonial-revival pieces. Though seldom used in the originals, bird's-eye, to the 20th-century mind, became associated with the nostalgic. "It was a hearkening back to an older time and style, even though it wasn't an accurate look back," Boyd said.

Today, bird's-eye maple has found favor as a highly prized specialty wood in the repertoire of many woodworkers. While Europeans, especially Germans and Italians, seem to favor bird's-eye veneer, American woodworkers employ both veneer and solid wood. It's not unusual in the United States to find furniture made entirely of solid bird's-eye maple.

Origins—As long as bird's-eye maple has been around, so have questions about its origin. Why does bird's-eye occur almost exclusively in maple? Why does it appear in such varied patterns throughout a given tree? Like random splotches from a frenzied painter's brush, bird's-eyes may appear over the entire length of a tree, be confined to one side or scattered in irregular patches. Why, no one knows.

Theories about what causes the swirling figure have been as varied as the patterns of the figure itself. Early investigators thought it was caused by a parasitic fungus that attacked the cambium, the thin layer between bark and wood that produces new wood cells. Others suggested it was caused by boring insects, or that wounds inflicted by birds during the tree's early growth resulted in pits or grooves, which over time were filled in with fresh layers of wood growth. But these explanations don't make sense, because wounds



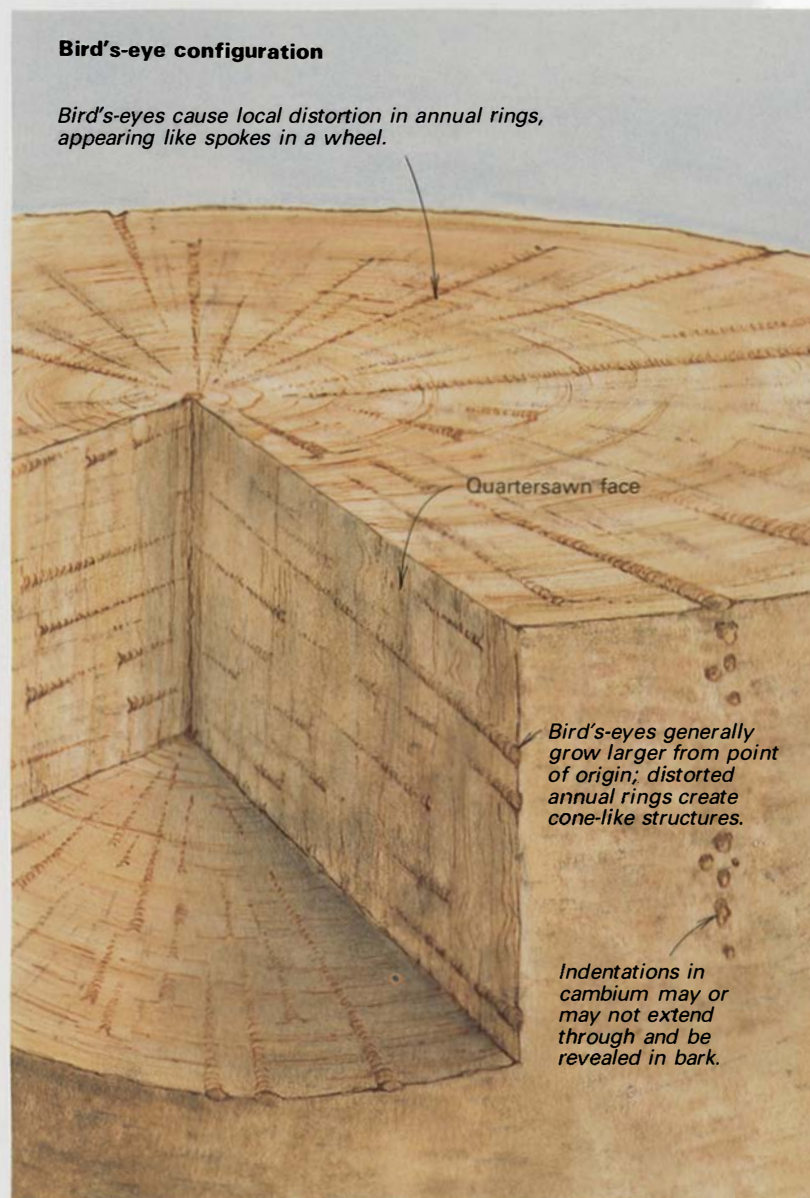
Long prized by woodworkers for its distinctive figured pattern, bird's-eye maple requires sharp tools and a deft touch to shape and smooth successfully.

in live parts of a tree normally heal over and disappear as new layers of growth are added. In bird's-eye maple, the eyes grow radially, like spokes on a wheel, and they usually increase in size. Another theory attributed the eyes to undeveloped buds that remain dormant in the inner bark. If this explanation were valid, you would expect the bird's-eyes to have dark cores and project in an outward direction. But the cores are clear and the eyes grow as conical indentations pointing inward, toward the tree's pith, as shown in the drawing at right.

In the wake of this speculation, wood scientists began to systematically sort out clues to the bird's-eye mystery. First, they noted that bird's-eye logs characteristically had dark stains or rotten heartwood. They also observed that figured trees were usually found in a dense portion of even-aged stands; they were often unhealthy and deformed. Researchers determined that maples with the bird's-eye pattern took an average of 60 years longer to reach an 18-in. dia. than the normal, unfigured trees growing in open stands. Regardless of how vigorous the trees' later growth, old bird's-eye maples had narrow early-growth rings, typical of young trees in a crowded stand that must fight for available light. Whatever the direct cause of bird's-eyes, suppression of the tree is probably linked to their development.

In the most recent effort to unravel the bird's-eye mystery, a researcher at the U.S. Forest Service's Northeastern Forest Experiment Station observed that a viral agent fit the known facts of bird's-eye formation better than any hypothesis so far. However, to date, the experimental work has been inconclusive: Nature continues to guard her secret well.

Finding bird's-eye maple—The value and popularity of bird's-eye maple, especially during the 1930s, prompted researchers to attempt to mass produce it using graftings of tissue from highly figured trees—without success. So bird's-eye aficionados cling to the few available clues to guide them in their search. Bird's-eye has been found in trees as small as 2 in. in diameter, and tiny depressions found on 1-in. maple saplings may be a sign of its beginning. As the tree adds layers of growth, these small depressions grow in size, sometimes extending through the bark. When present, and



often they're not, these depressions are advertisements for a buried treasure.

If you're in the woods looking for bird's-eye maples, check along hollows and gullies or on the northwest slopes of hills. These are areas where young trees have to tough it out, and consequently, are ideal environments for bird's-eye formation. It also helps to know if bird's-eye maples are apt to grow in your region. In southern Wisconsin, which is not prime bird's-eye maple country, foresters say you might find one tree out of 10,000 with good bird's-eye figure. But loggers say that 300 miles north, in Michigan's upper peninsula—bird's-eye maple heaven—you'll find approximately one maple in 400 with the figure.

Characteristics—Structurally, bird's-eye maple isn't much different from normal hard maple. Because figured maples grow slower, you might expect the wood to be a bit denser. Air-dried bird's-eye maple weighs 47 lbs. per cubic foot and has a specific gravity of .68, a bit higher than the .63 for normal air-dried maple.

Bird's-eye maple is a hard, tough wood. It has a uniform texture, glues well and takes a good finish. Its creamy white wood is often streaked amber to brown, usually the result of defects or disease in the tree. Technologists at the Forest Products Laboratory say grain deviation in mildly figured bird's-eye maple won't affect strength, but they caution that highly figured wood won't be as strong as straight-grained wood for spindle support members, such as chair legs.

Bird's-eye maple seasons slowly, and because of its wild grain, has a higher shrinkage factor than ordinary hard maple. This can cause buckling as it dries. In fact, careful drying of the wood is critical. Air-drying or the use of a solar kiln with a slow drying schedule are best. Rapidly kiln-dried bird's-eye maple can result in twisted lumber with eyes eager to chip out. Hairline cracks around the eyes are a sure sign the wood has been dried improperly. Because of the way the eyes grow, most bird's-eye lumber is plainsawn to reveal the full figure; if quartersawn, the figure will be masked.

Prices for bird's-eye lumber vary widely depending on the amount of figure. Strangely enough, through a quirk in the National Hardwood Association's rules, bird's-eyes, like so many knots, are counted as defects. Consequently, bird's-eye maple that's not sorted for specialty markets at the sawmill may be graded low. This, no doubt, accounts for a lot of 2-in.-wide bird's-eye maple strips I've seen ignominiously gracing gymnasium floors. Fortunately, loggers are a pretty shrewd bunch: Before maple logs are run through the sawmill, the obvious bird's-eye logs are sorted out. Good bird's-eye can bring a sharp-eyed logger an extra \$100 per 1,000 bd. ft.

European veneer buyers also have a warm spot for bird's-eye logs. According to one veneer exporter, the Europeans have their own grading system for bird's-eye veneer logs. He says they look for white wood, large eyes and a lot of curl. They examine a log by scooping out small portions of wood with a knife and by checking for the spoke-like pattern of bird's-eye on the ends of a log. Most woodworkers, however, aren't so particular: Some prefer bird's-eye maple that has rich streaks of brown in it, feeling that it gives the wood more character.

Working with bird's-eye—Despite my affection for bird's-eye maple, I use it sparingly. Because it's so "busy" visually, I think it requires a well-developed design eye to make it work effectively. But with some thought, this extravagantly figured wood can transform nice work into special work. The deviating grain around the eyes gives the wood a chatoyant quality: It gathers light in ripples, providing a luster as changeable as that of a fire opal.

The very qualities that make this wood so appealing to the eye

also make it a nightmare to work. The swirling grain is notorious for chipping out, so planing it can be an exasperating experience. The dense wood will burn on a belt sander if you aren't careful, so make sure your belts are reasonably new, and keep the work moving to avoid burn marks.

I've had good luck using a hand scraper for finishing touches. Hone the scraper and then put a light burr on it by running a burnisher over the edge once or twice. Use a shallow angle, and pull the scraper lightly across the wood's surface.

To find out how others approach the surly stuff, I talked to some woodworkers who use bird's-eye maple regularly. Some of them, especially the ones that require precise dimensions for joinery, don't like to mess with thicknessing it themselves. They prefer to buy it to thickness or glue it up and take it to someone who has a heavy-duty thicknessing sander. The dollars spent, they claim, are well worth the time saved and the avoided aggravation.

Those who do plane it themselves use varying techniques seasoned with a lot of common sense. Planing only the side of the board closest to the pith is a logical approach to bringing it to the desired thickness (the other side is just thickness-sanded). Because bird's-eye grows as a series of cones pointing toward the tree's pith, the planer blades, in theory, slice off the protruding cones, leaving a smooth surface. Another woodworker takes a similar approach with an added twist: He sharpens his planer blades and then gives them a 10° back bevel. In effect, the blades act as scrapers, so he can't remove much—sometimes as little as 1/64 in. on a pass, depending on the wood's figure. But, he ends up with a satin-smooth surface on bird's-eye maple and other troublesome woods, like quartersawn cherry.

Machining bird's-eye wood on a jointer is straightforward, but common sense should prevail. Examine the grain to determine which way to run the plank through. A reliable method is to run your thumb along the edge to feel the stubble of the opposing grain so you can tell which direction is the path of least resistance and thereby minimize tearout. Make sure your blades are razor sharp, then run the wood through slowly, taking off 1/32 in. or less on each pass.

The cross forces exerted by the wild grain in bird's-eye wood probably help to stabilize it. Once flat, bird's-eye lumber will generally stay that way. However, like other woods, bird's-eye lumber can cup if it dries unevenly. If you have the time, it's a good idea to let it adjust to conditions in your shop after preliminary machining. After a couple of weeks, you can true it up.

Bird's-eye maple turns nicely, and I haven't run into any problems with chipping: I keep my gouges and scrapers sharp and use a light touch. The orientation of the bowl blank on the lathe is a matter of preference, not utility.

Working with bird's-eye maple veneer isn't much different than working with other veneers, but according to furniture designer Dick Wickman of Verona, Wisc., bird's-eye veneer tends to crack along parallel lines that can break through the finish.

Bird's-eye maple can be finished like most other woods, but here's how professional woodfinisher Rob Ray of Madison, Wisc., finishes bird's-eye solid wood and veneer: First, he applies one coat of lacquer, diluted 3:1 with lacquer thinner, and allows it to dry. This fills the pinholes and makes loose fibers stand up. Then, he scuffs the surface lightly with 320-grit sandpaper, being careful not to sand through the lacquer surface. Now he applies a color-matched paste wood filler, thinned with naphtha. He lets this just barely dry, then wipes the surface with burlap and rags. He applies the surface finish of his choice, and completes the job by hand-rubbing. □

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A Chinese woodworker assembles an elaborately carved hall table at a furniture factory near Shanghai. During a tour of China, the authors visited large and small shops, factories and museums, and found centuries-old woodworking traditions coexisting with modern technology.

Woodworkers' Tour of China

Ancient ways persist in the age of automation

by John Kriegshauser and Nancy Lindquist

Our 16-day woodworking tour of China revealed a country in transition—married to centuries of tradition while plunging into the future. We saw wayfaring carpenters vying with automated factories, while the genius of Chinese woodworking lured us with its unique sense of design, bewildering complex joinery and mysterious lacquer finishes. Our purpose was to learn about Chinese woodworking by participating in shop and museum tours and by simply nosing about. Traveling extensively, we made stops in Guangzhou (Canton), Beijing, Shanghai, Hangzhou, Xi'an and Hong Kong.

Despite the availability of factory-made furniture, we saw itinerant carpenters plying their trade on sidewalks next to high-rise apartments. When a couple marries, furniture is traditionally provided by the husband's family. Frugal families will buy lumber and hire the carpenters to build traditional but crudely carved furniture. The family provides these journeymen with room and board plus a good wage by Chinese standards. And, the couple has their home furnished for about one-third of what it would cost retail. In the older neighborhoods of single-story houses, we saw several small shops equipped with crude machinery that produced old-style

doors, gates and window sashes that keep the houses in repair (see the top photo on the next page).

Even though we came to see traditional Chinese woodworking, we started the trip touring several factories, most as automated as their Western counterparts. But, many operations are more dependent on the country's vast labor pool than on machinery. The average Chinese factory employs 10 times as many workers as an American factory. Material handling, for instance, is a sanctioned form of "busy" work. The largest factory we saw, located in downtown Shanghai, is equipped with the latest veneer slicers, a plywood-seat mold and automated finishing equipment, but it has no conveyance system save for workers hustling hand trucks piled with planks and furniture parts. The factory employs 1,600 men and women, some in their late teens to early 20s; older workers are absent, having been driven from the craft by the social disruption of the last 30 years.

Our hosts proudly ushered us into their showroom: Chinese styles are out, clumsy looking French provincial and Scandinavian designs are in. Western styles are popular, because they are "modern," but they are reminiscent of the humble 1920s- and 1930s-style pieces



Joinery shops, such as this one in Beijing (above), supply the old-style gates, doors and window sashes needed to repair houses in older neighborhoods. Safety standards in these shops would make many Western woodworkers shudder: Note the jointer in the foreground without a safety guard or fence and the shopmade tablesaw in the background. Finishers line the windowless, dimly lit room (below) with damp straw mats to provide the high humidity environment necessary to properly cure their lacquer finishes. In the urban factories, burlap is sometimes used in place of the mats.



that clutter our secondhand furniture stores. Our guide had difficulty finding hand-crafted furniture to show us, but eventually he located the rural Shanghai Art Carving and Engraving Factory, where a fellow guide had taken President Jimmy Carter some years ago.

Shanghai factory—This rural factory is like a vision from the early days of the industrial revolution in the West. There are rows of workbenches lining a long wall of windows. Elsewhere, electricity is used mainly to power scattered fluorescent lights. Nonetheless, the showroom is filled with beautifully made lacquered reproduction furniture. The company's entire product line is exported. The 250 factory employees produce about 100 different designs in Brazilian mahogany, but they also rely on a variety of hardwoods from Thailand.

Power tools are used for sizing lumber and for roughing out simple work, but the carving, joinery and finish-planing are done exclusively with hand tools. We watched a worker deftly fit a door with a mitered frame to a cabinet slightly out of square. He sawed between the mitered shoulders, down to the tenon, on one face and repeated this on the opposite face. He brought the joint together, producing a door that was out of square just enough to match the cabinet. Chinese planes and saws, unlike Japanese tools, are pushed; the planes are equipped with a crossbar handgrip. Lack of machinery, however, doesn't prevent Chinese woodworkers from accomplishing their tasks quickly and efficiently. They have created many homemade tools especially for their style of wood-working, such as the "maya cuo" and "pang bao" scrapers, which are discussed in the sidebar and shown in the photo on the facing page.

Most of us knew of the natural lacquer used by the Chinese by its Japanese name "urushi," but we learned that the incredibly tough finish originated in China as "qishu" (pronounced: Chee shoo). The lacquer is the sap of the *Rhus vernicifera*, a relative of poison sumac. Finishers wear gloves and sleeves to prevent their sweat and body oils from ruining the finish, but they do nothing additional to protect themselves. Instead, workers who are allergic to the sap, which causes an irritating rash, are transferred to other jobs. Several of our group suffered from qishu rashes during our trip and took cortisone pills at the first itch, but we still had to contend with rashes, some pretty nasty, over the next two weeks.

Qishu is a major commodity in China, and more than 100,000 metric tons are exported annually to Japan. Domestic demand for qishu is high, but not just for its use as a furniture lacquer. Traditional Chinese ceremonial buildings are coated with gesso, covered with coarse cloth, then lacquered inside and out—a monumental task considering qishu's finicky curing requirements. Pigments have to be compatible with qishu's cross-linking chemical bonds or the finish loses its toughness. The pigments that work best are red cinabar and malachite, but the first is poisonous and the second is precious. Chinese finish experts don't consider qishu an effective exterior finish, but the 60-year-old lacquer finish we examined on one building showed few signs of cracking or peeling.

The workers at the factory brush at least four coats of qishu on each piece of furniture. After each coat, the piece is left in a wet room to cure overnight. Damp straw mats lining the room maintain the moisture level necessary for the finish to cure properly. The first coat, a mixture of qishu and a chalky white powder, serves as a paste filler. Between coats, bamboo shoots, which contain silica from the soil, are used to smooth tight corners; ordinary sandpaper smooths the flat surfaces. After the final coat, large bumps are removed with a chisel, and smoothing is done with wet leaves from the Chinese elm, appropriately referred to as the "sandpaper tree." A thin, final coat is padded on like French polish and then the piece is waxed. These finishers claim that only elm leaves will produce an acceptable finish, but the urban factories seem to do fine with wet-or-dry sandpaper.

Fish glue in the Forbidden City—In the center of Beijing is the colossal walled palace of the Ming and Qing dynasties (1368-1644 and 1680-1911 respectively), once known as the Forbidden City. This complex housed the imperial family, the bureaucracy and the emperor's eunuchs and concubines. It is now the Palace Museum, housing an unmatched collection of fine Chinese furniture. In the museum's restoration shops, we found one worker regluing a fine wood chair with locking tenon joints. He had disassembled the chair, because the fish glue holding the joints was failing. He was surprised that we thought such interlocking joints didn't require glue. After the repair, thin layers of hot wax are applied and buffed

Chinese shaping tools

Throughout China, we saw woodworkers using two tools new to us: the maya cuo and the pang bao. The maya cuo (pronounced: mai-YA tswa) is used primarily to contour surfaces. It has a wooden body up to 15 in. long, with a handgrip fore and aft. A row of 10 to 32 scraper blades are mounted in grooves cut into the underside of the body. Because of the simultaneous action of the multiple blades, the maya cuo possesses the advantages of both a plane and a scraper: It cuts aggressively, yet leaves a clean surface on the contrary grain of commonly used "ho mu," a red-color wood.

Workers often own several of these tools, usually of varying lengths and differing in the number and spacing of blades. Store-bought maya cuos are not as popular as homemade ones, which the workmen fashion from old sawblades.

The blades are held in place on the tool by compression alone. The stock is kerfed using a handsaw with all the set removed, which makes the kerf an exact match for the thickness of the steel. The extended projections of short grain between the kerfs are flexible enough to allow all the blades to slip into place, except for the last one. This one must be forced in, and this process tightens up the entire row. After mounting, the blades are filed into perfect



Photo this page: Michele Russell Slavinsky

Two Chinese tools that are unfamiliar to Western woodworkers, the maya cuo (top) and the pang baos (bottom), are used for surface shaping and smoothing; the pang baos are used most often on endgrain. The cutting teeth of the pang bao on the left are formed on a flat surface, while that of the one on the right are formed on a convex surface.

alignment, and the back side of each cutting edge is beveled to about 60°.

A workman showed us how the maya cuo is used to form the bead on the edge of a gently rounded leg. Using his extended forefinger as a guide, he rapidly forms a V-groove defining the bead. With the tool tilted at progressively smaller angles, he rolls the bead over in just a few more strokes.

The pang bao (pronounced: pahng bau) resembles a coarsely cut planemaker's float file with straight teeth. The pang bao is

about 6 in. long and mounted to an offset handle. It is exclusively a store-bought tool. On the mainland, we encountered coarse-cut, flat-bottom models that the workmen sharpened by scraping the face of the teeth. The pang baos shown above are from Hong Kong; they are cut finer, and one has a curved bottom.

Even though we saw these tools used as a follow-up to maya cuos, their principal application is for contouring and smoothing endgrain.

—J.K. and N.L.

to a rich luster. The finer woods were traditionally waxed, not lacquered, to highlight the beauty of the wood. We met another worker restoring diao tian (pronounced: tiao t'ien) or carved lacquer. Often 200 coats of colored lacquer are required before it is thick enough to carve. The results are amazingly intricate and beautiful, but repairing it takes an incredible amount of patience: If a piece is chipped, the patch is dabbed on a coat at a time. The lidded bowl this worker was repairing would take three months to complete.

A visit with Wang Shixiang—Recognized as China's preeminent furniture historian, Wang Shixiang (pronounced: Wahng Shee-shahng) wasn't always held in such high regard. During the cultural revolution, his obsession with the past earned him a "position" tending pigs on a commune. Wang was later reinstated as senior research fellow at the Palace Museum.

We met with him in a room furnished with antiques and stuffed sofas, where the vigorous 73-year-old Wang showed us the plates for his next book on Chinese joinery, which his wife, Yuan Chuan Yu, illustrated. When asked how to disassemble complex locking joints, Wang replied, "Well, you soak them in a pan of water and hit them with a hammer, but if you don't know what they look like inside, they might be ruined."

Wang views the work of the last century and a half as degenerate. In his book *Classical Chinese Furniture*, he explains that artisans "in their efforts to please their patrons, tried their utmost to outdo their competitors in producing furniture of original, curious and ornate designs. In doing so, they abandoned the strict principles that governed furniture design in Ming and early Qing, thus bring-

ing the golden age of classical furniture to a close." Gauging our interest in his work, he invited us to see his personal collection of furniture and artworks.

His home is a three-room house in picturesque decline, with tufts of grass growing from the tiles in the sagging roof. The interior is as humble as the exterior except for the spectacular pieces of classical furniture. He and his wife sleep on a Qing Dynasty rosewood platform bed; his desk is a 17th-century antique. The remainder of his house, save for a few narrow corridors, is stacked with books, tables, chairs and armoires he has collected over the past 40 years, not to mention bronzes, porcelains, scrolls and musical instruments. Even though the furniture would be worth a fortune in the West, selling these pieces is out of the question: Not only would Wang refuse to part with them, but they are considered cultural treasures and may not be taken out of the country. The national government plans to include his collection in a museum after he dies.

Our visit with Wang was the peak of our holiday. If you take a similar trip, make time to explore more than China's woodworking: Stroll down Shanghai's sycamore-lined streets; gasp as drivers of city buses plow through the bicycling throngs and the riders dart from disaster at the last moment. China's teeming streets turn quiet at dusk, and nightly sidewalk excursions reveal nothing frightening, only couples sparking under trees as boys on bicycles ride past singing Italian operas. You may be itching to see China, but avoid the qishu or you'll be itching even after you return home. □

John Kriegshauser and Nancy Lindquist operate Kansas City Woodworking in Kansas City, Mo. Photos by authors except where noted.



The International Turned Objects Show

New signs of the turning tide

by Michael Podmaniczky

When *Fine Woodworking* reviewed the first Turned Objects Exhibition seven years ago, former editor John Kelsey said that one of the exhibitors, Robert Leung, "is at the beginning of a journey, and it will be fascinating to see where he goes." Now that we are well into that journey, not only one individual's work, but the entire craft of woodturning has exploded into something that could only have been a dream at that first exhibition.

There is no better evidence of the ascension of woodturning in the last decade than the 1988 International Turned Objects Show (ITOS) at the Port of History Museum in Philadelphia, Penn. The exhibition is organized by Albert LeCoff and the Wood Turning Center, of which he is chairman. The ITOS is a rich smorgasbord of turned innovations and an important update of what has been going on in the world of turning. The show, which opened concurrently with the American Association of Woodturners Conference in Philadelphia (see p. 116), is scheduled to tour the United States and several countries through 1992.

The ITOS features the work of 39 turners from around the world who were invited by LeCoff, with selection assistance from American turners David Ellsworth and Rude Osolnik. These well-known turners (many of whom appeared in the first show) are joined by another 68 exhibitors who had their work juried by Osolnik, Jonathan Fairbanks, the curator from the Museum of Fine Arts in Boston, Mass., and Lloyd Herman, the founding director of the Renwick Gallery in Washington D.C.

Containing more than 300 pieces, the ITOS exhibit displays an eclectic variety of what the lathe has to offer, both as a primary

fabrication tool and as an incidental technique for turning objects made from wood, alabaster, ivory, plastic, metal and other materials. There is a staggering array of different kinds of turned pieces in evidence: vessels of all sorts, tables, stools, pens, boxes, instruments, jewelry, games and objects d'art.

Bowl turning remains the touchstone of the turner's craft in this show, and as far as materials go, burls still seem to command the interest of most turners. Turner Robyn Horn of Little Rock, Ark., emphasizes material over form with her "Redwood Geode," above, by contrasting a rich and lusciously finished interior vessel with surfaces that become coarser in texture and blander in color as the eye moves from the core to the outside.

Box turning has always allowed a lot of design and craftsmanship to be packed into a pint-size object, and there are few disappointments here. A collection of exquisite boxes by M. Dale Chase, a decorative turner from Chico, Calif., are shown above. These boxes are turned from exotic woods and ivory, and their decorative elements are machined on an antique Holtzapffel lathe. Chase's work reminds me of the simply turned, carved and lacquered boxes of the late Japanese master wood craftsman Tatsuaki Kuroda; his work was highly decorative, yet not overdone.

The turned furniture in the show includes Bob Ingram's dining table, above on the facing page, which is made of bird's-eye maple, bubinga and wenge. Ingram, a Philadelphia, Penn., furnituremaker who only does occasional turning, joined the wishbone-shape turned-and-cut-apart brackets to the tapered legs with a jig he designed 10 years ago while building a Shaker-style table.



Using a Holtzapffel ornamental lathe to cut the faceted designs, M. Dale Chase makes small boxes from many exotic materials, including these, left, made of Honduras rosewood, pink ivory wood, African blackwood and ivory. Robyn Horn's 'Redwood Geode,' below left, allows the exterior of the burl to remain naturally rough, in counterpoint to the finished vessel turned on the inside. Bob Ingram turned a 48-in.-dia. disc of bird's-eye maple for the top of his post-and-bracket-style dining table, below. The tapered legs are turned bubinga. After turning a simple ebony vessel, right, Frank E. Cummings III inlaid two bands of ivory with 14K-gold accents. He then carved a delicate openwork pattern around the top, allowing it to distort and create a lace-like effect.

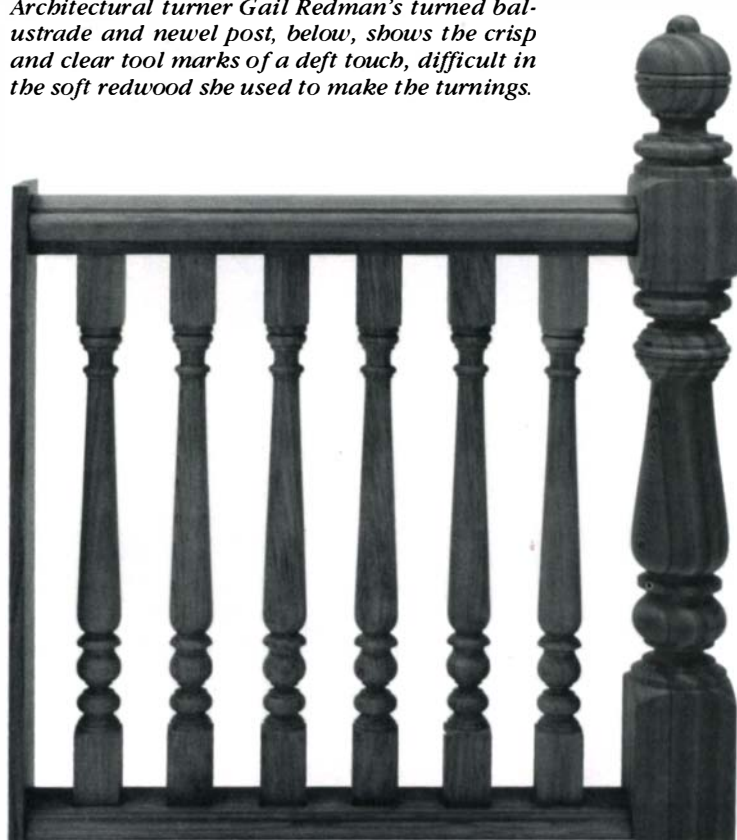


One of the loveliest objects in the exhibition is by Frank E. Cummings III of Long Beach, Calif., who produced a cup of arresting beauty he calls "Ebony Lace," shown above, right. This is a stemless cup that flows into a remarkable band of wavy, lacy carving around the lip. Around the base and lip, Cummings applied bands of ivory, overlaid by a balustrade of fine gold rods. The bands break up the flow of figure within the Macassar ebony, but the coloration is so strong that the eye cannot help being drawn up from the solid turning into the delicately carved fretwork.

Despite the kaleidoscopic range of styles and aesthetics in the ITOS, one turner's work appeals directly to my tastes. The architectural turnings of Gail Redman, right, embody all the truths of the turners trade: the simplicity and beauty of wood are unadulterated by a finish of any kind. The results of cutting edge on wood are left naked for inspection. And, the spongy, truculent redwood the San Francisco, Calif., turner chose maintains sharp, crisp corners and surfaces, and it bears not the slightest blemish of catch or tearout or any hint of an unsure hand. What is on display is nothing less than complete mastery of a craft. To me, this is what turning is all about. □

Michael Podmaniczky is a contributing editor to FWW and a furniture conservator at The Winterthur Museum in Winterthur, Del. For ITOS schedule information, contact the International Sculpture Center, 1050 Potomac St. N.W., Washington, D.C. 20007. The ITOS catalog, with pictures of all the exhibit pieces, is available from the Wood Turning Center, Box 25706, Philadelphia, Penn. 19144, for \$32 ppd. (softcover) or \$43 ppd. (hardcover).

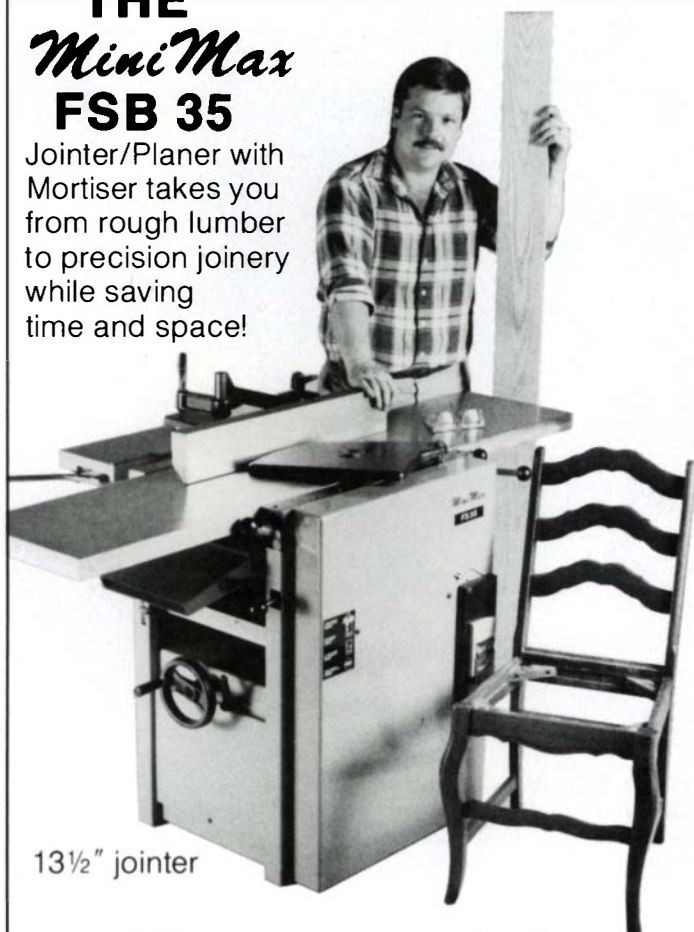
Architectural turner Gail Redman's turned balustrade and newel post, below, shows the crisp and clear tool marks of a deft touch, difficult in the soft redwood she used to make the turnings.



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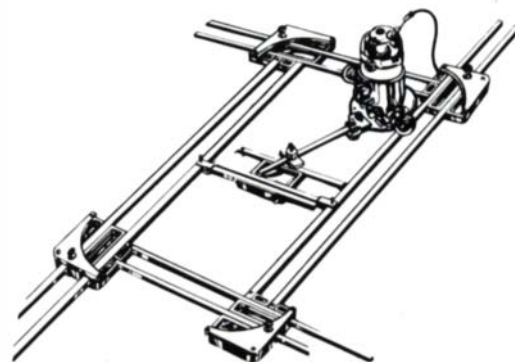
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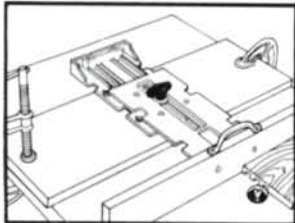
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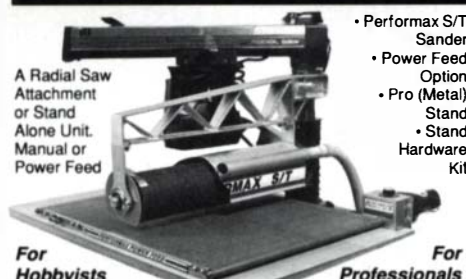
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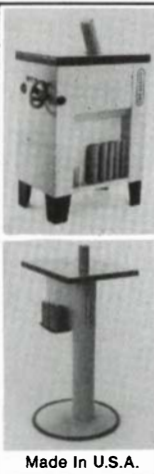
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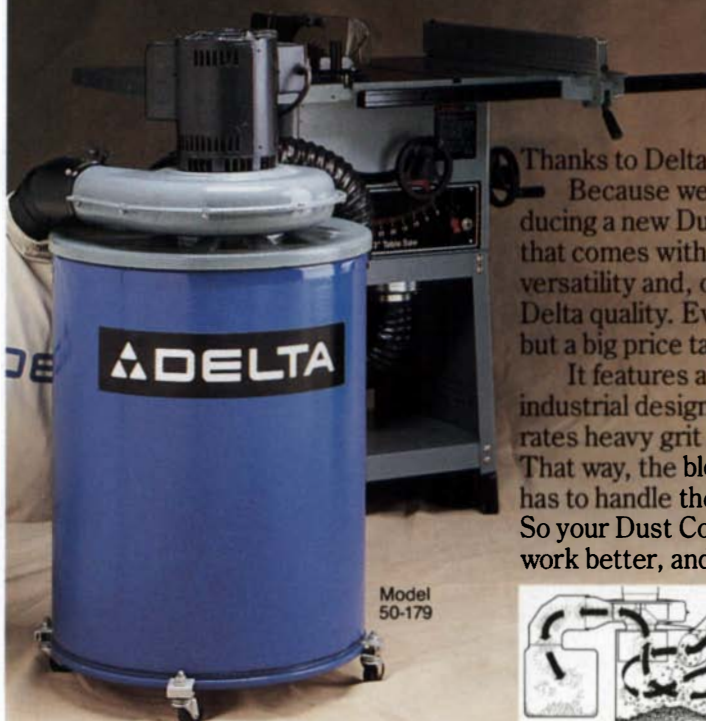
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Ryobi America Corporation, Itasca, Illinois, today announced it is making available a free upgrade kit to owners of the Ryobi 1985 Model Portable AP-10 Planer and Sears Craftsman Portable 10" Thickness Planer, Model No. 351.23372. The upgrade kit consists of a supplemental instruction sheet and outfeed table to eliminate the space between the main body of the planer and the rear outfeed support roller. Use of the outfeed table whenever operating the planer will prevent the user's fingers from being crushed between the emerging board and the rear support roller, which could result in serious personal injury.

The subject Ryobi planers bear serial numbers lower than and including 064155. Planers with serial numbers higher than 064155 include outfeed tables. The majority of units have been sold under the Ryobi brand name. However, some units were also sold under the Sears/Craftsman label through the Sears, Roebuck and Co. catalog. All owners of the Sears/Craftsman Portable 10" Thickness Planer, Model No. 351.23372, may order the upgrade kit by calling 1-800-525-2579 or by contacting their nearest Sears Service Center for further information.

Until owners receive and install the outfeed table, if the planer is used, caution must be taken to prevent finger entrapment. Wood must never be grasped until it has passed the rear outfeed support roller.

The upgrade kits for both the Ryobi and Sears models are also available from any of Ryobi America Corporation's 265 authorized service centers. For the name of the nearest service center, contact Ryobi America Corporation at 1433 Hamilton Parkway, Itasca, Illinois 60143, or call 1-800-525-2579.

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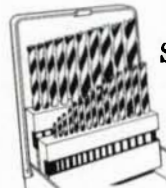
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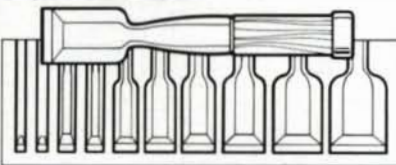


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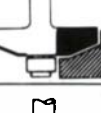
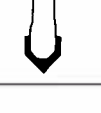
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891	1 1/2 HP router, d-handle	134.
555	NEW! plate joining machine	165.
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352	3"x21" dustless belt sander	125.
360	3"x24" dustless belt sander	195.
362	4"x24" dustless belt sander	205.
503	3"x24" wormdrive belt sander with bag	349.
314	4 1/2" Trim saw	125.
315-1	7 1/4" Top handle saw	105.
548	Heavy duty bayonet saw	165.
7546	VS, var. orbit, d-handle jigsaw	134.
7648	VS, var. orbit jigsaw	134.
9627	2-Spd. Tiger saw w/case	130.
9629	Var. spd Tiger saw w/case	130.
7523	Pos. clutch screwdriver	139.
7542	TEKS Driver	119.
7545	VSR Drywall driver	109.



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Model 2735:04

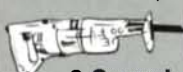
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77	7 1/4" worm drive saw	135.
5825	6 1/2" Worm drive saw	139.
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5790	10 1/4" Circular saw	225.
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EC-900	5 pc. door making shaper cutter set	319.
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LM72M008	8"x24" rip	32.
LM72M010	10"x24" rip	36.
LU73M010	10"x60" T ATB	42.
LU78M008	8"x64" TCG gen. purpose	59.
LU82M010	10"x60" T TCG	42.
LU84M008	8"x40" 4&R Combination	42.
LU84M011	10"x50T 4&R combination	37.
LU85M008	8"x64T ATB fine cut-off	49.
LU85M010	10"x80T ATB fine cut-off	59.
LU85M014	14"x108T ATB fine cut-off	98.
LU85M015	15"x108T ATB fine cut-off	105.
PS203	7 1/4"x24T ATB gen. purpose	18.
PS303	7 1/4"x40T ATB gen purpose	23.
WC106	6 pc. chisel set	34.

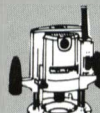
0239-1	1/2" drill, keyless chuck	115.
0224-1	3/8" Magnum horeshooter	105.
0234-1	1/2" Magnum horeshooter	105.
0375-1	3/8" close-quarter drill	135.
0379-1	1/2" close-quarter drill	159.
1676-1	Hole-hawg kit	225.
3002-1	Electricians rt. ang. drill kit	169.
3102-1	Plumbers rt. ang. drill kit	175.
5397-1	3/8" VS hammer drill kit	145.
5880	Heat gun	54.
5925	2 hp router	220.
5935	3"x24" dustless belt sander	219.
6012	4"x24" dustless belt sander	225.
6012	1/3 Sheet pad sander	99.
6014	1/2 Sheet pad sander	109.
8215	16" Electric chainsaw	139.
9226	2 speed bandsaw w/case	249.
6246	Single speed jigsaw	125.
6256	Variable speed jigsaw	140.



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2 Speed Sawzall
Model 6511

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6507	Var. sp. sawzall w/case	129.
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FREIGHT INCLUDED

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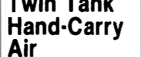
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3/4 HP
Twin Tank
Hand-Carry
Air
Compressor
Model
AM39-HC4

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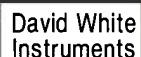
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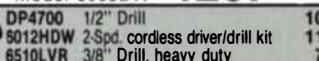
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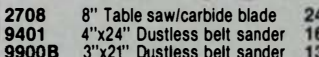
D1258-12 12" Dovetail jig, blind & through 259.

D1258-24 24" Dovetail jig, blind & through 309.



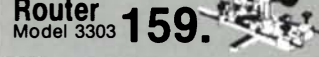
Makita
7 1/4" Framers Saw
w/hypoid gears
Model
5077B

139.



BLACK & DECKER
1 HP Plunge
Router
Model 3303

159.



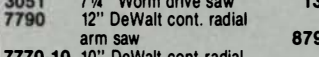
BLACK & DECKER
7 1/4" Super
Saw Cat
Model 3047-09

165.



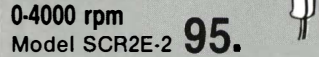
DELTA
10" Unisaw
1 1/2 HP
34-761F

1099.*



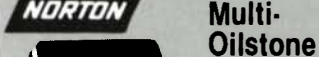
DELTA
10" Contractors
Saw w/1 1/2 HP
motor
Model
34-410

599.



DELTA
14" Wood bandsaw w/std.,
1/2hp motor

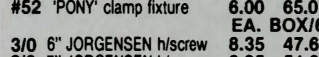
450.*



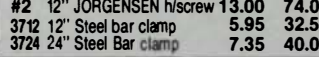
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43-122 Shaper, light duty, 1hp, 1 ph 450.*



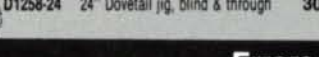
DELTA
22-851 RC-33 13" Planer



DELTA
37-150 6" long-bed jointer w/electricals



DELTA
37-350 8" long-bed jointer w/electricals



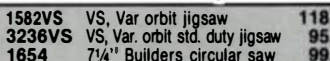
DELTA
31-730 6" Belt, 12" disc w/electricals



DELTA
34-985 Production stock feeder

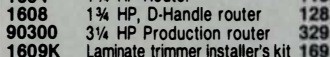
875.*

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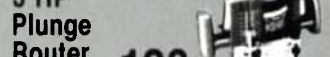
BOSCH
VS, Var orbit jigsaw

118.



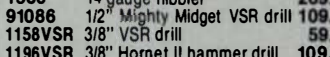
BOSCH
VS, Var. orbit std. duty jigsaw

95.



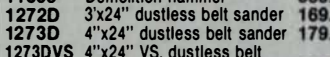
BOSCH
7 1/4" Builders circular saw

99.



BOSCH
16 gauge shears

205.



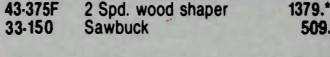
BOSCH
Heavy duty heat gun

69.



BOSCH
Std. duty heat gun

59.



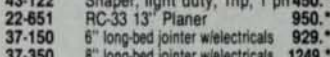
BOSCH
3 1/4" Power plane

119.



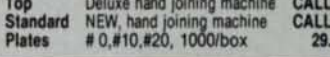
BOSCH
2 1/2 HP, D-Handle router

245.



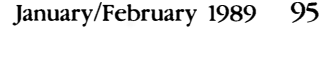
BOSCH
1 3/4 HP Router

119.



BOSCH
1 3/4 HP, D-Handle router

128.



BOSCH
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329.

Laminate trimmer installer's kit

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118.

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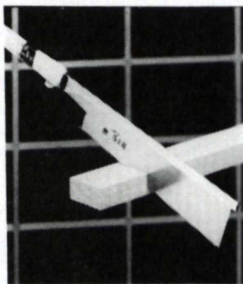
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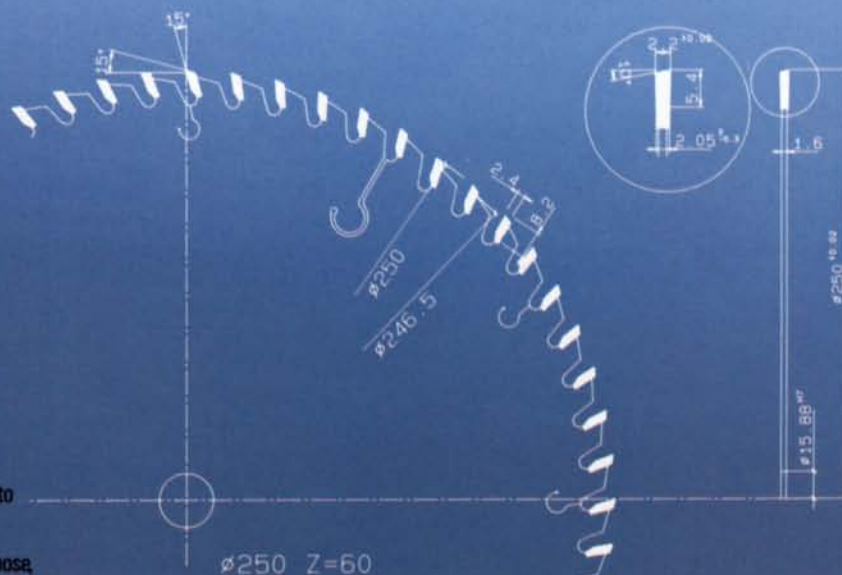
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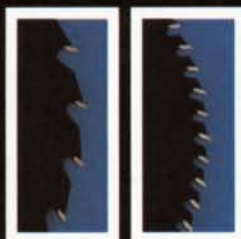
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Thin kerf blade compared to standard kerf blade



Freud thin kerf blades
Rip (left), Crosscut (right)

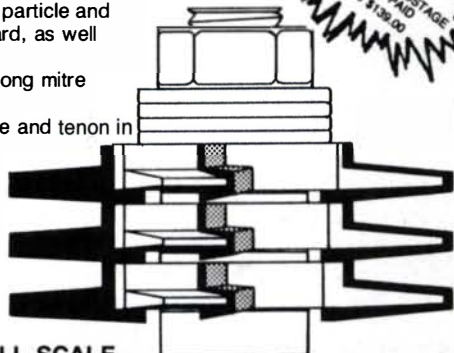
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1a. Title: Fine Woodworking. 1b. Publication no. 03613453 2. Date of filing: September 29, 1988. 3. Frequency of issue: Bimonthly. 3a. No. of issues published annually: 6. 3b. Annual subscription price: \$22.00. 4. Location of office of publication: 63 So. Main Street, PO Box 355, Newtown, CT 06470. 5. Location of the headquarters of the publishers: 63 So. Main Street, PO Box 355, Newtown, CT 06470. 6. Publisher: Paul Roman, 63 So. Main Street, PO Box 355, Newtown, CT 06470; Managing editor: Dick Burrows, 63 So. Main Street, PO Box 355, Newtown, CT 06470. 7. Owner: The Taunton Press, Inc., 63 So. Main Street, PO Box 355, Newtown, CT 06470. Stockholders owning or holding 1 percent or more of the total amount of stock: Paul Roman, 63 So. Main Street, PO Box 355, Newtown, CT 06470; Janice A. Roman, 63 So. Main Street, PO Box 355, Newtown, CT 06470. 8. Known bondholders, mortgagees and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages or other securities: None. 9. Not applicable. 10. Extent and nature of circulation:

	Average no. copies each issue during preceding 12 months	Actual no. copies of single issue published nearest to filing date Sept. 29, 1988
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2. Mail subscription.....	227,376	228,356
C. Total paid and/or requested circulation.....	286,116	289,331
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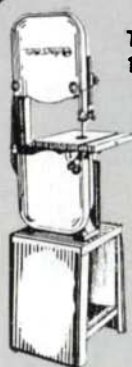
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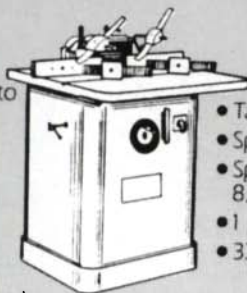
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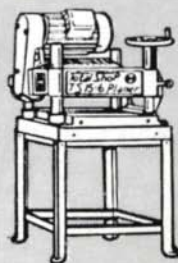
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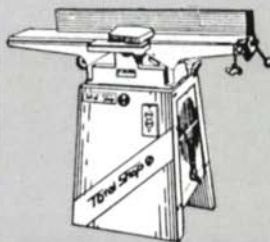
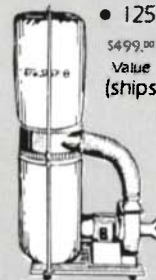


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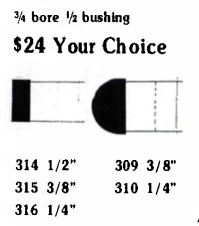
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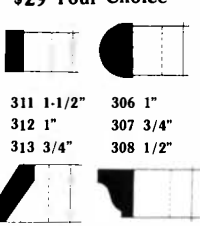
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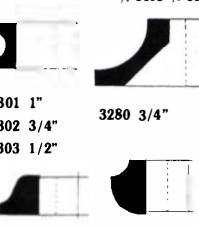
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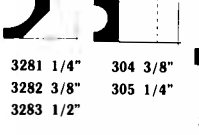
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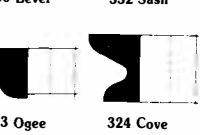
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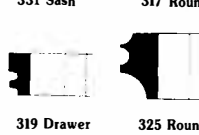
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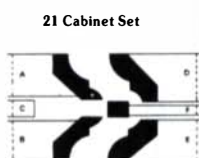
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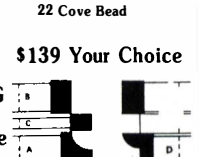


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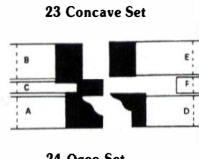
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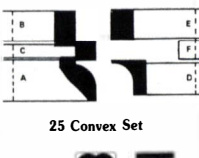
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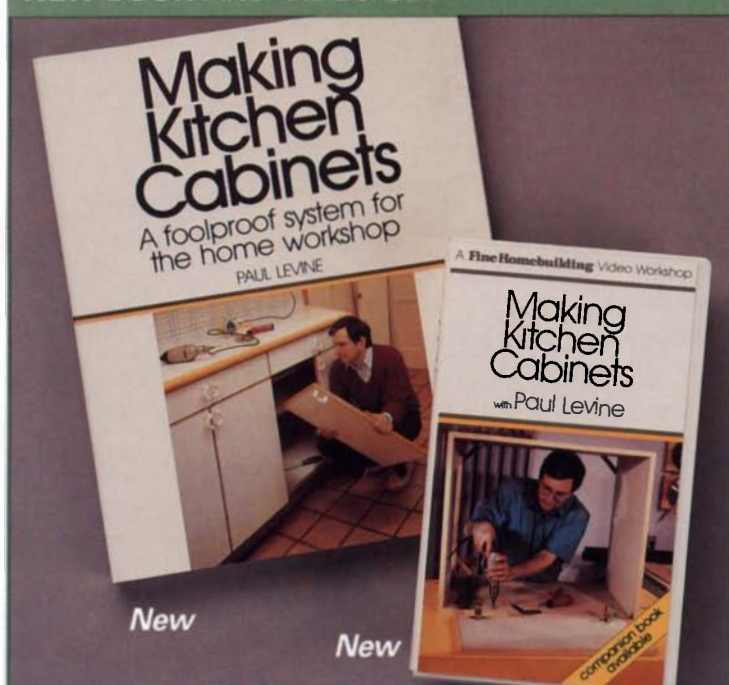


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Yellow poplar (*Liriodendron tulipif*

Listings of gallery shows, major craft fairs, lectures, workshops and exhibitions are free, but restricted to happenings of direct interest to woodworkers. We'll list events (including entry deadlines for future reviewed shows) that are current with the months printed on the cover of the magazine, with a little overlap when space permits. We go to press two months before the issue date of the magazine and must be notified well in advance. For example, the deadline for events to be held in March or April is January 1; for July and August, it's May 1, and so on.

ALASKA: Exhibit—"Design '89," an exhibit of furniture and jewelry, Jan. 6-29. Civic Center Gallery, Alaska, Fairbanks. For more info., contact Frances Brann Woodworking, Box 298, Delta Junction, 99737. (907) 895-4281. **Seminars/workshops**—Yearly seminars and workshops. Contact the Alaska Creative Woodworkers Assoc., Box 201796, Anchorage, 99520-1796. (907) 345-3077.

ARIZONA: Classes/workshops—1-yr. woodworking program, 4-mo. guitar-building course, various workshops, Jan. thru Dec. Write Roberto-Venn School of Luthiery, 4011 S. 16th St., Phoenix, 85040. (602) 243-1179.

CALIFORNIA: Show—California Art Buyers Caravan Show, Jan. 13-15. Long Beach Convention Ctr., Long Beach. Show's open to buyers from the trade only. For info., call Paul Karel at (314) 421-5445, or write him at Art Buyers Caravan, 408 Olive St., St. Louis, MO 63102. **Workshop**—A Day With Sam Maloof, master woodworker, Feb. 25 & Apr. 29. Contact Barbara Moore, Univ. of CA, Univ. Extension, Riverside, 92521-0122. (714) 787-4102. **Class**—Building the 10-ft. Herreschoff pram, with Simon Watts, Jan. 28-Feb. 4. Contact Crissy Field, National Maritime Museum Assoc., Bldg. 275, San Francisco, 94129. (415) 929-0202.

COLORADO: Workshops—1- & 2-week workshops in furnituremaking and design. Contact Anderson Ranch Arts Ctr., Box 5598, Snowmass Village, 81615. (303) 923-3181.

CONNECTICUT: Juried exhibit—32nd annual crafts expo, July 13-15. Historic Guilford Green, Guilford. Applications due: Mar. 10. Write 32nd Annual Guilford Handcrafts Expo, Box 589, 411 Church St., Guilford, 06437, or call Fern Hubbard or Joyce Wright at (203) 453-5947. **Exhibit**—An exhibit of turned wood, Feb. 1-Mar. 18. The Elements, Gallery of Fine Contemporary Crafts, 14 Liberty Way, Greenwich, 06830. (203) 661-0014. **Workshops**—Router techniques, Feb. 4; European cabinetmaking, with Paul Levine, author of "Making Kitchen Cabinets," Feb. 25-26; 18th-century chairmaking, Mar. 4-5; woodfinishing techniques, Mar. 18-19. For more info., contact the Brookfield Craft Center, Box 122, Brookfield, 06804, or call (203) 775-4526 or 853-6155.

DISTRICT OF COLUMBIA: Show—6th annual Woodworking World Show, Feb. 18-20. The DC Armory. Contact WANA, Box 706, Plymouth, NH 03264; or call (800) 521-7623 or (603) 536-3768 Mon. thru Thurs. **Fellowships**—2nd annual fellowship program for scholarly research in the modern American craft movement. Applications due: Jan. 15; appointments on or after Jan. 1. Write the Office of Fellowships & Grants, Smithsonian Institute, Ste. 7300 L'Enfant Plaza, 20560. (202) 287-3271.

FLORIDA: Show—Orlando Art Buyers Caravan Show, Feb. 11-13. Expo Centre, Orlando. Show's open to buyers from the trade only. For more info., call Paul Karel at (314) 421-5445, or write him at Art Buyers Caravan, 408 Olive St., St. Louis, MO 63102. **Shows**—"All About Wood," presentation of woodworking, forestry, tools, crafts, furniture. Located at various malls throughout FL between Jan. 19 & Apr. 16. For more info., contact The Micropolis, Inc., 251 Rolling Oaks, St. Augustine, 32086. (904) 797-2600.

GEORGIA: Show—Nat'l Assoc. of Home Builders 45th Annual Convention and Exposition, Jan. 20-23. World Congress Center, Atlanta. For registration info., contact Betty Christy, Public Affairs Division, NAHB, 15th and M Streets, N.W., Washington, DC 20005. (202) 822-0200. **Juried Exhibit**—36th Arts Festival of Atlanta, Sept. 16-24. Piedmont Park, Atlanta. Application deadline: Jan. 25. For prospectus, write Arts Festival of Atlanta, 501 Peachtree St. N.E., Atlanta, 30308, or call (404) 885-1125.

ILLINOIS: Show—"Artists in Wood," carving show, Feb. 18-19. Contact Rock River Valley Carvers, Box 204, Sterling, 61081, or call Steve Majewski at (815) 625-8531 or 625-3203 (evenings).

IOWA: Show—16th annual "Iowa State Woodcarvers Show—'89," Apr. 22-23. Waterloo Arts & Rec. Center, 225 Cedar St., Waterloo. For info., contact Roger Seehusen, RR 1, Parkersburg, 50665, (309) 346-1319 or Gary Loshman, 317 Oak Park Circle, Waterloo, 50701, (309) 232-6198.

KANSAS: Juried exhibit—Topeka Competition 13, Apr. 2-May 1. Slides due Jan. 9. Open to KS, NB, MO & OK residents. \$15 for up to 3 entries; include SASE, clay, glass, metalwork/jewelry, fiber, wood or a combination. Contact

Gallery of Fine Arts, Topeka Public Library, 1515 W. 10th, Topeka, 66604-1374. (913) 233-2040.

MARYLAND: Exhibit—The Winter Market of American Crafts (ACC Craft Fair), Feb. 14-16 (trade), 17-19 (public). Baltimore Convention Center, Pratt & Charles St., Baltimore. Contact ACC Craft Fair, Box 10, 256 Main St., New Paltz, NY 12561. (914) 255-0039.

Show/sale—9th annual Harford Day School Waterfowl Show and Sale, Feb. 18. Harford Day School, 715 Moores Mill Road, Bel Air, 21014. (301) 879-2350 or 838-4848.

MASSACHUSETTS: Exhibit—"Specific Spaces: Unique Furniture," Jan. 3-27. Clark Gallery, Box 339, Lincoln Station, Lincoln, 01773. (617) 259-8303.

Juried fair—19th annual craft fair, May 19-21. Grounds of the Worcester Center for Crafts. Application fee \$15; deadline Feb. 14. Write Craft Fair Registrar, WCFC, 25 Sagamore Road, Worcester, 01605. (508) 753-8183.

Workshop—10th annual Wood Identification Workshop, Jan. 3-6. Univ. of Mass. at Amherst. Introductory workshop by Dr. Bruce Hoadley; \$285 fee. Contact Alice Szlosek or Trudie Goodchild, Div. of Continuing Ed., Room 608, Goodell Bldg., Univ. of MA, Amherst, 01003. (413) 545-2484.

MICHIGAN: Juried fair—30th annual Ann Arbor Street Art Fair, July 19-22. S. & E. Univ. Avenues, Ann Arbor. Application deadline: Feb. 15. Write Ann Arbor Street Art Fair, Box 1352, Ann Arbor, 48106. (313) 994-5260.

MINNESOTA: Classes/seminars—For information, write Woodcarving School, 3056 Excelsior Blvd., Minneapolis, 55416. (612) 927-7491.

MONTANA: Class—Building the Chamberlin Dory-Skiff, with Simon Watts, Feb. 25-Mar. 4. Contact Scott Lohmuller, 3681 Sawmill Road, Kelly Canyon, Bozeman, 59715. (406) 587-3003.

NEW YORK: Workshops—Japanese tools, sharpening techniques, joinery, furnituremaking, instrumentmaking, Jan. 7-8, 21-22 & Feb. 4-5, 18-19. The Luthierie, 2449 W. Saugerties Road, Saugerties, 12477. (914) 246-5207.

Juried show—13th annual American Crafts Festival, July 1-2, 8-9, 15-16. Lincoln Center, Fordham Univ. Plaza, NYC. Application deadline: Jan. 28. Contact Brenda Brigham, American Concern for Artistry & Craftsmanship, Box 650, Montclair, NJ 07042. (201) 746-0091.

Classes—Woodworking (3 levels) w/ Maurice Fraser; bowl turning w/ Bill Gundling; finishing w/ Susan Perry, all beginning week of Feb. 6. Free dovetailing and bowl turning demo, Jan. 30, 6 P.M. The Craft Students League, 610 Lexington Ave. & 53rd, NYC, 10021. (212) 735-9732.

Juried show—4th annual Lilac Art Show, May 13-14. Highland Park, Rochester. Entry deadline: Feb. 10. Contact Arts for Greater Rochester, 335 E. Main St., Ste. 200, Rochester, 14604. (716) 546-5602.

Exhibit—Kamakura-Bori: 500 years of traditional Japanese lacquered woodcarving, Jan. 17 thru Feb. 5. Japan Society Gallery, 333 E. 47th St., NYC, 10017. (212) 832-1155.

Revival—Clearwater's 1989 Great Hudson River Revival, June 17-18. Westchester Community College, Valhalla. Application deadline: Feb. 25. Contact Clearwater's Great Hudson River Revival Crafts Committee, c/o Joan Silberberg, RFD #2, Pudding St., Carmel, 10512. (914) 454-7951.

Juried show—New Paltz Art & Crafts Fairs, May 27-29 and Sept. 2-4. Ulster County Fairgrounds, New Paltz. Application deadline: Feb. 1. Contact Scott & Neil Rubinstein, Quail Hollow Events, Box 825, Woodstock, 12498. (914) 679-8087 or 246-3414.

NORTH CAROLINA: Juried show—10th annual "Winterfest Art & Craft Show," Feb. 9-12. Asheville Mall. Contact Gail Gomez, High Country Crafters, 46 Haywood St., Asheville, 28801. (704) 254-7547 or 253-6893.

Workshop—Ladderback chairmaking, Jan. 23-27; Windsor chairmaking, Feb. 6-10 or 20-24. Country Workshops, 90 Mill Creek Road, Marshall, 28753. (704) 656-2280.

Exhibit—"Showcase of Woodcarvings," Mar. 4-5. Grady Cole Center, 310 N. Kings Drive, Charlotte. Deadline: Feb. 10. Contact Showcase of Woodcarvings, 1418 Armory Drive, Charlotte, 28204. (704) 336-2584.

Exhibit—American Wildfowl Decoys, Jan. 22-Mar. 18. Shorebird and duck decoys carved between 1870-1960. Hickory Museum of Art, Hickory. Contact Susan Flamm, 444 Park Ave. S., New York, NY 10016. (212) 481-3080.

OHIO: Show—4th annual Columbus Woodworking World Show, Jan. 13-15. Veterans Memorial Hall, Columbus. Contact WANA, Box 706, Plymouth, NH 03264; or call (800) 521-7623 or (603) 536-3768 Mon. thru Thurs.

OKLAHOMA: Workshop—Woodturning: between centers, Feb. 11; woodturning/bowl turning, Feb. 18 by Alan Lacer. Contact Deanna at Moore-Norman Vo-Tech School, 4701 12th Ave. N.W., Norman, 73069. (405) 364-5763.

OREGON: Workshops—Gilding workshop with Fran Strem, Jan. 28; opening of "Backwoods Whittler," Feb. 2; Japanese Ainu carving workshop with Masamichi Nitani, Feb. 26; art furniture: surface treatments workshop with Beth Yoe, Mar. 5. Contact Oregon School of Arts & Crafts, 8245 S.W. Barnes Road, Portland, 97225. (503) 297-5544.

PENNSYLVANIA: Expo—Northeast Wood Products

Expo '89, Mar. 2-4. The Hershey Lodge and Convention Ctr., Hershey. Intended for small- to medium-size manufacturers of primary and secondary wood products. Contact NEWPEX, Inc., Frank Netherwood, Dame Associates, Inc., 51 Church St., Boston, MA 02116. (617) 482-3596.

Workshops—Beginning bird carving with Bill & Grace White, Feb. 17-19; intermediate bird carving, Feb. 24-26. Chambersburg. 3-legged Windsor stool with Kai Pederson, Mar. 11. Lititz. Contact The PA Guild of Craftsmen, Box 820, Richboro, 18954. (215) 860-0731.

Workshop—33rd annual Hardwood Lumber Grading and Inspection workshop, Feb. 20-24. Penn. State Univ., Univ. Park. Contact Agricultural Conference Coordinator, 410 J.O. Keller Conf. Ctr., Univ. Park, 16802. (814) 865-9547.

TENNESSEE: Workshops—Woodturning: intermediate to advanced with Del Stubbs, Feb. 27-Mar. 3 or Mar. 6-10; hollow vessels—beginning to advanced with David Ellsworth, Mar. 13-17; tools & techniques with Ernie Conover, Mar. 20-24. Contact Arrowmont School of Arts & Crafts, Box 567, Gatlinburg, 37738. (615) 436-5860.

TEXAS: Show—4th annual Houston Woodworking World Show, Mar. 3-5. Pasadena Convention Ctr., Pasadena. Contact WANA, Box 706, Plymouth, NH 03264; or call (800) 521-7623 or (603) 536-3768 Mon. thru Thurs.

Show—Dallas Art Buyers Caravan Show, Mar. 11-12. Hyatt-Regency, Dallas/Ft. Worth Airport. Open to buyers from the trade only. Contact Paul Karel, Art Buyers Caravan, 408 Olive St., St. Louis, MO 63102. (314) 421-5445.

UTAH: Juried exhibit—"Exhibition '48," Cedar City's 48th annual multi-media art exhibit, Apr. 6-28. Slide deadline: Jan. 30. For prospectus, send SASE (letter size) to Cedar City Art Committee, c/o Braithwaite Gallery, Southern Utah State College, 351 W. Center, Cedar City, 84720.

VERMONT: Workshop—Shaker basketmaker John McGuire, Mar. 18-19. Contact the Vermont State Craft Center at Frog Hollow, Middlebury, 05753. (802) 388-3177.

VIRGINIA: Show—2nd annual VA Woodworking World Show, Jan. 6-8. The Norfolk Scope, Norfolk. For more info., contact WANA, Box 706, Plymouth, NH 03264; or call (800) 521-7623 or (603) 536-3768 Mon. thru Thurs. **Exhibit**—"Works in Wood," Mar. 3-Apr. 14. Furniture sculpture, boxes and vessels by contemporary Southeast woodworkers. Hand Workshop, 1812 W. Main St., Richmond, 23220. (804) 353-0094.

WASHINGTON: Class—Timber framing with Tedd Benson, Feb. 6-11. Contact Timbercraft Homes, 85 Martin Road, Port Townsend, 98368. (206) 385-3051.

Show—"For The Office," Jan. 5-29. Decorative wood artwork for the office by Northwest woodworkers. "Hands On Furniture," Feb. 2-22. Inlay as "hand" imagery as decoration for simple and elegant forms. Northwest Gallery, 202 First Ave. S., Seattle, 98104. (206) 625-0542.

Class—Building Sea Urchin, a 10-ft. traditional Nova Scotia rowing shell, Mar. 18-25. Contact Center for Wooden Boats, 1010 Valley St., Seattle, 98109. (206) 382-2628.

Workshops—Steam bending, Jan. 7; marine engine installation, Jan. 21; oar making, Feb. 11; pattern making and keels, Feb. 25. Northwest School of Wooden Boatbuilding, 251 Otto St., Port Townsend, 98368. (206) 385-4948.

WEST VIRGINIA: Exhibit—"Catch a Brass Ring: Carousel Art From The Charlotte Dinger Collection," Jan. 29-Mar. 25. Huntington Museum of Art, Huntington. For more info., contact Susan Flamm, 444 Park Ave. S., New York, NY 10016. (212) 481-3080.

WISCONSIN: Competition—Dremel/Ducks Unlimited MASTERS Carving Competition, Feb. 25-26. Racine's Festival Park, 5 Fifth Ave., Racine. Contact Dremel, MASTERS Carving Competition, 4915 21st St., Racine, 53406-9989.

CANADA: Show—The Forest City Wood Show, Feb. 17-19. Western Fairgrounds, London, Ontario. Contact London Show Productions, 565 3rd St., London, Ont. N5V 2C1. (519) 455-5888.

Juried exhibit—"Knock on Wood," Jan. 15-Feb. 12. Langley Centennial Museum and National Exhibition Centre, 9135 King St., Fort Langley, B.C. Furniture, sculpture, musical instruments, toys, boats, turnings and marquetry. Contact Diane Thorpe, assistant curator, at (604) 888-3922.

Show—The Canadian Workshop Show (formerly Woodworking World), Feb. 3-5. Exhibition Place, Toronto. Exhibits, demos, seminars, sales. For info., call (416) 475-8440 or write 130 Spy Court, Markham, Ont. L3R 5H6.

Show—Toronto Woodworking World Show, Feb. 17-19. The Skyline Toronto. For more info., contact CDI Productions, Box 796, Rt. 3 & Cummings Hill Rd., Plymouth, NH 03264. (603) 536-3768.

CHINA: Study tour—Visits to famous woodworking factories, Imperial Palace Museum, the Shanghai Furniture Factory, Xian Raw Lacquer Research Institute, June 3-19, 1989. \$3,505 includes air fare. Contact Eva Frank, 3504 Beneva Road, Sarasota, FL 34232. (813) 923-3377.

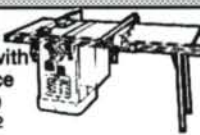
IRELAND: Tour—Guided tour by Liam O'Neill for woodworkers, turners and carvers, May 9-23. Departure points: Boston or New York. Deadline: Feb. 28. Call the Woodworking Assoc. of N. America at (603) 536-3876.

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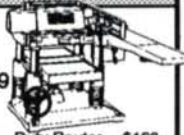


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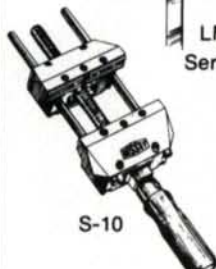
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Treasury of Woodcarving Designs by Alan & Gill Bridgewater. *Sterling Publishing Co., Inc., 2 Park Ave., New York, N.Y. 10016; 1988. \$12.95, paperback, 192 pp.*

I've been waiting for a book like this for 20 years. The authors claim, "This book is primarily a pattern source manual that draws its inspiration from worldwide woodcarving designs. To those who are searching for vigorous culture-related pattern and ornamentation, this book is essential and indispensable." I agree.

Treasury of Woodcarving Designs contains a wealth of material on non-European carving, which provides a fresh source of inspiration for woodworkers tired of classical Western styles. The introductory chapters give a comprehensive but brief history of carving, concentrating on the traditions of several cultures from around the world and of medieval Europe. The authors stop short of describing the "decadent and debased" designs of baroque and later styles of carving popular on the continent.

The numerous line drawings of carving motifs that make up the bulk of the book are well done and cover a broad range of material. Unfortunately, the accompanying photos are poorly lit and too small to show detail clearly.

This book's greatest strength is its organization, which groups designs by artistic themes, such as lines, circles and plant forms, rather than historically or geographically. This makes it much easier to find examples of any given type of design.

One omission is the lack of an authors' note. I would have liked to know more about Alan and Gill Bridgewater and how they came to put together such an extraordinary collection of designs. I strongly recommend their book as a source of historic carving styles.

—Richard Butz

Fine Tuning Your Radial Arm Saw by Jon Eakes. *Lee Valley Tools Ltd., 1080 Morrison Drive, Ottawa, Ont. K2H 8K7; 1987. \$9.95 (\$14.95 Canada), hardcover; 112 pp.*

An entire book on just adjusting the radial-arm saw? Well, yes. There's nothing superfluous here, and much more could be said, though a reader's patience might limit what's actually read. But then, if you don't have the patience to read this book, you certainly won't have the patience to coax fine results from a radial-arm saw. By revealing how much adjustment and step-by-step tuning and checking is required to get the saw to perform well, the book won't convince anyone to buy a radial-arm saw. But if you're already a proud albeit perplexed owner, the book will be invaluable in troubleshooting and tuning up your saw. As someone who uses the saw routinely for cutting joinery and doing other precision work, the book gave me a refresher on the basics, as well as new insights on tuning the saw.

The author, Jon Eakes, has appeared on Canadian television woodworking and home-renovation programs and has written several books on the same subjects. In addition, he has given seminars all across Canada. This experience shows throughout the book. His style is straightforward and easy to read, the step-by-step procedures are logical and the photos and diagrams are clear and pertinent to the text. But more important, the book proves Eakes has used the radial-arm saw extensively in actual work situations and is not just turning a fast buck by rewriting the owner's manual. He goes far beyond the "how to" of a standard manual by laying out a practical philosophy of precision. The following, in his own words, are his "principles of precision":

1. Snug movement: Things that move must move smoothly and firmly.
2. Positive clamping: Things that should not move, must not move.
3. Use of the end point of slack: Slack always has an end point—let's use it.

4. Squaring to actual work surfaces: Align a machine at its production end.
5. Verification on cut wood: Rough static alignment is done with instruments on the machine; dynamic fine-tuning is done with a blade cutting wood.
6. Definition of entry before cutting: Know where the blade will cut before cutting.

Even without elaboration, anyone who has spent time working with power tools can recognize a wealth of wisdom here that no amount of instruction, drawings or pictures can adequately convey. I particularly like numbers 3, 4 and 5—principles owner's manuals seldom acknowledge.

In the book, Eakes covers three major brands of radial-arm saws: Craftsman, DeWalt and Delta, with photos explaining the required adjustments on each tool. If you have a different-brand saw or even an older model of the "big three," the particulars of nut, bolt and lever placement probably won't apply, but the general principles will. There is also a brief rehashing of the argument over the merits of the radial-arm saw versus the tablesaw. As an apologist myself for the radial-arm saw, it's an argument I've been in many times. After all is said and done, however, each worker will use the tool that feels comfortable and suits his needs. In a sense, the radial-arm saw is like a handplane: No argument will convince you of the tool's usefulness until you actually learn how to use it and see the advantages for yourself.

—Curtis Erpelding

Making Spectacular Furniture for Kids by Peter Sylvester. *Sterling Publishing Co., Inc., 2 Park Ave., New York, N.Y. 10016; 1987. \$12.95, paperback; 128 pp.*

Very rarely are titles with words like "spectacular" accurate. This one is.

The projects in Sylvester's book are of simple, straightforward construction: plywood fastened with battens and screws. Each project is well designed to make the best use of a sheet of plywood, and all the furniture makes very efficient use of all the enclosed space. The step-by-step instructions are good, and the exploded drawings are clear, with accurate, easy-to-locate measurements. Sylvester even warns you away from likely errors, such as the location of the original drill holes in certain cutouts.

Sylvester gives us 14 projects in all, including a Winnebago-type camper bunk bed, with one bed in the camper and one on top; an elephant (or hippo) slide with a built-in playhouse; two closets; two playhouses; a bench; a table; and several beds. Color photographs of each project, along with painting patterns, are provided. The colors and patterns are clear, delightful and detailed without being tedious.

I like these projects: They tickle my fancy, and a certain two-year-old I know loves the pictures and cries when we take the book away. If you're thinking about making furniture for your child, look for this book in one of the tool catalogs. Most of the tool catalogs (for example, Garrett Wade and Woodcraft Supply) show the front covers of the books they sell. Take a good look at the British double-decker bed on the front of this book, and it'll give you a firm idea of the style of the other projects. If you like the bed, then buy with confidence: You're sure to like everything else Sylvester has to offer.

—Richard Griffin

Curtis Erpelding makes furniture in Seattle, Wash. He is featured in the videotape "Radial-Arm-Saw Joinery," by The Taunton Press, 63 S. Main St., Box 355, Newtown, Conn. 06470. Richard Butz of Blue Mountain Lake, N.Y., is a professional woodcarver and host of the nationwide Public Broadcasting System series "Woodcarving with Rick Butz." Richard Griffin is an amateur woodworker, a minister and a former librarian. He lives in Sumner, Neb.



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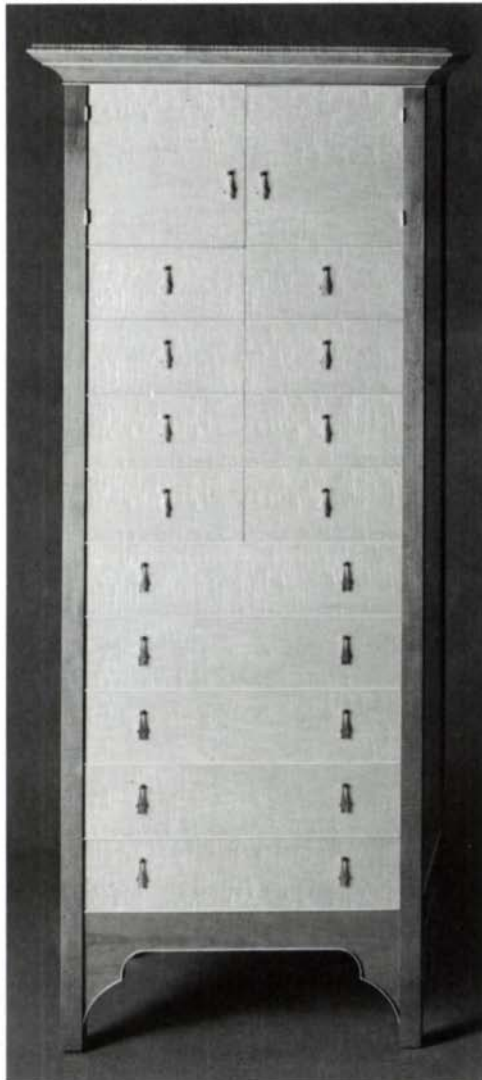
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Photo: Rick Echelmeyer, courtesy of Bernice Steinbaum Gallery



A exhibit of work by prominent women designers and furnituremakers included the 70-in.-high curly maple, Swiss pear and holly chest of drawers, above, by Wendy Stayman; a 33x50x14-in. wenge-and-holly window seat, top right, by Kristina Madsen; a Lucite, wood and upholstery side chair, near right, designed in 1939 by Elsie de Wolfe; and two tape-seat chairs, far right, by Eldress Sarah J. Collins and Sister Lillian Barlow.

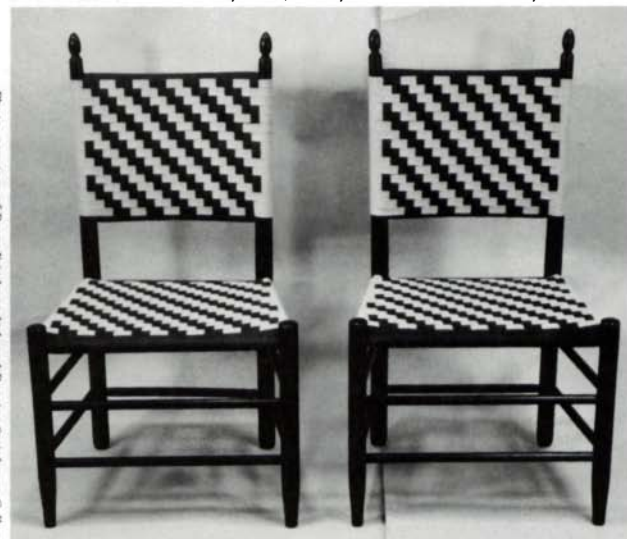
Photo: Dick Fish, courtesy of Bernice Steinbaum Gallery



Photo: ©1988 The Rathbun Gallery/Shaker, courtesy of Bernice Steinbaum Gallery



Photo: courtesy of Barry Friedman Ltd. and Bernice Steinbaum Gallery



Women furniture designers and makers

Woodworking may still be a male-dominated field, but some of the nicest and most innovative work being done today is by women.

According to Nina Stritzler, curator of an exhibit entitled "Pioneer & Pioneering: 20th-Century Women Furniture Designers and Furniture Designers/Makers," women began to play a substantial part in the design and making of furniture for the first time in Western history during the 20th century. Previously, women were sharply inhibited in their development as artisans, she said.

"They entered the male-dominated European design world at the beginning of the century, and by the outbreak of World War II,

they were firmly established as important figures in the development of modernism. During the past 10 years, a new generation of American women have moved beyond the role of designer to pioneer a professional place for themselves as furnituremakers," Stritzler said.

In a catalog detailing the exhibit, which was shown last summer at the Bernice Steinbaum Gallery at 132 Greene St., New York, N.Y., Stritzler cited the Shakers as one of the first groups to end the sexual division of labor that had so long made it virtually impossible for women to develop as independent artisans in male-dominated fields such as woodworking.

Stritzler's research indicated that by the turn of the century, Shaker women were an essential part of the communal-sects furniture industry. This is not too surprising in a community that credited the deity with feminine as well as masculine attributes and enjoyed songs with lines such as, "My mother is a carpenter."

At the Mount Lebanon, N.Y., Shaker community, for example, chairmaking operations were directed for 60 years by Eldress Sarah J. Collins, who died in 1947. She and Sister Lillian Barlow are credited with tape-seat chairs, shown in the bottom, right photo above.

The first half of the 20th century saw the

rise of the architect-designer in the furniture world, said Stritzler, an assistant curator at the American Craft Museum in New York City. Represented in the show were two prominent figures in this development: Eileen Gray and Charlotte Perriand, both of whom studied in Paris and London. Gray, considered a visionary, integrated furniture designs into the concept of "new architecture"; Perriand is now recognized as an innovator in the use of metal for furniture design.

As the center of design shifted from Europe to the United States, Florence Knoll contributed to the development of a distinctly American vision of modern furniture, Stritzler said. As head of the planning unit of Knoll Associates, which later became Knoll International, she designed complete interiors to complement International-Style architecture.

Also prominent in the exhibit was work by pioneering women makers and designers who emerged in the aftermath of the women's movement in the late 1960s and early 1970s and moved from the role of designer into the more traditionally male role of maker. Included were Kristina Madsen, Gail Fredell Smith, Rosanne Somerson, Wendy Maruyama, Judy Kensley McKie and Wendy Stayman.

"Their work, although highly individual in nature, shares a mastery of technique, materials and methods of construction," she said.

In discussing the two modern pieces shown on the previous page, Stritzler said both Madsen and Stayman design and create furniture that demonstrates an allegiance to tradition. She praised Madsen's window seat as one of her most distinctive pieces, which is "decorated with inlay in the most subtle manner and executed with elegantly defined proportions." She described Stayman's chest of drawers as "richly embellished with delicately textured veneers. This piece possesses a unique grace and distinct refinement of form...."

—Terrie Noll, San Francisco, Calif.

Furniture conservation training program

The Smithsonian Institution's Conservation Analytical Laboratory is accepting applications for its furniture conservation program, which is scheduled to begin in August 1989. The program is intended for experienced and skilled woodworkers interested in the preservation and restoration of historic furniture and other artifacts in museums and private laboratories. The program consists of 12 two-week-long courses, which are offered sequentially at three-month intervals. Students can maintain their current jobs while enrolled in the program.

The application deadline is Feb. 1, 1989. For more information, write FCTP Application, CAL/MS, Smithsonian Institution, Washington, D.C. 20560



David Eldridge is shown here measuring a piece of wood on the workbench made by his father. His younger brother, Michael, tries out his hammer.

A bench for children

Our son David made it clear that he had his 4-year-old heart set on receiving a workbench, "just like yours, Dad," for Christmas. I had built mine several years ago following Tage Frid's plans for a European model (see *FWW on the Small Workshop*), but of course, it is too big for David.

I decided to scale the Frid bench down to two-thirds its original size. At 4 ft. long, 2 ft. high and 1 ft. wide, it would be a good fit for the little man. And, I figured I could always add blocks under the legs to keep the bench useful as David grew.

Construction proceeded fairly quickly, following the Frid game plan, until I got to

the vise. None of the commercially available hardware was small enough, so I made a vise screw from 3/4-in. threaded rod and nuts. For brackets, I welded the nuts to a 1/4-in.-thick steel plate and drilled a hole in the center for the threaded rod. I completed the job by drilling and countersinking screw holes in the corners and attaching the brackets to the bench. I made the benchdogs from hardwood.

The bench was completed in time for Christmas, and David and his brother really enjoyed it. They quickly discovered an innovative use for it: The bench's end vise is the ideal tool for cracking open the nuts they receive in their Christmas stockings.

—Bradley Eldredge, Idaho Falls, Idaho

AAW Symposium '88

Philadelphia, Penn., was the place to be for woodturners last fall. The city featured the opening of the International Turned Objects Show (ITOS), a major traveling exhibit, turning shows at two local galleries—the Swan and the Snyderman—and the American Association of Woodturners' (AAW) second annual symposium. The AAW's theme at the mid-September show was "Form, Function and Fantasy," and the show drew an impressive list of turners and enthusiasts to a packed schedule of exhibits and demonstrations.

The symposium's location at the Philadelphia Holiday Inn was ideal, providing comfortable facilities for the inevitable off-hour camaraderie and a cluster of rooms for the wide range of exhibits and demonstrations. At the hub of it all was the "trade show,"

where tons of wood, tools and equipment were offered for sale. The demos ran the gamut, from Dennis Stewart's demonstration of his innovative line of turning tools to the more esoteric, such as Michael Mode's use of strobe lights to provide stop action while turning (see *FWW* #73, p. 71).

There were several conference rooms, each equipped with a lathe, near the trade-show area. Scheduled demonstrations were given by such turning luminaries as Ray Key, Dale Nish, Robert Stocksedale and Del Stubbs. With demonstrations, slide shows and exhibitions happening continuously and concurrently, there was more going on than an individual could reasonably absorb.

One large room was set up with tables and became an "instant gallery," a nonjuried display area where symposium participants could show off their latest work. The scope

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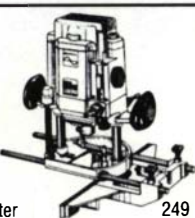
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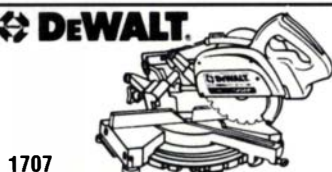
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and quality of the displayed work made the gallery an impressive rival to the more-heralded ITOS across town—not surprising since 75% of the ITOS exhibitors are also AAW members. The intimidation factor was high; rumor had it that some pieces earmarked for the “instant gallery” never emerged from their maker's car trunks.

The highlight and culmination of the symposium was an auction of donated tools, wood and turned pieces for the benefit of the Daphne Osolnik Memorial Fund, an arm of the AAW's education fund. Mrs. Osolnik, wife of Kentucky turner Rude Osolnik and a strong supporter of the turning renaissance in the United States, died last spring. Bidding was brisk, and the proceedings were hilarious thanks to West Virginian auctioneer Bob Flemming, himself a woodturner. There was something for every pocketbook, from a modest \$5 for a gavel to \$900 for a Macassar ebony hollow form turned by David Ellsworth. It was an ideal opportunity to pick up “collectibles” donated by some of AAW's better-known members: Stocksdale, Nish, Osolnik, Alan Stirt and Michael Shuler, to name just a few. Best of all, when the dust had settled, the auction had added nearly \$8,000 to the memorial fund.

This year's symposium will be in September in Seattle, Wash. For more information on the AAW and the number of the regional chapter nearest you, contact the American Association of Woodturners, Box 1059, Eastsound, Wash. 98245; (206) 376-5390.

—Michael Dresdner

The teacher with the twisted back

Julius Kaesz was his name, and had you ever met him, you would always remember him. The truth was that my long-ago professor of woodworking technology had a twisted back that shortened his stance to under five feet and a deeply lined face that's hard to forget.

Despite his rough outward appearance, Dr. Kaesz was a gentle man and an exceptionally good teacher. Apprentice woodworkers were eager to attend his courses at the woodworking institute in Hungary that now bears his name, and there were three times as many applicants as could be accepted. The prospective student had to pass a three-phase exam for admission by producing a flawless blind dovetail joint, a complex technical drawing and a freehand artistic drawing. For months, I prepared for this exam, but despite my deftness with dovetails and drafting, my freehand drawing was as far from my competence as belly dancing. I followed every bit of advice I could get, but then help came from an unexpected source.

I got to know a lady who lived in my building after helping haul coal upstairs for her stove. She needed my youth and strength

Product review

Bosch 1611 plunge router, Bosch Power Tool Corp., Box 2217, New Bern, N.C. 28560; (919) 633-4133.

To my knowledge, the Bosch 1611 is the first 220v plunge router available in this country. It's a big machine, with a powerful motor that draws 7 amps at 220v and a 12-lb. heft that make it feel similar to other 3-hp plunge routers I've tried.

The handles are comfortable, and the controls are laid out so the user's right hand can operate the locking trigger switch while the left hand releases and engages the spring-loaded carriage lock, allowing the router to plunge-cut. A revolving depth stop allows plunging to three preset depths, but it had a bit of play in the machine I tested. The depth scale on the 1611 is only divided into 16ths, much too coarse a scale for precision work.

The construction of the 1611 is very solid throughout. The fan is a casting and moves air well without screaming like routers with cheaper stamped-metal fans. The 1611 has an armature lock that allows one-wrench bit changes, a nice feature. Other Bosch collets have multiple splits for a uniform grip on the bits. Unfortunately, the 1611 collet has only one split. The router base is a ribbed aluminum casting with projections to receive adapter plates, for template work. But, these projections make it difficult to fit homemade subbases, something I do often. The edge



Photo: Patrick Warner

The industrial-strength Bosch 1611 plunge router has a lot of power for the money.

guide and hardware (not included) are substantial, and the router's instruction manual is better than average.

Because they carry their weight high, most plunge routers can be tippy when routing edges. The 1611 is no different. With the switched right handle more than 5 in. away from the cutter centerline, both handles must be grasped firmly at all times to prevent irregular cuts or burning the work.

Overall, the Bosch 1611 has good performance and handling, and with a mail-order discount price between \$200 and \$240, this industrial-strength machine seems to pack a lot of power for the price.

—Pat Warner, Escondido, Calif.

and compensated me with a hug and some much-welcome pocket money. Gentle Mrs. Forbath treated me as her own son. Her real son, Joseph, had gone off to fight the Russians in 1918 and never returned. Before the war, Joseph's ambition was to become an artist/painter. His mother proudly showed me many of his canvases, and I found scores of pencil drawings in a closet—just the kind I couldn't draw. The temptation was too great, and I borrowed one of the drawings—a lovely scene with four people playing cards at a round table—and submitted it as my own for Dr. Kaesz's exam.

There are few people in my life I remember with more love or gratitude than Dr. Kaesz, and learning woodworking from him was my greatest pleasure. I tried my best to please him, and as the months passed, I made good progress in my studies, including freehand drawing. And then it happened: One day Dr. Kaesz took a glass of milk and posed it on the table in front of the class. “Your assignment today,” he said, “is to draw this glass of milk so realistically that I'll be tempted to drink it.” Two hours later, he collected our handiwork.

The next day, Dr. Kaesz told us that we had all done better than he'd expected. But

then he put his hand on my shoulder and said, “But this little fellow made the milk look so real, I was scared I would spill it as I took the drawing to my office.” Then he whispered that he wanted to see me after class.

My heart had stopped beating as I opened the door to his office. Dr. Kaesz looked me in the eyes and said, “My son, I am proud of the progress you are making, but I think it's time we return your exam drawing to the mother of my good friend Joseph Forbath,” as he handed me the drawing with the four cardplayers. And then, pointing his finger to the cardplayer with only his back showing, he asked, “Do you know who this little fellow with the twisted back is?” I knew!

—George Frank, South Venice, Fla.

Notes and Comment

Do you know something we don't about the woodworking scene in your area? Please take a moment to fill us in. Notes and Comment pays for stories, tidbits, commentary and reports on exhibits and events. Send manuscripts and color slides (or, black-and-white photos—preferably with negatives) to Notes and Comment, Fine Woodworking, Box 355, Newtown, Conn. 06470.

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There was music in the air last summer, in harmony from coast to coast, as two stunning custom-built pianos simultaneously made their debuts in Manhattan and Seattle.

Steinway and Sons' 500,000th piano, bottom, was designed by Wendell Castle and built by craftsmen in his Scottsville, N.Y., studio. The concert grand piano, appraised at \$500,000, was presented at Carnegie Hall in New York City on June 2, 1988. The case is veneered with East Indian ebony and strips of dyed Swiss pear. The signatures of more than 800 musicians cited by Steinway for their excellence are engraved in the dyed pear and inlaid with acrylic resin. A bubinga molding trims the body and the legs.

By coincidence, on the same date Seattle furnituremaker Emmett Day unveiled his Steinway, top, at a gallery in Seattle, Wash. Day bought the piano in dilapidated condition, replaced the ebony and ivory on the keys and extensively modified the case while the works were being restrung and reconditioned. The case is Macassar ebony veneer, trimmed in Brazilian rosewood, with touches of brass and ivory. It's priced at \$43,000. The mid-size grand, Steinway's 252,995th, was originally completed on Sept. 6, 1927.



Photo above: Anil Kapahi; photo below: Dirk Bakker

